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PUBLICATIONS
on
COLORIMETRY AND SPECTROPHOTOMETRY
from the
National Bureau of Standards

Part I

Publications primarily related to Colorimetry.

Part II

Abstracts, reports, letter circulars, etc., not included in Part I.

Part III

Miscellaneous publications, not included in Parts I and II.

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PUBLICATIONS ON COLORIMETRY AND SPECTROPHOTOMETRY FROM THE NATIONAL BUREAU OF STANDARDS

Part I

Publications primarily related to Colorimetry

1. *Hyde, Edward P., Talbot's law as applied to the rotating sectored disk, B.S. Bull., vol. 2, p. 1, 1906. (S26)
The law is verified with light from the Nernst glower and with red, green, and blue light, respectively, for total angular openings between 288° and 10°.

2. *Nutting, P.G., A pocket spectrophotometer, B.S. Bull., vol. 2, p. 317, 1906. (S39)

3. *Nutting, P.G., The complete form of Fechner's law, B.S. Bull., vol. 3, p. 59, 1907. (S49)

4. *Nutting, P.G., A method for constructing the natural scale of pure color, B.S. Bull., vol. 6, p. 89, 1909-10. (S118)

5. *Ives, Herbert E., The daylight efficiency of artificial illuminants, B.S. Bull., vol. 6, p. 231, 1909-10. (S125)

6. *Ives, Herbert E., White light from the mercury arc and its complementary, B.S. Bull., vol. 6, p. 265, 1909-10. (S128)

7. *Nutting, P.G., The visibility of radiation. A recalculation of König's data, B.S. Bull., vol. 7, p. 235, 1911. (S154)

8. *Nutting, P.G., A photometric attachment for spectroscopes, B.S. Bull., vol. 7, p. 239, 1911. (S155)
By means of the attachment a spectrometer may be converted into a spectrophotometer; the original instrument is described.

9. *Nutting, P.G., A new precision colorimeter, B.S. Bull., vol. 9, p. 1, 1913. (S187)
Color is specified by the monochromatic method; an early form of instrument is described and typical results given.

10. Priest, Irwin G., Color specifications, Rep. Proc. Fourth Ann. Meet. Soc. Cotton Products Analysts (now American Oil Chemists' Society), p. 6, June 21, 1913.
The variations found among Lovibond red glasses of the same nominal grade are illustrated and discussed.

11. Priest, Irwin G., The quartz colorimeter and its applicability to the color grading of cotton seed oil, Rep. Proc. Fifth Ann. Meet. Soc. Cotton Products Analysts (now American Oil Chemists' Society), p. 22, May 16, 1914.

12. Priest, Irwin G., The Bureau of Standards contrast method for measuring transparency, Trans. Am. Ceramic Soc., vol. 17, p. 150, 1915.
For summary, see ref. 14.

13. Priest, Irwin G., and Peters, Chauncey G., Report on investigations concerning the color and spectral transmission of cotton seed oil, Rep. Proc. Sixth Ann. Conv. Soc. Cotton Products Analysts (now Am. Oil Chem. Soc.), p. 67, May 14-15, 1915.

14. *Specification of the transparency of paper and tracing cloth, B.S. Circular No. 63, 1917. (C63, 5¢)
Transparency is specified by measuring the contrast ratio, B/W, where B and W are the brightnesses resulting when the material is placed over black and white (MgO) surfaces, respectively.

15. *Priest, Irwin G., and Peters, Chauncey G., Measurement and specification of the physical factors which determine the saturation of certain tints of yellow, B.S. Tech. Paper No. 92, 1917. (T92)
Saturation of yellow samples is indicated by the ratio, reflectance for 578 mμ divided by reflectance for 436 mμ.

16. *Coblentz, W.W., and Emerson, W.B., Relative sensibility of the average eye to light of different colors and some practical applications to radiation problems, B.S. Bull., vol. 14, p. 167, 1918-19. (S303, 15¢)
Determinations were made on 125 observers by the flicker method. (See also ref. 34.)

17. Priest, Irwin G., The work of the National Bureau of Standards on the establishment of color standards and methods of color specification, Trans. Ill. Eng. Soc., vol. 13, p. 38, 1918.

18. *Gibson, K.S., and McNicholas, H.J., The ultra-violet and visible transmission of eye-protective glasses, B.S. Tech. Paper No. 119, 1919. (T119, 10¢)
Spectral transmission curves are given for 82 glasses. Methods of measurement are described.

19. *Gibson, K.S., Photo-electric spectrophotometry by the null method, B.S. Sci. Papers, vol. 15, p. 325, 1919-20. (S349, 5¢)
This method has been superseded by the more rapid method described in a later publication. (See ref. 35.)

20. Priest, Irwin G., The color of soya bean oil as compared with that of cotton seed oil, The Cotton Oil Press, vol. 3, No. 9, p. 37, 1919-20.
The transmission of soya bean oil in the visible spectrum is found to be of a similar type to that of cotton seed oil.

21. *Gibson, K.S., Tyndall, E.P.T., and McNicholas, H.J., The ultra-violet and visible transmission of various colored glasses, B.S. Tech. Paper No. 148, 1920. (T148, 10¢)
Spectral transmission curves are given for over 50 different kinds of glasses. Methods of measurement are briefly described and a chart is given by which transmittances for varying thicknesses may be obtained if known at any one thickness.

22. *Priest, Irwin G., Gibson, K.S., and McNicholas, H.J., An examination of the Munsell color system. I. Spectral and total reflection and the Munsell scale of value, B.S. Tech. Paper No. 167, 1920. (T167)
Data are given on 20 samples selected from the Atlas of the Munsell Color System (1916). It is shown that the "Munsell value" of these samples is closely proportional to the square root of their reflection for noon sunlight.

23. *Priest, Irwin G., Meggers, W.F., Gibson, K.S., Tyndall, E.P.T., and McNicholas, H.J., Color and spectral composition of certain high-intensity searchlight arcs, B.S. Tech. Paper No. 168, 1920. (T168, 5¢)
A method is described for measuring the spectral energy distribution of an illuminant of varying intensity. Data are given on 75-ampere cored-carbon arcs and on 10-ampere plain-carbon arcs.

24. Priest, Irwin G., Note on the relation between the frequencies of complementary hues, Jour. Opt. Soc. Am., vol. 4, p. 402, 1920; and vol. 5, p. 513, 1921.

25. Priest, Irwin G., A new study of the leucoscope and its application to pyrometry, Jour. Opt. Soc. Am., vol. 4, p. 448, 1920.
On page 482 of this publication is shown the variation in color of direct sunlight from sunrise to sunset in February.

