

May 10, 1950

(Supersedes  
LC809)

## COLOR CHARTS: A Descriptive List

This is a list of some of the color charts made in the United States of America. The National Bureau of Standards does not issue any general color chart showing samples representative of the various colors. It has, however, cooperated with the Inter-Society Color Council in the development of a method of designating colors (J. Research NBS 23, 355; 1939; RP1239). This method (known as the ISCC-NBS method) with others, has been recommended by the American War Standard for the Specification and Description of Color (ASA-Z44-1942). Revisions of both the ISCC-NBS method and the American Standard ASA-Z44-1942 have been prepared, and it is probable that both will be superseded soon by these revisions.

I. Charts issued or prepared by the National Bureau of Standards for some specific purpose.

Colors for Kitchen and Bathroom Accessories, a group of 10 colors, 6 of which apply to kitchen accessories, and 7 of which apply to bathroom accessories, there being 3 colors applying to both. The samples are 3 by 5 inch rectangles of vitreous enamel on metal and are obtainable from the National Bureau of Standards at \$10.00 for the set of 10 colors. These standards are described in two publications, Colors for Kitchen Accessories, Commercial Standard, CS62-38, and Colors for Bathroom Accessories, Commercial Standard, CS63-38. Both publications are obtainable from the Superintendent of Documents, Washington 25, D.C., price 5 cents each. The colors were selected by a committee of the National Retail Drygoods Association and have been accepted by producers, distributors and users of kitchen and bathroom accessories.

Sets of these samples calibrated in terms of reflectance for the amber, green and blue filters of tristimulus photoelectric reflectometry (see NPS Circular C429) are available in a box complete with report at \$75.00 a set.

National School Bus Chrome, Minimum Standards for School Buses. Developed and Approved by Representatives of the Forty-eight State Education Departments, in Conference, April 10-16, 1939, Teachers College, Columbia University, Revised Edition (1945) obtainable from National Education Association, 1201 16th St., Washington 6, D.C. Painted cards representative of the medium hue and of the red and green limits are obtainable from the National Bureau of Standards, free of charge.

Paint Pigment Standards for Color and Tinting Strength, issued by the National Bureau of Standards at \$2.00 per sample identified by name and number as follows:

<u>NBS No.</u>	<u>Material</u>
300	Toluidine Red Toner
301	Yellow Ocher
302	Raw Sienna
303	Burnt Sienna
304	Raw Umber
305	Burnt Umber
306	Venetian Red
307	Metallic Brown
308	Indian Red
309	Mineral Red
310	Bright Red
311	Carbon Black (High Color)
312	Carbon Black (All Purpose)
313	Black Iron Oxide
314	Yellow Iron Oxide, Light Lemon
315	Yellow Iron Oxide, Lemon
316	Yellow Iron Oxide, Orange
317	Yellow Iron Oxide, Dark Orange
318	Lampblack
319	Primrose Chrome Yellow
320	Lemon Chrome Yellow
321	Medium Chrome Yellow
322	Light Chrome Yellow
323	Dark Chrome Yellow
324	Ultramarine Blue
325	Iron Blue
326	Light Chrome Green
327	Medium Chrome Green
328	Dark Chrome Green

These standard samples are used to test colored paint pigments purchased in accord with Federal specifications.

## II. Charts issued or used by other Government agencies.

### A. Textiles.

United States Army Color Card, 1930-1943, and Supplement, 1943, issued by the Textile Color Card Association of the United States, Inc., 200 Madison Avenue, New York, N. Y. This card and supplement show 22 U. S. Army colors standardized for the different arms and services. It has been approved and accepted by the Quartermaster General as being in accord with the standards on file in that

office. The samples are rectangles of silk, 1 by 1/2 inch. Their colors have been measured in fundamental terms at the National Bureau of Standards (see RPl700). This card is used in the purchase of textile materials by the Army.

United States Army Color Card of Standard Shades for Slide Fastener Tapes, Supplement to U. S. Army Specification No. 100-31, issued in 1945 by the Textile Color Card Association of the United States, Inc., 200 Madison Avenue, New York, N. Y. This card shows 16 colors for slide-fastener tapes and has been approved and accepted by the Quartermaster General as being in accord with the standard on file in that office. The samples are actual tapes, 1/2 by 1 3/8 inch, double thickness.

