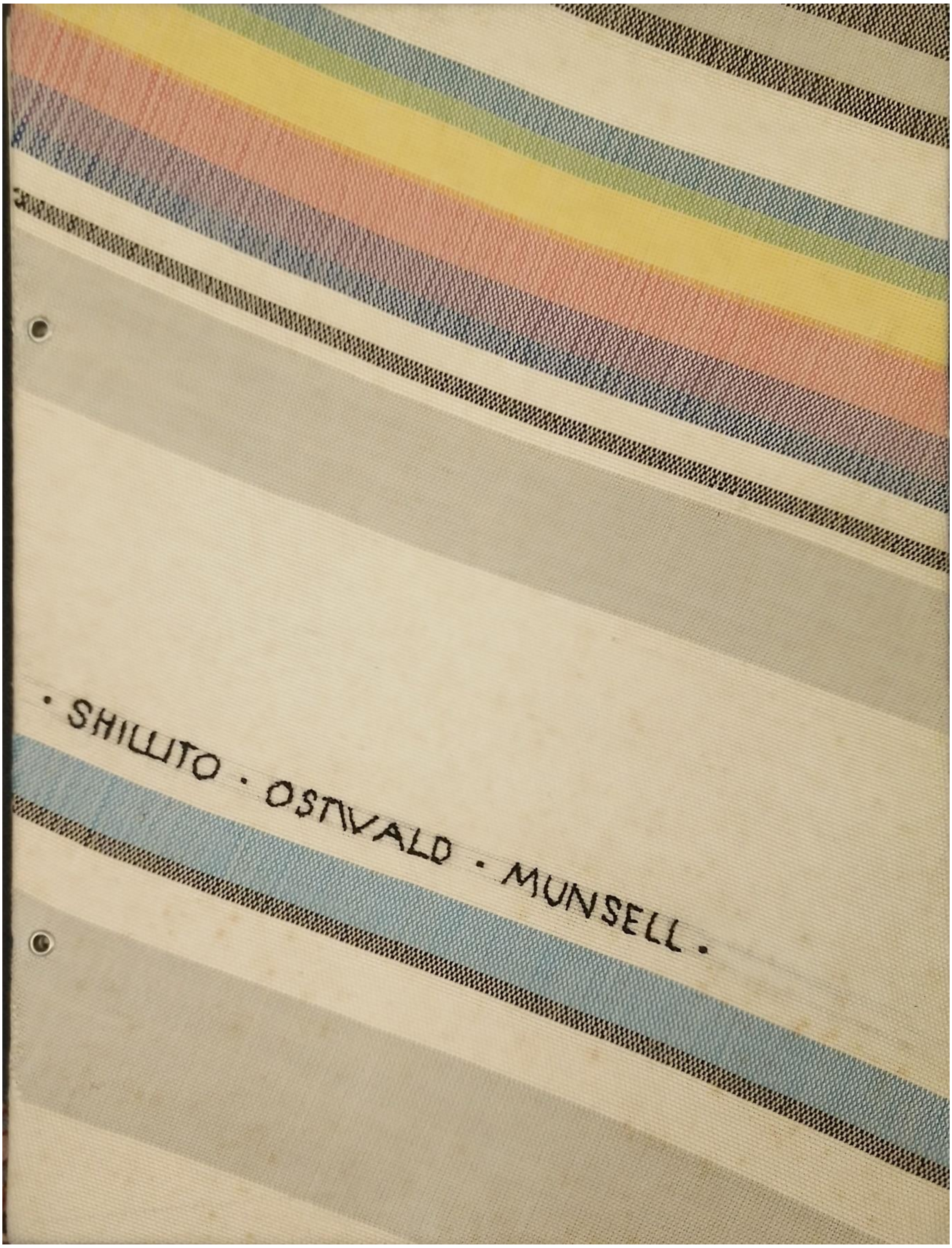
