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COLORIMETRY AND SPECTROPHOTOMETRY:

Publications by the staff of the National Bureau of Standards
for 1939 and 1940.

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GENERAL INFORMATION

This letter circular is a list of publications appearing during the years 1939 and 1940 on colorimetry, spectrophotometry, and related subjects. For publications prior to 1939, see NBS Letter Circular LC-398. Copies of LC-398 and other letter circulars may be obtained without charge from the National Bureau of Standards.

Some of the publications in this list have appeared in the regular series of publications of the Bureau, and others in various scientific and technical journals. Unless specifically stated, papers are not obtainable from the National Bureau of Standards. In those references preceded by an asterisk (*), the publication either is of joint authorship with an outside agency or has been issued by an outside agency with which the Bureau has cooperated.

Where the price is given, the publication can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The prices quoted are for delivery to addresses in the United States and its territories and possessions and in certain foreign countries which extend the franking privilege. In the case of all other countries, one-third of the cost of the publication should be added to cover postage. Remittances should be made either by coupons (obtainable from the Superintendent of Documents in sets of 20 for \$1.00 and good until used), or by check or money order payable to the "Superintendent of Documents, Government Printing Office" and sent to him with order.

Series letters with serial numbers are used to designate Bureau publications:

RP = "Research Paper". These are reprints of articles appearing in the Journal of Research of the National Bureau of Standards.

C = Circular.

FS = Federal Specification.

CS = Commercial Standard.

LC = Letter Circular.....

The list of Publications of the Department of Commerce, which includes all publications of the National Bureau of Standards that are still in print, is obtainable without charge on application to the Bureau.

For papers in the other scientific or technical journals, the name of the journal or of the organization publishing the article is given in abbreviated form, together with (usually) the volume number (underscored), page, and year of publication in the order named. The Bureau cannot supply copies of these journals, or reprints of them, although in some cases reprints of the papers are still available and may be obtained on request to the authors. The journals may usually be consulted in the leading libraries. Copies of the Journal of the Optical Society of America may be obtained from the American Institute of Physics, 175 Fifth Avenue, New York, N. Y.; those of the Paper Trade Journal from the Lockwood Trade Journal Company, 15 West 47th Street, New York, N. Y.; and those of the Technical Associations Papers from the Technical Association of the Pulp and Paper Industry, 122 East 42nd Street, New York, N. Y. Addresses for other journals are given in the references.

Those who wish to keep informed concerning work at the National Bureau of Standards should subscribe to the "Technical News Bulletin". It is a monthly publication which lists all papers published by members of the staff, whether appearing in Bureau publications or in other journals. It contains abstracts of papers appearing in the Journal of Research of the National Bureau of Standards, notes on progress of work in the laboratories, important conferences at the Bureau, and other items of general interest. Subscriptions should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 50 cents per annum.

COLORIMETRY

<u>Title</u>	<u>Series</u>	<u>Price</u>
<p>Standardization of the luminous transmission scale used in the specification of railroad signal glasses. Kasson S. Gibson and Geraldine Walker Haupt. J. Research NBS <u>22</u>, 627 (1939). Also published in J. Optical Soc. Am. <u>29</u>, 188 (1939).</p> <p>New signal glass specifications were formulated by the Signal Section of the Association of American Railroads in 1935 and 1938. The present paper gives the spectral transmissions of the basic standards -- red, yellow, green, blue, purple, and lunar white glasses--on which the AAR scale of luminous transmission is based, and defines that scale in fundamental, absolute units. Comparison is made with the scales defined in the 1908 and 1918 signal glass specifications.</p>	RP1209	5c
<p>Method of designating colors. Deane B. Judd and Kenneth L. Kelly. J. Research NBS <u>23</u>, 355 (1939)</p> <p>The method is to designate color by combinations of two or three simple English words, such as <u>moderate brown</u> or <u>vivid purplish blue</u>. The definitions of these designations are given in terms of the Munsell color standards by means of a series of 34 "name charts". The designations are to be used to describe the colors of drugs and chemicals in the revisions of the National Formulary and the U. S. Pharmacopoeia now in preparation (1940), and have been recommended for this purpose by the Inter-Society Color Council.</p>	RP1239	10c
<p>Hue, saturation, and lightness of surface colors with chromatic illumination. Deane B. Judd. J. Research NBS <u>24</u>, 293 (1940).</p> <p>It has been found possible to predict with fair reliability the color of a surface viewed against a gray background from its tristimulus specifications under the illuminant used combined with the luminous apparent reflectance of the background. Formulas are presented and checked against experimental data.</p>	RP1285	10c