United States Army Standard Color Card for the Official Standardized Shades of Olive Drab, Khaki and Drab Sewing Threads, 2nd Ed. Revised, 1943, issued by the Textile Color Card Association of the United States, Inc., 200 Madison Avenue, New York, N. Y. This card shows swatches of threads dyed to the eight standard colors identified by TCCA cable number, a shade letter, and name, and has been approved by the Quartermaster General, United States Army, as being in accord with the standards on file in that office.

Bureau of Federal Supply, Specifications Division, Colors for Upholstery Leather, three colors (blue, red, brown) in actual leather (6 inches square) for purchases in accord with Federal Specification KK-L-29b, Leather, Upholstery; one color (green) in actual leather (6 inches square) of Grade A, Type II, Finish C, which is generally specified on all leather upholstered furniture contracts; and four colors (blue, red, green, brown) in artificial leather (3 by 4 1/2 inches) for purchases in accord with Federal Specification KK-L-136b, Leather, Artificial (Upholstered, Type III).

United States Maritime Commission Standard Colors for Flags, May 26, 1943, issued by the Materials Section, U. S. Maritime Commission, Washington, D. C. Five flag colors are provided in the form of 6 inch squares of dyed bunting. These standard colors are used in the purchase of materials for flags including International Code Flags.

Binding Materials, issued by United States Government Printing Office, Washington, D.C., 1948. Contains 73 samples (6 by 3 inch) of binding materials identified by color name and number classified under Buckram (20 samples), Book Cloth and Vellum (36 samples), Fabricoid (3 samples), Drilling (2 samples), Kraftco (2 samples), and Duck or Canvas (5 samples).

## B. Paint.

The Application of Color to Shore Establishment, U. S. Navy Department, 1948. obtainable from Bureau of Yards and Docks, Washington, D. C. The color charts included show 23 gloss colors identified by name and number. The samples are painted paper, 1 1/2 by 1 1/8 inch. Daylight reflectance, Munsell book notation, and ISCC-NBS color name are given for each color. Complete instructions are given for the use of these colors to reduce accidents and improve working environments.

Supplement to U. S. Army Specification No. 3-1, Revised April 21, 1943, General Specification for Paint and Related Materials, issued by the Office of the Quartermaster General, Washington, D. C. This card shows 28 gloss colors, Nos. 101 to 128; 12 semi-gloss colors, Nos. 201 to 212; and 32 lustreless colors, Nos. 301 to 332. The samples are painted paper, 1 by 3 inches, and are identified by name as well as number. This card is used in the purchase of paint and related materials by the Army.

Army-Navy Aircraft Color Standards, issued by the Supply Officer, U. S. Naval Aircraft Factory, Philadelphia, Pennsylvania. This is a group of 15 colors identified by name. The samples are 4 by 6 inch rectangles of vitreous enamel on metal. They are used in the purchase of aircraft finishes.

Army-Navy Aircraft Camouflage Standard Colors, issued by the Supply Officer, U. S. Naval Aircraft Factory, Philadelphia, Pa. This is a group of nineteen colors identified by both name and number which was first issued in June 1943. The samples are 4 by 6 inch rectangles of cardboard coated with mat paint. They are used in the purchase of aircraft finishes and accessories.

Color Standards for Public Buildings, issued by Public Buildings Administration, Washington 25, D. C., to contractors. The standards are in the form of 3 by 5 inch painted cards with flat to eggshell finish identified by Munsell color notation. About one-half of the 117 colors are duplicates of some one of those in the Munsell book; the remainder are interpolated. They are used as guides in the painting of both interiors and exteriors.

Veterans Administration Master Paint Color Guide, issued by Veterans Administration Construction Service, Color Design Unit, Washington 25, D. C., January 1, 1948. Contains 39 rectangles (2 1/2 by 1 1/2 inches) of painted paper identified by the letter V followed by a number. Instructions for using these colors in painting the exteriors and interiors of Veterans Administration Hospitals and Facilities is given in detail together with the name, brand, or number under which these colors are supplied by various paint manufacturers.

United States Maritime Commission, Standard Color Card, issued July 1, 1946. This card shows 49 painted chips (2 1/2 by 1 1/2 inches) identified by color name, and is used to indicate the color and gloss of some of the paints and paint materials purchased by the U. S. Maritime Commission, Washington, D. C.