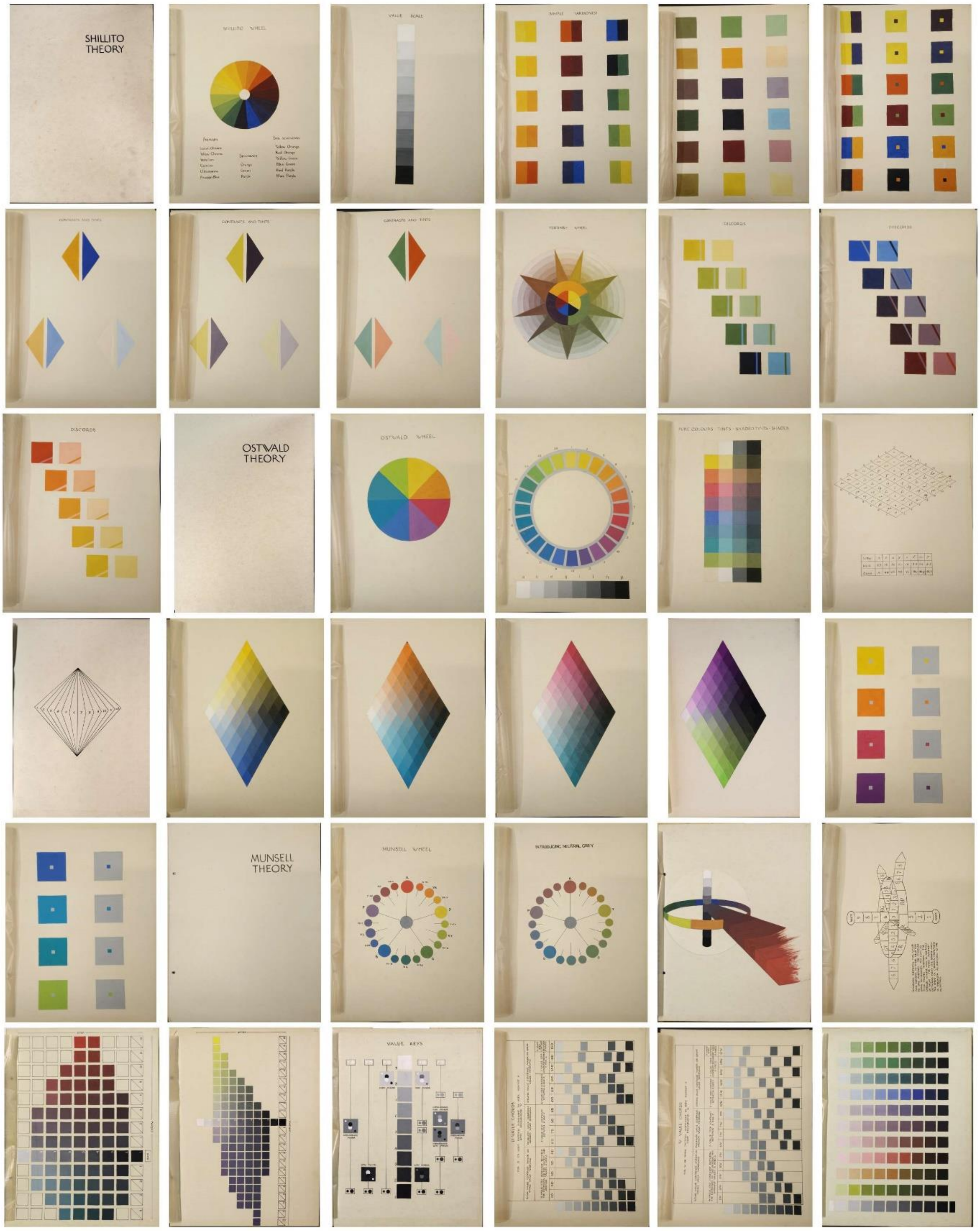