<u>Title</u>	<u>Series</u>	<u>Price</u>
A multipurpose photoelectric reflectometer. Richard S. Hunter. J. Research NBS <u>25</u> , 581 (1940) Also published in J. Optical Soc. Am. <u>30</u> , 536 (1940).	RP1345	10c
This is a null-type instrument designed to measure (45°, 0°) apparent reflectance, specular gloss, and approximate trichromatic coefficients. The selection of photocells, the choice of design, the calibration, the elimination of errors, and many of the applications of the instrument are described.		
Photoelectric colorimeters. NBS Letter Circular (March, 1939). (Supersedes LC-473).....	LC545	Free
Preparation and colorimetric properties of a magnesium-oxide reflectance standard. NBS Letter Circular (March, 1939). (Supersedes LC-395).....	LC547	Free
Color of illuminant and efficiency of the worker. NBS Letter Circular (January, 1940). (Supersedes LC-352).....	LC581	Free
Standardization of railway signal glasses -- Reports on measurements and investigations undertaken by the Colorimetry Section of the National Bureau of Standards at the request of the Signal Section, Association of American Railroads. E. S. Gibson, Geraldine Walker Haupt, and H. J. Keegan. Signal Section Proceedings, A.A.R. <u>36</u> , 136, 147 (1939). (Obtainable from the Secretary, Signal Section, A.A.R., 30 Vesey Street, New York, N. Y.)		
Report No. 6. Examination of 65 duplicate limit glasses. Report No. 7. Colorimetric data leading to Specification 59-38 for kerosene hand lantern globes; comparisons of Specifications 59-38, 69-38, and 69-35; certification of duplicate lantern glasses. (For reports Nos. 1 to 5, see LC-398).		
Development of a method of classifying paints according to gloss. Richard S. Hunter and Deane B. Judd. ASTM Bulletin (260 S. Broad Street, Philadelphia, Pa.) No. 97, 11 (1939). Also published in Paint and Varnish Production Manager, (Mills Building, Washington, D. C.), <u>19</u> , 152 (1939).		

The specular gloss of specimen panels of high-gloss, eggshell and flat paints were measured under several different angular conditions to find which gave the best separation of the paints according to gloss designation. The optimum angular conditions thus determined, namely, 60° with 5- by 12-degree angular spread, are recommended for adoption by the ASTM as standard for designating the gloss of paint finishes.

Specification of uniform color tolerances for textiles. Deane B. Judd, Textile Research (65 Franklin St., Boston, Mass.) 9, 253 and 292 (1939).

A formula for amount of color difference is derived from information in the literature of vision combined with the assumption that color-space is subject to Euclidean geometry. A subtractive colorimeter for measurement of small chromaticity differences is described together with its calibration. Data obtained with the colorimeter and reduced by the formula are compared with estimates of the amounts of the corresponding differences by direct visual comparison.

The physics of color tolerance. Deane B. Judd, Am. Dyestuff Reporter (Am. Assoc. of Textile Chem. and Colorists, 440 Fourth Ave., New York, N. Y.) 28, 441 (1939).

The use and limitations of the spectrophotometer in the administration of color tolerances are described in a dialogue between Mr. Dyer, who depends on color matching by eye, and Mr. Meter, an expert in spectrophotometry.

Specification of color tolerances at the National Bureau of Standards. Deane B. Judd. Am. J. of Psychology (Morrill Hall, Cornell Univ., Ithaca, N. Y.) 52, 418 (1939).