Standard Yellow for Highway Signs, issued by the Public Roads Administration, Washington 25, D. C. The standard consists of a set of three painted cards, 3 by 4 inches, representing the medium hue and the red and green limits. This standard is referred to in the Manual on Uniform Traffic Control Devices for Streets and Highways, August, 1948, obtainable from U. S. Government Printing Office.

Post Office Department Olive Green and Cream, issued by the Post Office Department, Washington 25, D. C., on loan to prospective suppliers of paint. The standards are 3 by 5 inch rectangles of vitreous enamel on metal showing the color of the olive green enamel used on mail collection boxes and mail trucks, and the cream striping enamel used on mail trucks.

Paint Color Card, available from the Office of the Chief of Engineers, Department of the Army, Washington, D. C. The set consists of 9 cardboard rectangles, 4 by 2 inches, showing in paint the colors for maintenance or repairs, alterations, additions, and improvements to or minor new construction of buildings owned or leased by the Department of the Army. Seven of these are of mat finish for interiors (Fed. Spec. TT-P-47), and two for exteriors, one mat-finish, the other semi-gloss (Fed. Spec. TT-P-40).

### C. Miscellaneous.

A.M.S. Ink Color Guide, issued by Army Map Service, Corps of Engineers, U. S. Army, Washington, D. C., to provide a standard basis for the production of A.M.S. maps. Each of 41 inks identified by color name is shown solid (5 1/2 by 1 1/4 inches), in six different kinds of cross-hatching and half-tone scale (each block 5/8 inch square), and in various weights of solid lines and sizes and styles of type. There are also three fluorescent inks (gold, flesh, and cream) printed (5 1/2 by 3 1/2 inches) on fluorescent paper.

Rock-Color Chart, 1948, distributed by the National Research Council, Washington, D. C. This chart was prepared by the Rock-Color Chart Committee representing the U. S. Geological Survey, The Geological Society of America, American Association of Petroleum Geologists, Society of Economic Geologists, and Association of American State Geologists. The chart shows 115 rectangles 1/2 by 5/8 inch, of nearly mat painted paper. The colors are identified

by Munsell notation and by the ISCC-NBS color designation with some slight modifications. They are intended to cover the full color range of rocks, wet or dry, except possibly for very rare rocks of high chroma.

Color Standards for Electrical Insulation, issued by Bureau of Ships, Navy Department, 1946. The color standards are 22 rectangles of painted paper cards, 2 1/2 by 5 inches, semi-gloss finish. They represent light and dark limits for eleven colors used for electrical insulation to facilitate tracing of circuits. A color notation chart accompanying the standards gives the daylight reflectance, ICI chromaticity coordinates, Munsell book notations, and Munsell renotations, of the colors together with the cable number of the nearest match from the Standard Color Card of America issued by the Textile Color Card Association of the United States, Inc.

Army-Navy Aeronautical Design Standard AND10376, Chart: Humidity Indicator Color Comparison, issued November 13, 1941, approved by joint action of the War and Navy Departments. This chart shows four printed colors (2 1/8 by 1 inches) intended to represent the colors taken on by cobaltous chloride in a silica gel at various relative humidities (0, 20, 40 and 60 percent). This gel is used to keep bomb-sights, and other delicate mechanisms, dry. The amount of unused drying capacity of the gel is indicated by its color.

Standard Colors for Grading Maple Sirup, Agricultural Chemical Research Division, Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture, Washington, D. C. Sets of master standards consisting of solutions of caramel in glycerine are available to state authorities for use in the preparation of working standards by which maple sirup is graded "Fancy" or Grades A, B, or C.

Ringelmann's Scale for Grading the Density of Smoke, obtainable from the Publications Section, Bureau of Mines, Department of the Interior, Washington, D. C., consists of four rectangular patterns ( 5 1/2 by 8 1/4 inches ) in black and white to be used as color standards for smoke. The patterns when viewed from a distance of 50 feet are equivalent to 20, 40, 60 and 80 percent black, respectively.