26. Priest, Irwin G., Report on calibration of sixteen Lovibond red glasses of nominal value 7.6, The Cotton Oil Press, vol. 4, No. 9, p. 43, 1920-21.
A maximum variation of approximately 0.7 of a Lovibond red unit was found among sixteen glasses, all of nominal grade 7.6, when tested in combination with Lovibond 35 yellow.

27. Priest, Irwin G., A method of obtaining radiant energy having the visible spectral distribution of a complete radiator at very high temperatures, Jour. Opt. Soc. Am., vol. 5, p. 178, 1921.
The method is more completely described in ref. 36.

28. *Priest, Irwin G., The spectral distribution of energy required to evoke the gray sensation, B.S. Sci. Papers, vol. 17, p. 231, 1922. (S417, 10¢)
It is found that the average dark-adapted observer calls a Planckian stimulus at 5200°K gray.

29. *Gibson, K.S., McNicholas, H.J., Tyndall, E.P.T., and Frehafer, M.K., with the cooperation of Mathewson, W.E., Bureau of Chemistry, The spectral transmissive properties of dyes. I. Seven permitted food dyes, in the visible, ultra-violet, and near infra-red, B.S. Sci. Papers, vol. 18, p. 121, 1922-23. (S440, 15¢)
Data are given on naphthol yellow S, ponceau 3R, orange I, amaranth, erythrosine, light green SF yellowish, and indigo disulpho acid. The spectrophotometric methods used in the measurements are described.

30. *Priest, Irwin G., Measurement of the color temperature of the more efficient artificial light sources by the method of rotatory dispersion, B.S. Sci. Papers, vol. 18, p. 221, 1922-23, (S443, 5¢); also Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 6, p. 27, 1922.
The spectral-centroid method of determining color temperature is described and applied to the rotatory-dispersion instrument and to certain standard lamps; data are given on incandescent lamps at 2,850° and 3,100°K, and on the carbon arc (cored carbons, 3,420°; uncored, 3,780°K). Intercheck was made with Nela Research Laboratory to test the accuracy of calibration. (See also ref. 36.)

31. Optical Society of America Committee on Colorimetry, L.T. Troland, Chairman,* Report for 1920-21, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 6, p. 527, 1922.
This is an important comprehensive treatment of colorimetry, including authoritative discussions of nomenclature, methods of color specification, methods of interconversion, and tables of data required for colorimetric computation. The report lists standard conditions for observation, gives excitation data long used as standard, also wave lengths of complementaries and spectral chroma scale. The Lovibond, Munsell, Ridgway, and Ostwald color systems are described. The following methods of colorimetry are interrelated by way of excitation data: spectrophotometry, monochromatic analysis, trichromatic analysis, rotatory dispersion systems, and Planckian distribution analysis.

32. Priest, Irwin, G., Preliminary data on the color of daylight at Washington, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 78, 1923.
The color temperatures of various phases of sunlight and daylight are tabulated.

33. Gibson, K.S., Spectrophotometry, Dict. of Applied Physics, edited by Sir Richard Glazebrook (MacMillan and Co., Ltd., London), vol. 4, p. 737, 1923.

34. *Gibson, K.S., and Tyndall, E.P.T., Visibility of radiant energy, B.S. Sci. Papers, vol. 19, p. 131, 1923-24, (S475, 15¢); see also Trans. Ill. Eng. Soc., vol. 19, p. 176, 1924.
Determinations were made on 52 observers by the so-called step-by-step, equality-of-brightness method. Comparisons are made with the results obtained by other investigators. A study of all available data leads to a new set of recommended values for the average normal observer under standard photometric conditions. (See also ref. 39.)

35. Gibson, K.S., Direct-reading photo-electric measurement of spectral transmission, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 693, 1923.
The method described has been extended throughout the visible spectrum and into the infra-red with the caesium cell as detector. A thermo-electric method is also described.

36. Priest, Irwin G., The colorimetry and photometry of daylight and incandescent illuminants by the method of rotatory dispersion, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 1175, 1923.
The rotatory dispersion colorimetric photometer is described in detail; by its use the color temperature of incandescent illuminants and the various phases of daylight may be determined and their relative intensities measured under color-match conditions. The colors of various illuminants are classified on the color-temperature and spectral-centroid scales. (See also ref. 30.)

37. Priest, Irwin G., McNicholas, H.J., and Frehafer, M. Katherine, Some tests of the precision and reliability of measurements of spectral transmission by the König-Martens spectrophotometer, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 8, p. 201, 1924.
The reliability is tested by measuring the transmission of rotating sectored disks of accurately known aperture; a formula and chart are given for computing the probable error of the transmission from the instrumental readings. (See also refs. 62 and 78.)

38. Priest, Irwin G., Apparatus for the determination of color in terms of dominant wave length, purity, and brightness, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 8, p. 173, 1924.
An elaborate "monochromatic colorimeter" is described; explicit directions for its use, instrumental calibrations and checks, and tests of performance and accuracy, are also given.

39. Gibson, K.S., The relative visibility function, Proc. of the Int. Comm. on Ill., 6th Meeting, Geneva, 1924 (University Press, Cambridge, Eng.), pp. 67 and 232, 1926.
The material in B.S. Sci. Paper No. 475 (ref. 34) is summarized. The Gibson-Tyndall recommended values for the relative visibility function were provisionally adopted by the International Commission on Illumination in 1924, were incorporated in the so-called 1931 I.C.I. standard observer (see ref. 91), and were accepted in 1933 by The Advisory Committee on Electricity and Photometry of The International Bureau of Weights and Measures.

40. Gibson, K.S., Spectral characteristics of test solutions used in heterochromatic photometry, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 9, p. 113, 1924.
Spectral and luminous transmissions are given for the yellow and blue solutions used to test observers for heterochromatic photometry; the Y/B ratio is computed on the basis of various visibility functions.

41. Tyndall, E.P.T., and Gibson, K.S., Visibility of radiant energy equation, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 9, p. 403, 1924.

42. Priest, Irwin G., Tuckerman, L.B., Ives, Herbert E., and Harris, F.K.* The computation of colorimetric purity, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 9, p. 503, 1924.
Colorimetric purity for spectral colors is defined, the Priest and Tuckerman formulas derived, errors in previous computations illustrated, and the Ives formula substantiated.