Three methods are used. If perceptibility of the color difference is not important, the tolerance is specified by delineation of the permissible area on the (x, y) diagram of the standard 1931 ICI coordinate system. If simplicity and rapidity are primarily important, specification is by standard and tolerance sample. The third method is by NBS unit of color difference, and formulas defining this unit are given.

Report on the measurement and specification of the color designated as National School Bus Chrome. E. S. Gibson and E. F. Hickson. (1939). (Obtainable from Professor Frank W. Cyr, chairman, National Conference on School Bus Standards, Teachers College, Columbia University, New York, N. Y.)

*A.A.R. Signal Section Specification 59-39. Kerosene hand lantern globes. Manual of the Signal Section, Association of American Railroads, Part 66 (1939). (Obtainable from the Secretary, A.A.R. Signal Section, 30 Vesey Street, New York, N. Y.).

*A.A.R. Signal Section Specification 69-39. Signal glasses (exclusive of kerosene hand lantern globes). Manual of the Signal Section, Association of American Railroads, Part 136 (1939). (Obtainable from the Secretary, A.A.R., Signal Section, 30 Vesey Street, New York, N. Y.)

Systematic color designations for paper. Deane B. Judd. Paper Trade J., Tech. Sec., 111, 201 (1940).

Possible uses of systematic color designations such as described in RP1239 are discussed, and the studies required before adoption of such designations are suggested.

The Munsell Color System, Foreword. Deane B. Judd. J. Optical Soc. Am. 30, 574 (1940).

This foreword introduces a series of five papers on the Munsell color system, of which the following paper is one.

*An Analysis of the Munsell Color System based on measurements made in 1919 and 1926. Lasson S. Gibson and Dorothy Nickerson (Agricultural Marketing Service, U. S. Dept. of Agriculture). J. Optical Soc. Am. 30, 591 (1940).

A psychophysical system is developed based on the disk-mixture relations given in the Atlas of the Munsell Color System. The 1919 and 1926 data are examined for conformity both to this system and to a system of perceptually equal spacings.

Color systems and their inter-relation. Deane B. Judd. Preprint for Illuminating Engineering Society Convention, September 1940. (To be published in Illuminating Engineer (51 Madison Avenue, New York, N. Y.), March 1941).

Colors may be specified either by means of combinations of lights or by material standards. Combinations of lights include tristimulus systems and polar-coordinate systems. The tristimulus systems summarized include the standard 1931 ICI system, the 1922 OSA "excitations", the uniform-chromaticity-scale systems of Judd, Breckinridge-Schaub, and MacAdam, and the systems suggested by the color theories of Young-Helmholtz, Ladd-Franklin, Hering, and Wright. The polar-coordinate systems described are the dominant-wave length-purity system and several variations of it. Summaries are also given of material color standards based on transparent media (Lovibond glasses, Army solutions) and on pigmented surfaces (Munsell, Ostwald),

Papers and reports on the application of the ISCC-NBS system of color names (See RP 1239, above) to drugs and chemicals.

(Obtainable from the American Pharmaceutical Association, 2215 Constitution Ave., Washington, D. C.)

Progress report on color names for the U.S.P. and N.F. N.F. Bulletin p. 2563 (March 22, 1937) (Omitted from LC-398).

*Color names in the botanical monographs. Color names in the chemical monographs. Color names in the pharmaceutical monographs. E. N. Gathercoal. The Bulletin of the National Formulary Committee (N.F. Bulletin) 7, 269 (1939).

*Scientific naming of colors in the U.S.P. and N.F. monographs. A.Ph.A. Laboratory. N.F. Bulletin 8, 17 (1939).

*General notice on color terms. E. N. Gathercoal and Kenneth L. Kelly. N.F. Bulletin 8, 201 (1940).

*The new color names for the N.F. botanical monographs. A.Ph.A. Laboratory. N.F. Bulletin 8, 209 (1940).

A list is given of the color names for the N.F. VI vegetable drugs recommended for inclusion in the N.F. VII. These include the color names for the crude and powdered drugs, for the microscopic structures, and for the several chemical tests.

A preliminary report on the suitability of the Hunter multipurpose reflectometer for the color measurement of near whites. Kenneth L. Kelly. N.F. Bulletin 8, 229 (1940).