### III. Charts issued by non-government agencies for some specific purpose.

#### A. Textiles.

Standard and Seasonal Color Cards, issued by the Textile Color Card Association of the United States, Inc., 200 Madison Avenue, New York, N. Y. The samples are 1 7/8 by 1 1/4 inch rectangles of fabric.

Each sample is identified by name and TCCA cable number. The standard cards are revised only infrequently and show about 200 colors for which there is a continuing demand. The 9th edition Standard Color Card of America shows 216 swatches of satin-finish pure-dye silk, the back or mat side being displayed over most of the area of each. The colors of these swatches have been measured in fundamental terms at the National Bureau of Standards (J. Research NBS 36, 209; 1946; RP1700; J. Opt. Soc. Am. 36, 128; 1946). There are at least two seasonal color cards issued each year, a spring card and a fall card; they show swatches of crepe-finish rayon. Similar seasonal Woolen Color Cards are issued, and there are also seasonal color cards for men's shoe leathers, for women's shoe leathers, for felt bodies for men's hats, and for women's gloves and hosiery. These cards are widely used in the textile and allied industries, and they are also used in color specification by government agencies and by industries quite unrelated to the fashion trades.

### B. Paint.

Nu-Hue Color System, The Martin-Senour Company, 2520 Quarry St., Chicago, Ill., contains 1,000 painted cards, mat finish, available in two forms, 3 by 5 inch cards in a plastic case, and disks mounted in systematic array between plexiglass cover plates. This is a paint-gamut mixture system developed from 8 base paints, 6 chromatic, 1 dark gray and 1 white. The 10 Plexiglass-protected charts correspond to different admixtures of the white paint. At the periphery of the darkest chart there are 54 hues. On this level there are 9 rings around the gray center, each ring of painted disks corresponding to successive admixture of the gray paint to the 6 chromatic base paints. Each succeeding lighter chart has one less ring, decreasing systematically from 9 rings at the bottom level to zero rings at white. The 1,000 color chips in the system illustrate the extent to which paint mixtures of these particular 6 chromatic paints can be developed by admixture of these particular gray and white paints. For each of these 1,000 colors the amounts by weight of the 8 base paints are known, and it is possible by weighing out these amounts to mix a satisfactory dry match for any of the colors shown. The Nu-Hue Color System is not suitable for general use because there are no very dark colors or near-blacks in the system, but it includes all of the colors usually used in painting interiors and exteriors of houses, and has been very successful in promoting the sale of prescription-mixed paint.

Color Coordinator, Martin-Senour Company (Attn. Spencer R. Stuart), 2520 South Quarry St., Chicago 8, Ill., 1949. Consists of a pentagon-shaped chart showing as circles around the edge the colors of the ten basic toners of the system, and showing in the interior also as circles six moderate grayed colors at the apices of a hexagon. Between the 35 neighboring pairs of the 16 starting

colors (circles) are rectangular chips showing the colors produced by mixing the starting colors in equal parts. Between the 20 edge colors (shown as circles and rectangles) are 20 more equal-part mixtures shown as triangles, making 71 color chips in all. These colors are also available in a sample book of 3 by 5 inch chips. Nearly any color desired for interior or exterior painting can be produced by mixture of not more than 3 of the 16 starting paints plus white paint. The particular merit of this small collection of color chips is that the equal-parts mixtures shown provide a painter with the tinting-strength information about these particular starting paints that he requires to make from them a rapid and accurate interpolation by mixture to the desired color.

Plochere Color System, Gladys and Gustave Plochere, 1820 Hyperion Avenue, Los Angeles 27, California, 1948. Consists of 1248 rectangles (3 by 5 inch) of mat-finish painted cards, each identified by a serial number. There are 26 hues corresponding to the Ostwald 24-point hue scale plus two additional at 24 1/2 and at 1/2 on this scale. For the base paint of each hue there are five shades produced by adding progressive amounts of a dark gray paint. For each member in these six-point series (26 by 6 = 156 mixed base paint ) there are seven tints produced by adding progressive amounts of white making up the 1248 (156 x 8) paints of the system. In the book accompanying the box of cards there are given for each serial number the hue notation, shade and tint, the proportions by volume of the paints used to produce the color, and a color name. This system develops in a very satisfactory way the color gamut of the paints used, and is of some use as a set of color standards for general purposes. The Munsell notations of these 1248 colors have been determined by Middleton (Canadian J. Research, F, 27, 1; January, 1949). It is intended primarily as an aid to color matching and selection of color harmonies by those who use the same set of base paints.