43. Optical Society of America Progress Committee for 1922-23, K.S. Gibson, Chairman* Report on spectrophotometry, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 10, p. 169, 1925.
The report includes sections on nomenclature, spectrometry, photometry, visual instruments, and auxiliary methods; the calibration and use of spectrophotometers are discussed in considerable detail; a brief but fairly complete review of visual instruments is presented; the applications of spectrophotometry are briefly considered.

44. *Frehafer, M. Katherine, and Snow, Chester L., Tables and graphs for facilitating the computation of spectral energy distribution by Planck's formula, B.S. Miscellaneous Pub. No. 56, 1925. (M56, 35¢)
Large scale graphs are given for temperatures between 1,000° and 24,000°K and for every 10 mμ in wave length between 400 and 720 mμ. Energy distributions corresponding to C_2 different from the adopted value (14,350) may also be determined with slight additional labor. A table is given of the complete function in a form which facilitates extension to higher and lower wave lengths and temperatures. (See also refs. 65 and 75.)

45. Gibson, K.S., Some tests on the accuracy of measurement with the rotatory dispersion colorimetric photometer, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 11, p. 75, 1925.

46. Lloyd, Morton G.* Traffic signals, Proc. Int. Ass'n. Municipal Electricians, 30th Meeting, Detroit (Int. Ass'n. Munic. Elect., West New York, New Jersey), p. 154, 1925.
This paper includes the colorimetric specifications for luminous and non-luminous traffic signals as adopted by a Sectional Committee of the American Engineering Standards Association; the former were approved by the American Standards Association as the "American standard colors for traffic signals". (See ref. 61 in Part II.)

47. Gibson, K.S., Spectral centroid relations for artificial daylight filters, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 11, p. 473, 1925.
It is shown that (1) for a given illuminant there is a linear relation between the thickness of the filter and the spectral centroid of the transmitted light, (2) for a given filter there is a linear relation between the spectral centroids of the incident and transmitted light, when the color temperature of the former is varied.

48. Priest, Irwin G., Standard artificial sunlight for colorimetric purposes, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 12, p. 479, 1926.
Data are given on the colors of natural sunlight and Abbot-Priest sunlight.

49. Priest, Irwin G., The computation of colorimetric purity, II, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 123, 1926.
The Priest purity formulas are applied to non-spectral (purple) colors; Ives' definition rather than Troland's is followed.

50. Judd, Deane B., The computation of colorimetric purity, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 133, 1926.
The Judd formulas for colorimetric purity are derived; routine methods of computation and sources of error affecting previous published results are discussed; extension is made to purple colors according to the Ives and the Troland definitions; and inverse formulas are derived for computing trilinear coordinates from values of purity and dominant wave length.

51. Gibson, K.S., Spectral filters, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 267, 1926; see also Int. Crit. Tab. (National Research Council, Washington, D.C.), vol. 5, p. 271, 1929.
Filters are described for isolating or absorbing various spectral regions in the ultra-violet, visible, and infra-red.

52. Priest, Irwin G. and Brickwedde, F.G., The minimum perceptible colorimetric purity as a function of dominant wave length with sunlight as neutral standard, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 306, 1926.
These data have been presented in more detail in Jour. Opt. Soc. Am., vol. 20, p. 262, 1930, and in Jour. Opt. Soc. Am., vol. 22, p. 96, 1932. (See ref. 84.)

53. *Gibson, K.S., Harris, F.K., and Priest, Irwin G., The Lovibond color system. I. A spectrophotometric analysis of the Lovibond glasses, B.S. Sci. Papers, vol. 22, p. 1, 1927-28. (S547, 15¢)
Spectral transmission data are given for Lovibond red, yellow, and blue glasses and for certain combinations of these glasses. The approximately linear relation between $-\log_{10} T_\lambda$ and Lovibond numeral is illustrated. Luminous transmissions for noon sunlight are also given.

54. Priest, Irwin G., Correction of a prevalent error in regard to the data on photometric sensibility as a function of wave length at low brightness, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 15, p. 82, 1927.
Contrary to numerous misstatements the Fechner fraction for red light is higher than that for blue at low brightness.

55. Priest, Irwin G., Note on the relative comfort in reading by artificial daylight and unmodified gas-filled tungsten lamps, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 15, p. 131, 1927.
One reader found artificial daylight satisfactory and a clear-bulb incandescent lamp giving the same number of foot-candles entirely useless.

56. Appel, W.D., A method for measuring the color of textiles, Am. Dyestuff Reporter, vol. 17, p. 49, 1928.
An abridged spectrophotometric method is described, consisting of Martens photometer, sample holder, and mercury and incandescent illuminants. Reflectance is measured at seven wave lengths in the visible spectrum obtained by means of filters.

57. Judd, Deane B., and Walker, Geraldine K., A study of 129 Lovibond red glasses with respect to the reliability of their nominal grades, Oil and Fat Industries, vol. 5, p. 16, 1928.
The routine method of comparing test glasses with standard glasses is described; inconsistencies as high as one unit are revealed in the maker's marks for these red glasses, which are given to tenths of a unit.

58. Priest, Irwin G., Tests of color sense of A.O.C.S. members and data on sensibility to change in Lovibond red, Oil and Fat Industries, vol. 5, p. 63, 1928.
A method of testing observers for chromaticity sensibility is described; it is found that 0.1 standard Lovibond red unit is close to the least difference perceptible with certainty at 35-yellow plus 7.6-red.

59. Macbeth, Norman* Color temperature classification of natural and artificial illuminants, Trans. Ill. Eng. Soc., vol. 23, p. 302, 1928.
Priest's blue-wedge colorimetric photometer is illustrated in this publication.

60. Davis, Raymond, and Gibson, K.S., Artificial sunlight for photographic sensitometry, Proc. 7th Int. Cong. of Photography, London, 1928 (W. Heffer and Sons, Ltd., Cambridge, Eng.), p. 161, 1929; also Trans. Soc. Motion Picture Engineers, vol. 12, p. 225, 1928.
See ref. 75 for more complete publication.

61. *McNicholas, H.J., Absolute methods in reflectometry, B.S. Jour. Research, vol. 1, p. 29, 1928. (RP3, 10¢)
The Helmholtz reciprocity law is applied to the theory of reflectometry; it is shown that reflectance for any angular distribution of illumination may be derived from the unidirectional reflectances for completely diffused illumination. Apparatus is described and measurements presented of samples of various materials chosen to cover a wide range of reflectance and gloss. Comparative measurements are also reported by the methods of Sharp and Little, Karrer, and Taylor.