Scientific color names in the U.S.P. and N.F. Kenneth L. Kelly. U.S.P. Circular 24, p. 55-V (1940).

A general discussion of the development and application of the ISCC-NBS system of color names is given. The number and type of color names used in the U.S.P. X and U.S.P. XI and in the proposed system are analysed and examples given of fields other than pharmacy where this system could be profitably used.

Instructions for determining the color names for drugs and chemicals. Kenneth L. Kelly: Bulletin of the National Formulary Committee 8, 359 (1940).

These instructions contain detailed descriptions of the technique for determining the color names, according to the ISCC-NBS system; for crude and powdered vegetable drugs, powdered chemicals, microscopic structures, liquids, and translucent and fluorescent media.

Abstracts on Colorimetry

The Inter-Society Color Council tentative system of color names. Deane B. Judd. J. Optical Soc. Am. 29, 142 (1939).

Definition of artificial daylight. Deane B. Judd. J. Optical Soc. Am. 29, 144 (1939).

- Definition and tolerances for artificial daylight for color matching. Deane B. Judd. J. Optical Soc. Am. 29, 145 (1939).
- Progress in developing a photoelectric method for measuring color difference. Richard S. Hunter. Bull. Am. Ceramic Soc. 18, 121 (1939).
- Hue, saturation and lightness of surface colors with chromatic illumination. Deane B. Judd. J. Optical Soc. Am. 29, 260 (1939).
- The physics of color tolerance. Deane B. Judd. J. Optical Soc. Am. 29, 261 (1939).
- Specification of color tolerances at the National Bureau of Standard Deane B. Judd. J. Optical Soc. Am. 29, 264 (1939).
- Sources of error in operation of the multipurpose reflectometer. Richard S. Hunter. J. Optical Soc. Am. 30, 89 (1940).
- Correction of multipurpose reflectometer data. R. S. Hunter. Bull. Am. Ceramic Soc. 19, 132 (1940).
- Further progress in developing a photoelectric method for measuring color difference. Richard S. Hunter. Bull. Am. Ceramic Soc. 19, 133 (1940).
- Applications and accuracy of three-filter photoelectric colorimetry. Richard S. Hunter. J. Optical Soc. Am. 30, 272 (1940).

SPECTROPHOTOMETRY

- Spectral luminosity factors. Kasson S. Gibson. J. Optical Soc. Am. 30, 51 (1940).

Data entering into the adoption of standard luminosity factors by the International Commission on Illumination in 1924 are reviewed and recent measurements are considered. The validity of the standard ICI luminosity data in the photometry of lights of different colors was reaffirmed by the ICI in 1939.

- Introductory dialogue (for a symposium on spectrophotometry in the pulp and paper industries). Deane B. Judd and Lester C. Lewis. Tech. Assoc. Papers 23, 473, 477, 479, 489, 490, 493, 499, and 505 (1940). Also published in Paper Trade J., Tech. Sec., 111, 133, 137, 141, 151, 155, 165, 183, and 193 (1940).

The dialogue is between Mr. Papermaker, a practical color man, and Mr. Meter, a specialist in color measurement by instruments. It brings out the color problems of paper-making and shows how instruments may be used either to supplement or to supplant direct visual examination.

Survey of spectrophotometers. Kasson S. Gibson. Tech. Assoc. Papers 23, 475 (1940). Also published in Paper Trade J., Tech. Sec., 111, 135 (1940).

Photoelectric spectrophotometers for the measurement of spectral reflection are discussed, with consideration of the importance of the geometrical conditions of illuminating and viewing on the values of apparent reflectance obtained.

Abstracts on Spectrophotometry

An improved luminosity filter. Kasson S. Gibson, Ray P. Teele, and Harry J. Keegan. J. Optical Soc. Am. 29, 144 (1939).

Approximate spectral energy distribution of skylight. Kasson S. Gibson. J. Optical Soc. Am. 30, 88 (1940).

Introduction. Dialogue between Mr. Papernaker and Mr. Meter. D. B. Judd and L. C. Lewis. J. Optical Soc. Am. 30, 272 (1940).