### C. Agronomy.

Munsell Soil Color Charts, prepared and distributed by Munsell Color Company, Inc., 10 East Franklin St., Baltimore 2, Maryland. The charts show 264 colors of Munsell hue from 7.5 Red through 5 Yellow, including colors of Munsell chroma /1 for hues 10 Red, 5 Yellow-Red, 10 Yellow-Red, and 5 Yellow. The samples are rectangles, 1/2 by 5/8 inch, of nearly mat painted paper. There are two forms having the samples mounted on gray paper, the special form having half-inch diameter holes punched in the gray paper beside each sample. These charts are intended for the use of soil scientists, geologists and archaeologists, and were approved in 1946 by the Soil Survey Color Committee, U. S. Dept. of Agriculture.



The American Colorist, by Faber Birren (The Crimson Press, 40 Gorham Avenue, Westport, Connecticut). Contains 550 colors in half-tone screen printing, including a 10-step gray scale, and 45 colors of each of 12 hues, arranged in triangles like the Ostwald system. Although this pamphlet serves as an aid in the design of effective color schemes and provides a means of describing colors in every day terms, it was written primarily for horticulturists and members of garden clubs.

The Fischer Color Chart, Pinkham Press, Boston, obtainable from the New England Gladiolus Society (C. W. Brown, Sec'y, Ashland, Mass.). There are 108 colors printed on semi-glossy paper. 6 variations from light to dark of each of 18 hues; arranged in a 12-inch circle, dark colors toward the center, light toward the edge.

Color Standards for McIntosh Apple Leaves, Cornell University Agricultural Experiment Station Bulletin 824A, obtainable from the Mailing Room, Experiment Station, Ithaca, N. Y. These standards are used to determine whether McIntosh apple trees are obtaining the correct amount of nitrogen fertilizer.

#### D. Miscellaneous.

Colors for Molded Urea Plastics, available from Plastic Materials Manufacturers Association, Tower Building, 14th and K Streets, N. W., Washington 5, D. C. at \$2.50 per set of 17. Each sample is a 2 1/4 inch diameter plastic disk identified by the letters MUP followed by a number. The colors of the samples conform to the ICI specifications given in Commercial Standard CS147-47, U. S. Department of Commerce, obtainable from the U. S. Government Printing Office, Washington 25, D. C. A tolerance of 1 NBS unit is permitted. Munsell notation, ISCC-NBS name, nearest match in first edition of the Color Harmony Manual, and nearest hue match from the Standard Color Card of America (TCCA) are also given.

Cheskin Color System, Color Research Institute of America, 176 West Adams Street, Chicago 3, Illinois, 1949. Contains 4,800 different colors (3/4 by 1 1/4 inch rectangles) produced by printing, both solid and half-tone screen. There are 48 hue charts, 100 colors of each, and each color is identified by an arbitrary hue number, sometimes followed by a row letter indicating white content, and a column number, indicating black content. The pure colors (produced by solid printing of specific bulk units of the primary colors, cyan, magenta, and lemon yellow, with no admixture of black or white ink) appear at the upper left-hand corner of each chart and are designated simply by the hue number. The tints are produced by progressively adding to the pure color either bulk units of white pigment or percentages of the white base paper with screened printing plates, and are designated by the hue number followed by

a letter. The shades are produced by adding to the pure color either bulk units of black pigment or black ink with screened printing plates, and are designated by the hue number followed by a number in smaller type designating the shade. The tones are produced by combinations of the processes used for the tints and shades, and are designated by hue number followed by the tint letter and the shade number. The Cheskin Color System is a detailed presentation of the colors producible by the particular cyan, magenta, and lemon yellow inks used. It is of some use as a set of color standards for general purposes, but it is intended primarily as an aid to color matching by those who print with the same set of inks.