Shillito – Ostwald – Munsell by Helen Jean Burgess (1926-2018)

A reproduction of a portfolio of student colour exercises and notes produced for the Design diploma course at the East Sydney Technical College (now the National Art School, Sydney) in the mid-1940s, with an introduction and annotations by David Briggs and Eva Fay.

This pdf provides additional documentation for our paper *A Shillito Student Portfolio from the mid 1940s*, which is soon to appear in the Proceedings of the AIC2022 conference, Toronto, Canada. We also provide a zip file of Eva Fay's lecture notes from the Shillito Design School in 1976/77 at http://www.huevaluechroma.com/Fay.zip.



Overview of plates 1 -36

A Shillito Student Portfolio from the Mid-1940's

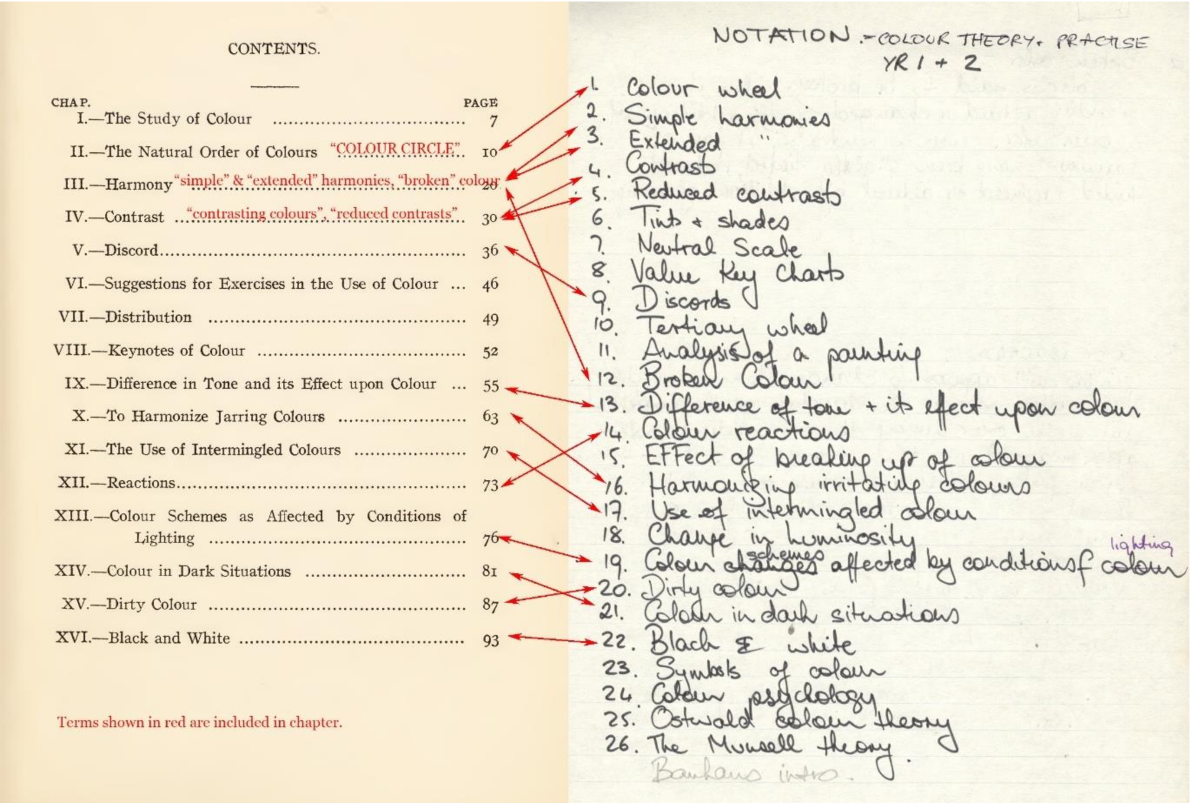
We illustrate here a remarkable portfolio of colour exercises and notes produced at the East Sydney Technical College (now the National Art School, Sydney) by Helen Jean Burgess (1926-2018) while she was a student in the Design diploma course in 1943-47. The portfolio is important as an early record of the colour curriculum of Phyllis Sykes Shillito (1895 – 1980), who was a major influence on colour design education in Australia from the 1920's to the 1970's (Kent, 1995), and an indirect influence on subsequent colour education in both design and fine art in Australia through her former students, including one of us (Eva Fay). The catalogue entry for the item at the Caroline Simpson Library & Research Collection in Sydney includes a biographical note on Helen Jean Burgess.

Our interest in this research began when one of us (DB) recognized some previously overlooked influences on the Shillito colour curriculum in a 1958 portfolio by Jocelyn Maughan OAM, and documented some of these in a Colour Society of Australia exhibit for International Colour Day 2017 (Briggs, 2017). Eva Fay attended the exhibit and recognized the same influences in her notes and exercises from the Shillito Design School in 1976-77, as noted in her recent book on these exercises (Fay, 2021). The Burgess portfolio came to our attention when it was highlighted in a talk for the CSA 2021 National Conference by curator Michael Lech on the collection of the Caroline Simpson Library and Research Collection.