62. *McNicholas, H.J., Equipment for routine spectral transmission and reflection measurements, B.S. Jour. Research, vol. 1, p. 793, 1928. (RP30, 20¢)
The König-Martens spectrophotometer and the auxiliary equipment constructed at the Bureau are described in detail; the theory of the instrument and its use in practice are discussed, particularly those factors affecting the reliability of the data obtained.

63. *Judd, Deane B., Effect of temperature change on the color of red and yellow Lovibond glasses, B.S. Jour. Research, vol. 1, p. 859, 1928. (RP31, 5¢)
Heating by 25°C a 35-yellow glass (or a combination of 35-yellow with 7.2-red) was found by the spectrophotometric method to cause a slight reddening-- about the same as that produced by adding 0.2-red.

64. *McNicholas, H.J., Use of the under-water spark with the Hilger sector photometer in ultra-violet spectrophotometry, B.S. Jour. Research, vol. 1, p. 939, 1928. (RP33, 5¢)
The construction and adjustment of the spark apparatus are described; improvements in the optical design of the sector photometer are suggested.

65. *Skogland, J.F., Tables of spectral energy distribution and luminosity for use in computing light transmissions and relative brightnesses from spectrophotometric data, B.S. Miscellaneous Pub. No. 86, 1929. (M86, 10¢)
The wave lengths for the energy tables extend from 320 to 760 mμ by steps of 10 mμ and the temperatures extend from 2,000° to 3,120°K by steps of 20°K. (C_2 = 14330.) The luminosities embody the Gibson-Tyndall recommended values adopted by the International Commission on Illumination (ref. 39). (See also refs. 44 and 75.)

66. *Judd, Deane B., Least retinal illumination by spectral light required to evoke the "blue arcs of the retina", B.S. Jour. Research, vol. 2, p. 441, 1929. (RP43, 5¢)

67. Crittenden, E.C., and Taylor, A.H.* An interlaboratory comparison of colored photometric filters, Trans. Illum. Eng. Soc., vol. 24, p. 153, 1929.
The luminous transmissions obtained directly by flicker and equality-of-brightness photometry are compared with those obtained by spectrophotometric measurement and computation with standard visibility data. The practicability and propriety of using this latter procedure as a basis for standard values is shown. Seven laboratories cooperated in this work.

68. *Priest, Irwin G., Judd, Deane B., Gibson, K.S., and Walker, Geraldine K., Calibration of sixty-five 35-yellow Lovibond glasses, B.S. Jour. Research, vol. 2, p. 793, 1929. (RP58, 10¢)
The glasses are specified by their equivalent in terms of standard Lovibond yellow and red and by the transmission for sunlight. No serious errors in the grades of these glasses were found.

69. *Judd, Deane B., Reduction of data on mixture of color stimuli, B.S. Jour. Research, vol. 4, p. 515, 1930. (RP163, 10¢)
This paper deals with coordinate systems for representing tristimulus specifications, some for practical, others for theoretical purposes; it gives the variation in luminosity coefficients of the primary stimuli with change in coordinate system.

70. Priest, Irwin G., and Riley, J.O., The selective reflectance of magnesium oxide, Jour. Opt. Soc. Am., vol. 20, p. 156, 1930.

71. Priest, Irwin G., Note on the yellowness of commercial magnesium carbonate and the alleged yellowness of magnesium oxide, Jour. Opt. Soc. Am., vol. 20, p. 157, 1930.

72. Gibson, K.S., The use of the photoelectric cell in spectrophotometry, Photoelectric Cells and Their Applications (The Physical and Optical Societies, London, England; also obtainable from Adam Hilger, Ltd., London), p. 157, 1930.
The subject is reviewed from its beginning, near 1900, to 1930. The advantages and limitations of amplified-current instruments are discussed, in addition to the various types of errors to which all spectrophotometric methods, including the phòtoelectric, are liable.

73. *Judd, Deane B., Precision of color temperature measurements under various observing conditions; a new color comparator for incandescent lamps, B.S. Jour. Research, vol. 5, p. 1161, 1930. (RP252, 10¢)
Precision is raised considerably by increasing the field size or by decreasing the width of a black line separating the two halves of the field; it is ràised somewhat by using both eyes instead of one, or by decreasing the width of a non-contrasting dividing line, or by using fields in the same plane.

74. Judd, Deane B., The mixture data embodied in the tentative curves of Hecht's theory of vision, Jour. Opt. Soc. Am., vol. 20, p. 647, 1930.
A change in coordinate system reveals that Hecht's first curves do not accurately express normal mixture data although they seem to do so from direct comparison.

75. *Davis, Raymond, and Gibson, K.S., Filters for the reproduction of sunlight and daylight and the determination of color temperature, B.S. Miscellaneous Pub. No. 114, 1931. (M114, 45¢)
The color of the Planckian radiator may be reproduced over the range from that of the incandescent lamp (yellow)to approximately 19,000°K (blue); the color temperatures of incandescent lamps may be determined by means of these filters. Detailed spectrophotometric analyses are given both of the filter components and of a considerable number of complete filters; the effects of time, temperature, impurities, and other factors are discussed and illustrated; details regarding selection of chemicals and preparation of solutions and cells are given. Tables of spectral energy distribution of the Planckian radiator with C_2 = 14350 are included, covering the temperature range from 2,000° to 20,000°K and the wavelength range from 350 to 720 mμ; values of the trilinear coordinates (r, g, b) are also given for the Planckian radiator from 1,600° to 20,000°K, computed on the basis of the O.S.A. excitations and with Davis-Gibson mean sun as basic stimulus. (See also refs. 79 and 82.)

76. *Judd, Deane B., Extension of the standard visibility function to intervals of 1 millimicron by third-difference osculatory interpolation, B.S. Jour. Research, vol. 6, p. 465, 1931 (RP289, 5¢); also Jour. Opt. Soc. Am., vol. 21, p. 267, 1931.

77. *Judd, Deane B., Interpolation of the O.S.A. "excitation" data by the fifth-difference osculatory formula, B.S. Jour. Research, vol. 7, p. 85, 1931 (RP334, 5¢); also Jour. Opt. Soc. Am., vol. 21, p. 531, 1931.

78. Gibson, K.S., Spectrophotometry at the Bureau of Standards, Jour. Opt. Soc. Am., vol. 21, p. 564, 1931.
The various spectrophotometric methods used in the Colorimetry Section are described and data given showing the degree of agreement obtained in the measurement of spectral transmission by the visual, photoelectric, and thermoelectric methods.