Munsell Value Scales for Judging Reflectance, available from the Munsell Color Co., Inc., 10 East Franklin Street, Baltimore 2, Maryland. There are 20 scales, 8 chips each, comprising two scales for each of the 10 basic hues of the Munsell system, and there is a 19-chip neutral value scale, making 179 chips in all. For each hue there is a value scale of near-neutral colors (chroma /2) and a value scale of the colors of maximum chroma for that hue and value. The color chips are rectangles, 1/2 by 5/8 inch, of mat-finish painted paper. They are mounted on the edges of 11 cards for easy comparison with surfaces whose reflectance it is desired to estimate. Each chip is identified by its Munsell notation (Hue Value/Chroma), and beside each chip is printed its percentage reflectance for each of three sources (ICI source A representative of incandescent-lamp light, ICI source C representative of average daylight, and a source S representative of light from the clear blue sky). These scales were developed as a result of the activity of the delegates of the Illuminating Engineering Society to the Inter-Society Color Council during compilation of the color section of the IES Lighting Handbook.

Standard Colors of Tag Stocks, page 22, Manual of Standard Specifications, issued October 31, 1947, by the Tag Manufacturers Institute (Attn. Frank H. Baxter, Executive Director), 370 Lexington Ave., New York 17, N. Y. The chart shows 17 rectangles (1 by 2-inch) printed or painted tag stocks identified by color name.

#### IV. Charts for general purposes.

Color Standards and Color Nomenclature, by Robert Ridgway, A. Hoen and Company, Baltimore, Md., 1912 (now out of print). Contains approximately 1,000 named color samples, each sample being a mat or nearly mat paper rectangle (1 by 1/2 inch). The samples are arranged on each page with light samples at the top of the page grading down from white through eight steps to black at the bottom. Each column shows colors of constant hue, the hue circle being represented by 35 such columns. The first series of hue columns gives samples whose colors are of maximal saturation, then there are four similar series,

each showing colors progressively dulled by the addition of gray. The color names are listed alphabetically and the corresponding sample located by giving the plate number and an approximate hue, saturation, and lightness notation. Munsell notations have been found by Hamly (J. Opt. Soc. Am. 39, 592; 1949). These charts have been widely used for the specification of the colors of flowers, insects, and birds.

Munsell Book of Color, Vol. I (1929), Vol. II (1943), obtainable from Munsell Color Company, 10 East Franklin Street, Baltimore, Md. Two editions, library and pocket, each giving approximately 1,000 different color samples, are available. The pocket edition is intended for practical color-specification work. Volume I consists of 20 charts, one for each of 20 different hues with equal visual spacing, showing colors varying in lightness (Munsell term: value) and saturation (Munsell term: chroma). Volume II consists of 20 similar charts of the intermediate hues. The samples of these charts are  $1/2$  by  $5/8$  inch rectangles of painted paper nearly flat and are arranged in rows and columns, the samples in any one row being equally light, when illuminated by daylight, and the samples in any one column being equally saturated, when illuminated by daylight and observed by a daylight-adapted observer. The colors progress from very light at the top of each chart to very dark at the bottom by steps which are visually equal; and they progress from achromatic colors (black, gray or white) at the left side of each chart to saturated colors at the right by steps which are also visually equal. Each sample is identified by three symbols - the first indicating Munsell hue, the second Munsell value and the third, Munsell chroma. The samples of Volume I have been measured spectrophotometrically both at the Massachusetts Institute of Technology (J. Opt. Soc. Am. 30, 609; 1940) and at the National Bureau of Standards (J. Research NBS, 31, 55; 1943; RP1549; also J. Opt. Soc. Am. 33, 355; 1943). The samples of Volume II have been measured spectrophotometrically at the Inter-chemical Corporation (J. Opt. Soc. Am. 33, 376; 1943). These charts, because of the logical arrangement of the samples and the fact that the color differences between successive samples are visually equal, are widely used as aids in the determination of the Munsell notation (hue value/chroma) of unknown colors. They are recommended for use, together with other methods, by American War Standard ASA-Z44-1942. The Munsell notation is estimated along the color scales provided by the charts. Because of the visual uniformity of the scales, the estimates of Munsell notation have a reliability corresponding to the use of a much larger collection of unequally spaced color standards. On this account the pocket edition is widely used as a practical color standard for general purposes, particularly in the setting of color tolerances. The library edition has larger samples,  $5/8$  by  $7/8$  inch, than the pocket edition, and it shows

charts of constant chroma and charts of constant value, in addition to the charts of constant hue. Because of its larger size it is not adapted to convenient determination of the Munsell notation of an unknown color. It serves admirably, however, to teach the organization of the psychological color solid, and is considerably used in color education. Separate charts from either the Library or Pocket editions may be purchased, also papers of each separate color in the form either of sheets or of disks slit along a radius with center hole for use as Maxwell disks for rotary mixture.