The Burgess portfolio comprises a woven fabric cover and 36 loose boards comprising three sections, "Shillito Theory" (13 boards), "Ostwald Theory" (12 boards) and "Munsell Theory" (11 boards). Thirty of these boards feature renderings in gouache that range in complexity from a simple nine-step value scale (Plate 3) to intricate Ostwald and Munsell pages (Plates 20-23, 31-32) that each required careful mixing in gouache of dozens of colour chips. The portfolio also includes six annotated transparent overlays, three pen and ink versions of Munsell and Ostwald diagrams, and 44 part-sheets or full sheets of typed text attached to the reverse sides of 24 of the boards. We have examined these sheets and found that in their entirety they closely paraphrase or copy verbatim passages from a total of just seven texts. These texts comprise Henry Barrett Carpenter's *Suggestions for the Study of Colour* (Carpenter, 1915, 1923, 1932), Maitland Graves' *The Art of Color and Design* (1941) and five texts on the Munsell and Ostwald systems and theories of colour harmony. The only significant addition is that on some sheets Shillito's distinctive 15-hue classification (see below) replaces Carpenter's hue terms. Some of the passages on these sheets also appear in typed or handwritten pages included in other Shillito student portfolios of the later 1940's and 1950's.

We believe that these typed sheets are likely to be typed-up lecture notes. One of us (Eva Fay) studied at the Shillito Design School in the late 1970's and still possesses the notes that she copied down during lectures at the School, including the complete colour component of the course. Our examination of these lecture notes from 30 years later shows that they also closely paraphrase or copy *verbatim* most of the same sources, including Graves and especially Carpenter, with some additions near the end of the course including notes on colour symbolism, colour psychology and the Bauhaus. In particular, Eva Fay's lecture notes contain many subject headings and long passages taken nearly *verbatim* from Carpenter's book, including notes under the headings "Harmonies" (including "simple harmony" and "extended harmony", as in Carpenter, Ch. III, "Harmony"), "Contrasts" (including "reduced contrasts", as in Ch. IV, "Contrasts"), "Discords" (cf. Ch. V, "Discord"), "Broken colour" (cf. Ch. III, "Harmony", p. 25, "The breaking of a colour …"), "Differences in tone and its effect upon colour" (cf. Ch. IX, "Differences in Tone and its Effect Upon Colour"), "Colour reactions" (cf. Ch. XII, "Reactions"), "Harmonizing jarring or irritating colours" (cf. Ch. X, "To Harmonize Jarring Colours"), "Use of intermingled colour" (cf. Ch. XI, "The Use of Intermingled

Colours"), "Colour schemes affected by conditions of lighting" (cf. Ch. XIII, "Colour Schemes Affected by Conditions of Lighting", "Dirty colour" (cf. Ch. XV, "Dirty Colour"), "Colour in dark situations" (cf. Ch. XIV, "Colour in Dark Situations"), and "Black and white" (cf. Ch. XVI, "Black and White"). Fay's notes also include a few additional topics including "Symbols of Colour" (*verbatim* from Graves), "Colour Psychology" (mainly after Birren, 1955, 1961, with a passage *verbatim* from Cheskin, 1947), and a handout on the Bauhaus manifesto. Surprisingly we found no passages we could attribute to the colour theory texts of Itten or Albers of the early 1960's. These texts were already highly influential in contemporaneous teaching institutions internationally and in Sydney, but their similarities with the Shillito colour curriculum, noted by O'Connor (2013), are very broad compared to the direct links we identify here.