Survey of instruments - spectrophotometers. K. S. Gibson. J. Optical Soc. Am. 30, 272 (1940).

FEDERAL SPECIFICATIONS AND COMMERCIAL STANDARDS CONTAINING COLORIMETRIC OR SPECTROPHOTOMETRIC SPECIFICATIONS

<u>Title</u>	<u>Series</u>	<u>Price</u>
*Federal Specification for goggles; protective (glare and welders'). March 28, 1938..... (Omitted from LC-398).	GGG-G-511	10c
*Federal Specification for cloth; tracing. December 1, 1938..... (Omitted from LC-398).	CCC-C-531a	5c
*Federal Specification for enamel; interior, gloss, light-tints and white, December 1, 1938.....	TT-E-506a	5c
Ground and polished lenses for sun glasses. NBS Commercial Standard (1940).....	CS78-39	5c
Blown, drawn and dropped lenses for sun glasses. NBS Commercial Standard (1940).....	CS79-39	5c
Electric direction signal systems other than semaphore type for commercial and other vehicles subject to special motor-vehicle laws (after market). NBS Commercial Standard (1940).....	CS80-41	5c
Adverse-weather lamps for vehicles (after market). NBS Commercial Standard (1940).....	CS81-41	5c

<u>Title</u>	<u>Series</u>	<u>Price</u>
Clearance, marker, and identification lamps for vehicles (after market). NBS Commercial Standard (1940) - - - - -	CS83-41	5c
Electric tail lamps for vehicles (after market). NBS Commercial Standard (1940) - - - - -	CS84-41	5c
Electric license-plate lamps for vehicles (after market). NBS Commercial Standard (1940) -	CS85-41	5c
Electric stop lamps for vehicles (after market). NBS Commercial Standard (1940) - - - - -	CS86-41	5c
Red electric warning lanterns. NBS Commercial Standard (1940). - - - - -	CS87-41	5c

APPLICATIONS OF COLOREMETRY AND SPECTROPHOTOMETRY TO
CHEMICAL ANALYSIS

Solubility of lead sulfate in solutions of sulfuric acid, determined by dithizone with a photronic cell. D. Norman Craig and George W. Vinal. J. Research NBS <u>22</u> , 55 (1939) - - - - -	RP1165	5c
Rate of oxidation of steels as determined from interference colors of oxide films. Dunlap J. McAdam, Jr., and Glenn W. Geil. J. Research NBS <u>23</u> , 63 (1939). - - - - -	RP1221	10c
Separation and colorimetric determination of Rhenium and Molybdenum. James I. Hoffman and G.E.F. Lundell. J. Research NBS <u>23</u> , 497 (1939). - - - - -	RP1248	5c
Colorimetric determination of arsenic in ferrous and nonferrous alloys. Clement J. Rodden. J. Research NBS <u>24</u> , 7 (1940). - - - - -	RP1267	5c

MISCELLANEOUS

Note on the spectral reflectivity of rhodium. W. W. Coblenz and R. Stair. J. Research NBS <u>22</u> , 93 (1939) - - - - -	RP1168	5c
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<u>Title</u>	<u>Series</u>	<u>Price.</u>
International temperature scale and some related physical constants. H. T. Wensel. J. Research NBS <u>22</u> , 375 (1939) - - - - -	RP1189	5c
Inks. C. E. Waters. Circular NBS. - - - - - (Supersedes C413).	C426	15c
Paper and related subjects: Publications by members of the staff of the National Bureau of Standards. NBS Letter Circular (February, 1939). (Supersedes LC-447)	LC543	Free
Information on ultraviolet transparency of window materials and fabrics. NBS Letter Circular (March, 1939). (Supersedes LC-511)	LC549	Free
Fluorescence and phosphorescence. NBS Letter Circular (April, 1939) - - - - -	LC-550	Free
Measurement of the reflectance of manila rope fiber. NBS Letter Circular (November, 1940). - - - (Supersedes LC-393).	LC-617	Free
Terminology and standards of illumination. E. C. Crittenden. J. Optical Soc. Am. <u>29</u> , 103 (1939)		