79. Optical Society of America Committee on the photographic standard of intensity, K.S. Gibson, Chairman* Report on the photographic unit of intensity, Jour. Opt. Soc. Am., vol. 21, p. 654, 1931; see also Bericht VIII. Internationalen Kongress Photographie, Dresden, 1931 (J.A. Barth, Leipzig, Germany), p. 84, 1932.
Data are given supporting the use of the Davis-Gibson 2,360°K-to-noon-sunlight filter, which with illuminant at 2,360°K was adopted by the Eighth International Photographic Congress in 1931 as the standard illuminant for photographic sensitometry.

80. *Davis, Raymond, A correlated color temperature for illuminants, B.S. Jour. Research, vol. 7, p. 659, 1931. (RP365, 10¢)
A method is described for computing the approximate temperature of the Planckian stimulus most nearly matching any reasonably similar stimulus. Tables facilitating this computation are given for temperatures from 1,600°to 20,000°K.

81. Judd, Deane B., Comparison of Wright's data on equivalent color stimuli with the O.S.A. data, Jour. Opt. Soc. Am., vol. 21, p. 699, 1931.
It is found that these new data refer to an observer of definitely heavier macular pigmentation and exhibit other significant differences; individual differences between normal observers are, however, considerably greater than either of these. Revision of the O.S.A. data is discussed.

82. *Davis, Raymond, and Gibson, K.S., The relative spectral energy distribution and correlated color temperature of the N.P.L. white-light standard, B.S. Jour. Research, vol. 7, p. 791, 1931. (RP374, 5¢)
Description is also given of the Davis-Gibson 2,848°-to-4,800°K filter; this and the 2,848°-to-6,500°K filter, with illuminant at 2,848°K, were adopted by the International Commission on Illumination in 1931 as standard illuminants B and C for colorimetric purposes.

83. *Judd, Deane B., A general formula for the computation of colorimetric purity, B.S. Jour. Research, vol. 7, p. 827, 1931 (RP377, 5¢); also Jour. Opt. Soc. Am., vol. 21, p. 729, 1931.
The formula is general in the sense that any point in the plane may be taken to represent the heterogeneous stimulus instead of just the center of the Maxwell triangle and in the sense that any coordinate system obtained by homogeneous, linear transformation of the data may be used instead of some particular coordinate system. Purity of the stimulus is discussed in relation to saturation of the color evoked.

84. Judd, Deane B., Chromaticity sensibility to stimulus differences, Jour. Opt. Soc. Am., vol. 22, p. 72, 1932.
The (r,g)-plot of the O.S.A. color triangle is found to make a better "sensation" diagram than other forms of plotting. The difference in r-coordinate or that in the g-coordinate, whichever is the greater, is taken as a measure of the degree of chromaticity difference; this is somewhat better than actual distance on the plot.

85. Helson, Harry, and Judd, Deane B.* A study in photopic adaptation, Jour. of Exp. Psychology, vol. 15, p. 380, 1932.

86. Judd, Deane B., Sensibility to color-temperature change as a function of temperature, Jour. Opt. Soc. Am., vol. 23, p. 7, 1933.
The least perceptible difference in color temperature is found to be proportional to the square of the color temperature from 1,700° to 11,000°K, as indicated by previous fragmentary data.

87. Tyndall, E.P.T., Chromaticity sensibility to wave-length difference as a function of purity, Jour. Opt. Soc. Am., vol. 23, p. 15, 1933.
Adding white light to both sides of the field decreases sensibility to wave-length difference for wave lengths greater than 480 mμ, and for those less than 480 mμ it first decreases, then increases, then finally decreases it.

88. Judd, Deane B., Saturation scale for yellow colors, Jour. Opt. Soc. Am., vol. 23, p. 35, 1933.
The saturation scale is given by specifying in terms of dominant wave length and purity the series of stimuli exhibiting equal saturation steps.

89. Priest, Irwin G., A proposed scale for use in specifying the chromaticity of incandescent illuminants and various phases of daylight, Jour. Opt. Soc. Am., vol. 23, p. 41, 1933.
Reciprocal temperature is proposed because it forms a uniform chromaticity scale and because computations involving the Wien formula for spectral distribution of energy deal directly with reciprocal temperature. (In particular, the additive value of a blue or yellow filter in changing the apparent reciprocal color temperature of a source is expressed simply as a difference in reciprocal color temperature.)

90. Gibson, K.S., and Walker, Geraldine K., Standardization of railway signal glasses--Reports on measurements and investigations undertaken by the Colorimetry Section of the Bureau of Standards at the request of the Signal Section of the American Railway Association, Signal Section Proceedings, A.R.A., vol. 30, p. 384, 1933.
Report No. 1. The transmission (A.R.A. scale) of 36 specimens of signal glass relative to transmission of 6 A.R.A. standards marked "J.C. Mock 10/3/30", a report on measurements made at Corning Glass Works, December 9-11, 1930.
Report No. 2. Measurements of spectral and luminous transmissions leading to the derivation of new A.R.A. transmissions for the 36 glasses listed in report No. 1.
Report No. 3. Spectral and luminous transmissions and derivation of new values of A.R.A. transmission for the 22 "limit" glasses selected by Committee VI, A.R.A., at Corning, November 5-6, 1931 and engraved "J.C.M. 11-6-31".
Report No. 4. Chromaticities and luminous transmissions, with illuminants at 1,900°K and 2,848°K, for the 22 "limit" glasses described in Report No. 3.
Report No. 5. Tentative specifications for railway signal colors.

91. Judd, Deane B., The 1931 I.C.I. standard observer and coordinate system for colorimetry, Jour. Opt. Soc. Am., vol. 23, p. 359, 1933.
This report makes available in convenient form the properties of the standard observer recently recommended for colorimetric purposes by the International Commission on Illumination. These data supersede the values published in the 1922 report of the committee on colorimetry (Ref. 31) known as the O.S.A. excitation data. Forms are given for computing trilinear coordinates (trichromatic coefficients), dominant wave length, colorimetric purity, and luminous transmission (or reflectance) from spectrophotometric data. Tables of the data needed are included for the 1931 I.C.I. standard illuminants A, B, and C.

92. Gibson, K.S., Transmissions de quatre verres bleus destinés a être employés comme étalons photometrique internationaux, Com. Int. des Poids et Mesures, Proces-verbaux des seances, vol. XVI, Annexes du Com. Consultatif d'Elect. et de Phot., p. 307, 1933.
This is a French translation of a report prepared by the author. The glasses are to be used as standards in the heterochromatic photometry of incandescent illuminants.

PUBLICATIONS ON COLORIMETRY AND SPECTROPHOTOMETRY FROM THE NATIONAL BUREAU OF STANDARDS

Part II

Abstracts, reports, letter circulars, etc., not included in Part I

If the abstract has been superseded by a more complete publication, the number in parentheses following the date gives such publication reference in Part I.