A Dictionary of Color, by A. Maerz and M. Rea Paul, McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York, N. Y., 1930. (Now out of print but in course of being reprinted) contains approximately 7,000 different color samples printed on semi-glossy paper, about 6,000 of which are  $1/2$  by  $5/8$  inch rectangles, and about 1,000 of the darker of which are  $1-1/16$  by  $5/8$  inch rectangles. The hue circle is covered in 8 intervals, each interval by a series of 8 charts each, the hues within each interval being obtained by mixtures of the pigments representing the extremes of the interval. The first chart in a series shows one extreme pigment at the upper right-hand corner, the other at the lower left. The upper-left corner is white, the lower right a mixture in about equal proportions of the two extreme pigments. The samples intermediate on the chart represent colors which are intermediate, and the color steps between successive samples have been adjusted so that they are, in general, about equal. Each chart, therefore, shows a progression of hues from the upper-right to the lower-left corner, while the hues of the samples along the straight lines through the upper-left corner are nearly constant. The second chart in a series differs from the first by admixture of a gray ink; the third chart corresponds to admixture of a darker gray ink; and so on down to the eighth chart which shows very dark colors. An alphabetical list of about 4,000 color names is given together with a key by means of which each corresponding sample may be found in the charts. These samples are also identified by name in the charts themselves. Munsell notations of the red to yellow colors have been found by Nickerson (Paper Trade J. 125, 153; Nov. 6, 1947). The large number of the samples makes the steps between successive colors so small that interpolation is often not necessary. On this account they may be used conveniently as practical color standards in nearly every field. Furthermore, the scholarship and thoroughness of treatment have given this work a wide reputation as the foremost authority on color names.

Color Harmony Manual, Color Laboratories Division, Container Corporation of America, Chicago, Ill., first edition, 1942, no longer available, second edition, 1946, and third edition, 1949. In the second edition the 680 chips (1-inch square) are mounted on 12 double-triangle charts. Each sample is identified by the Ostwald notation in which hue is given by number on the 24-hue circle, and

the black content, white content and fullcolor content are indicated by double-letter symbols (pa, na, pa, and so on). There are 28 colors of each of the 24 hues which together with the 8-sample gray scale make the 680 colors. The color chips have been prepared by applying a pigmented film to a base of clear transparent cellulose acetate, so that each chip has a dull side and a glossy side. The colors of the dull sides of the chips have been measured spectrophotometrically at the Electrical Testing Laboratories (J. Opt. Soc. Am. 34, 382; 1944), and have been shown to correspond to the Ostwald system more closely than any previous standards. The chips are easily removable from the mounting to facilitate comparison with unknown colors and for combination with each other in the engineering of color harmonies. The double triangle form of the Manual emphasizes the important single-hue and complementary-hue harmonies. In the third edition the chips take the form of 7/8-inch hexagons. Charts of six additional hues (Ostwald 1 1/2, 6 1/2, 7 1/2, 12 1/2, 13 1/2, and 24 1/2) have been provided and show 28 colors each as in the second edition except that the charts of the two added red hues (6 1/2 and 7 1/2) omit one shadow series. Extra shadow series of 7 steps each are provided for the hues 1, 2, 3, 5, 7, 10, 13, 15, 19, 22, 24, and 24 1/2, and extra equal-black-content series, just darker than the light clear series, are provided for hues 24 1/2, 1, 1 1/2 and 2, bringing the total number of colors in the third edition up to 943. Each chip of this edition is also available separately. The colors of these 943 chips have been measured spectrophotometrically, both glossy and dull sides, and it is expected that the results will be published in J. Opt. Soc. Am. sometime in 1950. The Manual is designed, as the name implies, chiefly to promote the knowledge and study of color harmony and color coordination in design. Because of the fact, however, that there is a shiny and a dull side to the chips both of which are easily available for comparison with unknown colors, the Manual is exceptionally well suited to serve also as a set of color standards for general use.