1. Priest, Irwin G., A photometric error sometimes accompanying the use of a pair of nicols, and a proposal for its elimination, Jour. Wash. Acad. Sci., vol. 3, p. 298, 1913.

2. Priest, Irwin G., A simple colorimeter of the monochromatic type, Jour. Wash. Acad. Sci., vol. 6, p. 74, 1916.

3. Priest, Irwin G., A proposed method for the photometry of light of different colors, Phys. Rev. (2), vol. 6, p. 64, 1915; vol. 9, p. 341, 1917; vol. 10, p. 208, 1917. (36)

4. Priest, Irwin G., A precision method for producing artificial daylight, Phys. Rev. (2), vol. 11, p. 502, 1918. (48)

5. Priest, Irwin G., The law of symmetry of the visibility function, Phys. Rev. (2), vol. 11, p. 498, 1918.

6. Priest, Irwin G., A one-term pure exponential formula for the spectral distribution of radiant energy from a complete radiator, Jour. Opt. Soc. Am., vol. 2-3, p. 18, 1919.

7. Gibson, K.S., Photo-electric spectrophotometry by the null method, Jour. Opt. Soc. Am., vol. 2-3, p. 23, 1919. (19)

8. Priest, Irwin G., A new formula for the spectral distribution of energy from a complete radiator, Phys. Rev. (2), vol. 13, p. 314, 1919; vol. 14, p. 191, 1919.

9. Priest, Irwin G., Meggers, W.F., McNicholas, H.J., Gibson, K.S., and Tyndall, E.P.T., in cooperation with the Searchlight Investigation Section, Corps of Engineers, U.S.A., The spectral composition and color of certain high intensity searchlight arcs, Phys. Rev. (2), vol. 14, p. 184, 1919. (23)

10. Priest, Irwin G., and Tyndall, E.P.T., Optical and photographic methods for the detection of invisible writing, Phys. Rev. (2), vol. 14, p. 188, 1919.

11. Priest, Irwin G., and Gibson, K.S., Report on the applicability of ultra-violet rays to signaling, Phys. Rev. (2), vol. 14, p. 188, 1919.

12. Gibson, K.S., Tyndall, E.P.T., and McNicholas, H.J., The spectral transmission of filters used to detect camouflage or improve visibility, Phys. Rev. (2), vol. 14, p. 261, 1919.

13. Priest, Irwin G., A method for the color grading of red flares, Phys. Rev. (2), vol. 14, p. 264, 1919.

14. Priest, Irwin G., Recommendations in regard to color grading of cotton seed oil, The Cotton Oil Press, vol. 3, No. 3, p. 86, 1919-20.

15. Optical Society of America Committee on Colorimetry, Irwin G. Priest, Chairman; Report for 1919. (Not published; manuscript copy may be borrowed from Bureau of Standards library. See Jour. Opt. Soc. Am., vol. 4, p. 186, 1920.)

16. Priest, Irwin G., The application of rotatory dispersion to colorimetry, photometry and pyrometry, Phys. Rev. (2), vol. 15, p. 538, 1920. (36, 25)

17. Priest, Irwin G., Preliminary note on the relations between the quality of color and the spectral distribution of light in the stimulus, Jour. Opt. Soc. Am., vol. 4, p. 389, 1920.

18. Priest, Irwin G., Abstract of report on investigation of the color and spectral transmissivity of vegetable oils, The Cotton Oil Press, vol. 4, No. 3, p. 95, 1920-21.

19. Priest, Irwin G., Statement to the color committee, American Oil Chemists' Society meeting at the National Bureau of Standards, Washington, July 30, 1920, The Cotton Oil Press, vol. 4, No. 6, p. 45, 1920-21.

20. Priest, Irwin G., and Frehafer, M.K., The optical basis of Bittinger's camouflage paintings, Jour. Wash. Acad. Sci., vol. 11, p. 238, 1921. (See also Jour. Opt. Soc. Am., vol. 4, pp. 390-395, 1920.)

21. Priest, Irwin G., A direct reading spectrophotometer for measuring the transmissivity of liquids, Phys. Rev. (2), vol. 18, p. 127, 1921.

22. Priest, Irwin G., The spectral distribution of energy required to evoke the gray sensation, Jour. Opt. Soc. Am., vol. 5, p. 205, 1921; also The Photographic Journal (Harrison & Sons, Ltd., London, Eng.), vol. 61 (new series 45), p. 360, 1921. (28)

23. Priest, Irwin G., The complete scale of color temperature and its application to the color grading of daylight and artificial illuminants, Phys. Rev. (2), vol. 20, p. 93, 1922. (36)

24. Priest, Irwin G., Progress on the determination of normal gray light, Jour. Opt. Soc. Am., and Rev. Sci. Inst., vol. 7, p. 72, 1923. (28)

25. Priest, Irwin G., and Cottrell, Casper L., The effect of various conditions upon the determination of the normal stimulus of gray, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 73, 1923. (28)

26. Priest, Irwin G., Apparatus for the determination of hue sensibility (wave length differences perceptible by difference in hue) and the visibility of radiant energy, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 99, 1923. (87)

27. Priest, Irwin G., The colorimetry and photometry of daylight and incandescent illuminants by the method of rotatory dispersion, Trans. Ill. Eng. Soc., vol. 18, p. 861, 1923; also Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 75, 1923. (36)

28. Priest, Irwin G., Review of Peddie's "Colour Vision", Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 7, p. 1251, 1923.

29. Priest, Irwin G., Gibson, K.S., and Munsell, A.E.O., A comparison of experimental values of dominant wave length and purity with their values computed from the spectral distribution of the stimulus, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 8, p. 28, 1924.

30. Priest, Irwin G., Apparatus for the determination of color in terms of dominant wave length, purity, and brightness, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 8, p. 28, 1924. (38)

31. Priest, Irwin G., McNicholas, H.J., and Frehafer, M. Katherine, Some tests of the precision and reliability of measurements of spectral transmission by the König-Martens spectrophotometer, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 8, p. 30, 1924. (37)

32. Priest, Irwin G., Gibson, K.S., and Munsell, A.E.O., The specification of color in terms of dominant wave length, purity, and brightness, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 10, p. 291, 1925.

33. Priest, Irwin G., Gibson, K.S., and Harris, F.K., Measurements of illumination and color temperature at Washington during the solar eclipse, January 24, 1925, Phys. Rev. (2), vol. 25, p. 901, 1925.

34. Priest, Irwin G., Gibson, K.S., and Harris, F.K., Determination of the time of a solar eclipse from measurements of relative illumination, Phys. Rev. (2), vol. 25, p. 902, 1925.

35.*American Engineering Standards Committee, Sectional Committee* Code proposed for colors and forms of traffic signals, Public Roads, U.S. Dept. Agri., vol. 6, p. 134, 1925.

36. Priest, Irwin G., Gray skies and white snow, Jour. Wash. Acad. Sci., vol. 15, p. 306, 1925; also Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 11, p. 133, 1925.

37. Burgess, George K., United States Bureau of Standards eclipse observations, Scientific American (Munn & Co., Inc., 24 W. 40th St., New York, N.Y.), vol. 133, pp. 170-171, 1925.

38. Optical Society of America Progress Committee on Radiometry and Photometry* Report presented Oct. 24, 1924, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 11, p. 357, 1925.

39. Gibson, K.S., and Harris, F.K., A spectrophotometric analysis of the Lovibond color system, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 12, p. 481, 1926. (53)

40. Judd, Deane B., The computation of colorimetric purity, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 12, p. 482, 1926. (50)

41. Optical Society of America Committee on unit of photographic intensity, L.A. Jones, Chairman* Report, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 12, p. 567, 1926.

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44. Gibson, K.S., The production of radiant energy of uniform intensity over the visible spectrum, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 305, 1926.

45. Priest, Irwin G., An experiment bearing on the adoption of a standard neutral stimulus in colorimetry: the choice as between "sun" and "equal energy", Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 13, p. 306, 1926.

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47. *Colorimetry at the National Bureau of Standards, B.S. Letter Circular, LC-217, December, 1926.

48. Davis, Raymond, and Gibson, K.S., Reproducible liquid filters for the production of "white light", Jour. Opt. Soc. Am., and Rev. Sci. Inst., vol. 14, p. 135, 1927. (75)

49. Gibson, K.S., A proposed method for the measurement of the relative visibility function, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 14, p. 135, 1927.

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52. Priest, Irwin G., and Judd, Deane B., Sensibility to wave-length difference and the precision of measurement of dominant wave length for yellow colors of high saturation, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 14, p. 137, 1927.

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54. McNicholas, H.J., On the use of the integrating sphere in reflectometry, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 14, p. 142, 1927. (61)

55. Winters, S.R.* Colors in relation to business, Trade Winds (The Union Trust Co., Cleveland, Ohio), vol. 6, p. 16, 1927.

56. Davis, Raymond, and Gibson, K.S., Reproducible liquid filters for the determination of the color temperatures of incandescent lamps, Phys. Rev. (2), vol. 29, p. 916, 1927. (75)

57. Judd, Deane B., Purity and saturation: a saturation scale for yellow, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 14, p. 470, 1927. (88)

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59. Priest, Irwin G., Misuse of the name "Leucoscope", Science, vol. 66, p. 78, 1927.

60. *Fluorescence as a means of detecting the admixture of refined in unrefined edible olive oil, B.S. Tech. News Bull. No. 127, p. 7, 1927.

61. American Standards Association* American standard colors for traffic signals (American Standards Association, 29 West 39th St., New York, N.Y., 25 ¢), 1927.

62. Judd, Deane B., Saturation of colors determined from the visual response functions, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 115, 1928. (88)

63. Judd, Deane B., Sensibility to color change determined from the visual response functions: extension to complete and partial dichromasy, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 115, 1928. (84)

64. Priest, Irwin G., and Gibson, K.S., Standardizing the red and yellow Lovibond glasses, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 116, 1928.

65. Priest, Irwin G., Preliminary data on the least perceptible difference in dominant wave length by the method of right and wrong answers, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 117, 1928.

66. Davis, Raymond, and Gibson, K.S., Filters for the reproduction of sunlight and the determination of color temperature, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 332, 1928. (75)

67. McNicholas, H.J., Equipment for routine spectral transmission and reflection measurements, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 16, p. 333, 1928. (62)

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69. Standardization of Lovibond glasses (monthly reports from Colorimetry Section to president of American Oil Chemists' Society), Oil and Fat Industries, vol. 4, p. 433, 1927; vol. 5, p. 27, p. 58, p. 92, p. 114, p. 152, p. 184 (there are many typographical errors in this report), p. 220, p. 247, p. 278, 1928.

70. Optical Society of America Committee on Standard of Photographic Intensity, L.A. Jones, Chairman* Report on resolutions dealing with the photographic unit of intensity presented at the 7th International Congress of Photography, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 162, 1929.

71. McNicholas, H.J., Apparatus for the measurement of the reflective and transmissive properties of diffusing media, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 165, 1929.

72. Gibson, K.S., Apparatus for accurate and rapid measurement of spectral transmission and reflection, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 166, 1929.

73. McNicholas, H.J., The absorptive properties of carotin and xanthophyll in the visible and ultraviolet, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 172, 1929. (See ref. 45 in Part III.)

74. Judd, Deane B., Least retinel illumination by spectral light required to evoke the "blue arcs of the retina", Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 172, 1929. (66)

75. Judd, Deane B., The reduction of data on mixture of color stimuli, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 441, 1929. (69)

76. Gibson, K.S., and Davis, Raymond, Methods for determining the color of sunlight and daylight, Jour. Opt. Soc. Am. and Rev. Sci. Inst., vol. 18, p. 442, 1929. (75)

77. Judd, Deane B., Thomas Young's theory of color vision and the hue change by addition of white light, Jour. Opt. Soc. Am., vol. 20, p. 156, 1930. (See also ref. 58, above.)

78. Priest, Irwin G., Note on the relative sensitiveness of direct color comparison and spectrophotometric measurements in detecting slight differences in the spectral distribution of light, Jour. Opt. Soc. Am., vol. 20, p. 159, 1930.

79. Gibson, K.S., An illumination sphere for reflectometry and photoelectric spectrophotometry, Jour. Opt. Soc. Am., vol. 21, p. 144, 1931.

80. Judd, Deane B., The mixture data embodied in the tentative curves of Hecht's theory of vision, Jour. Opt. Soc. Am., vol. 21, p. 141, 1931. (74)

81. Judd, Deane B., Precision of color temperature measurements under various observing conditions; a new color comparator for incandescent lamps, Jour. Opt. Soc. Am., vol. 21, p. 145, 1931. (73)

82. Judd, Deane B., Comparison of distribution curves embodying Wright's recent results with the O.S.A. "excitation" curves, Jour. Opt. Soc. Am., vol. 21, p. 434, 1931. (81)

83. Judd, Deane B., Extension of the O.S.A. "excitation" curves to intervals of one millimicron by fifth-difference osculatory interpolation, Jour. Opt. Soc. Am., vol. 21, p. 436, 1931. (77)

84. Judd, Deane B., A new set of distribution curves for use in colorimetric computation, Jour. Opt. Soc. Am., vol. 21, p. 436, 1931.

85. Judd, Deane B., Extension of the standard visibility function to intervals of one millimicron by third-difference osculatory interpolation, Jour. Opt. Soc. Am., vol. 21, p. 437, 1931. (76)

86. Judd, Deane B., Chromaticity sensibility to temperature change as a function of color temperature, Jour. Opt. Soc. Am., vol. 22, p. 9, 1932. (86)

87. Judd, Deane B., A general formula for the computation of colorimetric purity, Jour. Opt. Soc. Am., vol. 22, p. 10, 1932. (83)

88. A report on the spectral reflection of eleven samples of dyed cloth (B.S. Test 64397), American Dyestuff Reporter, vol. 21, p. 163, 1932.

89. Judd, Deane B., Investigation of sources of errors in color temperature determinations of incandescent lamps, Jour. Opt. Soc. Am., vol. 22, p. 429, 1932.

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91. Priest, Irwin G., Report on the work of the Colorimetry Committee of the International Commission on Illumination and the actions taken at the meeting in Cambridge, England, Sept. 1931, Jour. Opt. Soc. Am., vol. 22, p. 431, 1932.

92. *Color of illuminant and efficiency of the worker, B.S. Letter Circular, LC-352, January 1933.

93. *Color charts, B.S. Letter Circular, LC-358, February 1933.

94. Judd, Deane B., Color temperature of tungsten-filament lamps as a function of time in service at constant voltage, Jour. Opt. Soc. Am., vol. 23, p. 118, 1933.

95. Priest, Irwin G., A proposed scale for use in specifying the chromaticity of incandescent illuminants and various phases of daylight, Jour. Opt. Soc. Am., vol. 23, p. 119, 1933. (89)

96. *Color and legibility, B.S. Letter Circular, LC-351 (revised), July 1933.

97. *Color Harmony, B.S. Letter Circular, LC-356 (2nd ed.), July 1933.

98. *Preparation and colorimetric properties of a magnesium-oxide reflectance standard, B.S. Letter Circular, LC-395, December 1933.

PUBLICATIONS ON COLORIMETRY AND SPECTROPHOTOMETRY FROM THE NATIONAL BUREAU OF STANDARDS

Part III

Miscellaneous publications, not included in Parts I and II.

Numerous papers of primary importance in other fields, such as photometry, radiometry, and dyes, are not listed here. For complete list consult B.S. Circular No. 24 and supplements, or see letter circulars listed below.

1. *Nutting, P.G., The luminous equivalent of radiation, B.S. Bull., vol. 5, p. 261, 1908-9. (S103)

2. *Nutting, P.G., Luminosity and temperature, B.S. Bull., vol. 6, p. 337, 1909-10. (S133)

3. *Coblentz, W.W., The diffuse reflecting power of various substances, B.S. Bull., vol. 9, p. 283, 1913. (S196, 10¢)

4. *Middlekauff, G.W., and Skogland, J.F., An interlaboratory photometric comparison of glass screens and of tungsten lamps, involving color differences, B.S. Bull., vol. 13, p. 287, 1916-17. (S277, 10¢)

5. *Crittenden, E.C., and Richtmyer, F.K., An "average eye" for heterochromatic photometry, and comparison of a flicker and an equality-of-brightness photometer, B.S. Bull., vol. 14, p. 87, 1918-19. (S299, 5¢)

6. *Coblentz, W.W., and Emerson, W.B., Luminous radiation from a black body and the mechanical equivalent of light, B.S. Bull., vol. 14, p. 255, 1917. (S305, 5¢)

7. *Coblentz, W.W., Emerson, W.B., and Long, M.B., Spectroradiometric investigation of the transmission of various substances, B.S. Bull., vol. 14, p. 653, 1918-19. (S325, 5¢)

8. *Coblentz, W.W., and Emerson, W.B., Glasses for protecting the eyes from injurious radiations (3rd edition), B.S. Tech. Paper No. 93. (T93, 10¢)

9. *Karrer, Enoch, and Tyndall, E.P.T., Contrast sensibility of the eye, B.S. Sci. Papers, vol. 15, p. 679, 1919-20. (S366, 5¢)

10. *Karrer, Enoch, and Tyndall, E.P.T., Relative spectral transmission of the atmosphere, B.S. Sci. Papers, vol. 16, p. 377, 1920. (S389, 10¢)

11. *Taylor, A.H., Measurement of diffuse reflection factors and a new absolute reflectometer, B.S. Sci. Papers, vol. 16, p. 421, 1920. (S391, 5¢)

12. Gibson, K.S., Infra-red absorption spectra of vegetable oils, The Cotton Oil Press, vol. 4, No. 5, p. 53, 1920-21.

13. *Taylor, A.H., A simple portable instrument for the absolute measurement of reflection and transmission factors, B.S. Sci. Papers, vol. 17, p. 1, 1922. (S405, 5¢).

14. *Karrer, Enoch, Use of the Ulbricht sphere in measuring reflection and transmission factors, B.S. Sci. Papers, vol. 17, p. 203, 1922. (S415, 5¢)

15. *Coblentz, W.W., Spectroradiometric investigation of the transmission of various substances, II, B.S. Sci. Papers, vol. 17, p. 267, 1922. (S418, 5¢)

16. Sando, Charles E., and Bartlett, H.H.* Pigments of the Mendelian color types in maize: isoquercitrin from brown-husked maize, Jour. Biol. Chem., vol. 54, p. 629, 1922.

17. Danielson, R.R., and Frehafer, M.K., The effect of some substitutes for tin oxide on the opacity of white enamels for sheet steel, Jour. Am. Ceramic Soc., vol. 6, p. 634, 1923.

18. *Lofton, R.E., Measure of the color characteristics of white paper, B.S. Tech. Papers, vol. 17, p. 667, 1922-4. (T244, 5¢)

19. *Schertz, F.M.* The quantitative determination of carotin by means of the spectrophotometer and the colorimeter, Jour. Agri.Res., U.S. Dept. Agri., vol. 26, p. 383, 1923.

20. Appel, W.D., and Brode, W.R., Spectrophotometric analysis applied to chromotrope 10B, Ind. Eng. Chem., vol. 16, p. 797, 1924.

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