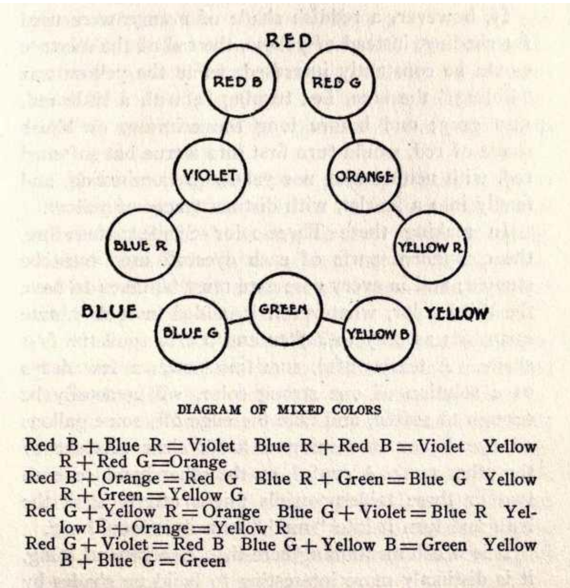


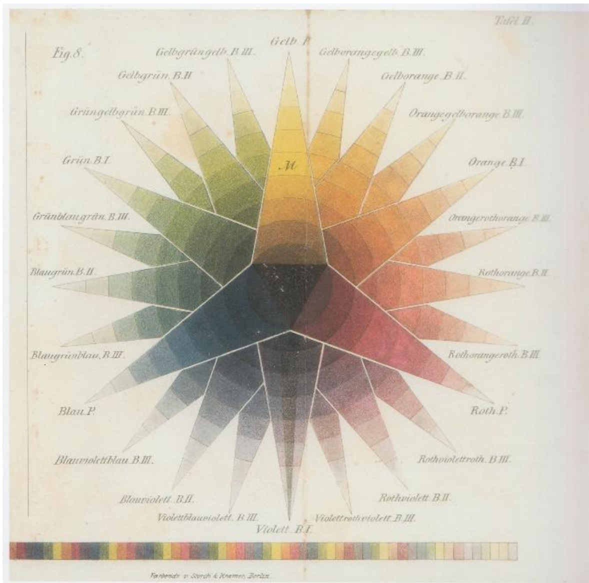
Left: Contents page of Carpenter's *Suggestions for the Study of Colour* (2nd edn, 1923). Right: Scan from Eva Fay's "Colour" lecture notes from the Shillito Design School in 1976-77 showing the list of lecture topics for this component of the course.

The Burgess portfolio stands out from later Shillito portfolios by the exceptional emphasis on carefully mixed Munsell and Ostwald atlas pages and diagrams, and by the quantity of accompanying text. A slightly later colour theory portfolio by Barbara Abbott held at the Powerhouse Museum, Sydney, has generally similar content, including closely comparable but less numerous typed notes, but the Munsell component is reduced somewhat and there are more numerous colour design exercises, some of them applying Ostwald notations. As far as we can see these trends of diminishing the amount of Munsell and Ostwald content and increasing emphasis on more creative colour design exercises continue progressively in later Shillito colour theory portfolios through to the late 1970's (cf. Fay, 2021, p. 53).

The notes in the "Shillito Theory" section of the portfolio all derive from Henry Barrett Carpenter's *Suggestions for the Study of Colour* (Carpenter, 1915, 1923, 1932), and the plates in this section illustrate "Simple Harmonies" and "Discords" in the sense that these constructs were defined by

Carpenter, plus “Pure Colours, Tints and Shades”, “Contrasts and Tints”, a grey scale, and two “colour wheel” diagrams designed by Shillito. The “Shillito Wheel” (Plate 2) illustrates a distinctive 15-step paint-based hue scale that was Shillito’s own invention. On this plate the fifteen hues comprise six “primary colours”, each corresponding to a specified pigment, plus three “secondary” and six “subsecondary” colours (called “Sub-Primary” colours in some other Shillito student portfolios), all mixed from facing pairs of the six “primary colour” paints. Double-primary palettes like this are used as a practical remedy for the severely limited colour gamut obtainable from any set of just three “primary” red, yellow and blue paints, and became very popular for this purpose with painters [from the 1960’s onwards](), but there are very few comparable earlier examples apart from those by Shillito and her students. The closest possible antecedent that we are aware of is the diagram of six primary colours and three secondary colours illustrated by Pellew (1918, p. 79). The 15-step hue scale remained part of Shillito’s colour curriculum through to the late 70’s, when it was used as the basis for several additional exercises in gouache (see Fay, 2021, pp. 15, 16, 20). The arrangement must therefore have been quite well known at that time, and could well have inspired later instances of “double-primary” palettes, though we are not aware of any direct evidence to support this. The “Tertiary Wheel” (Plate 10) is another original Shillito design lacking clear antecedents. With its radiating triangles grouped in hierarchical orders and its concentric bands lightening in tone radially there are some very tenuous resemblances to a diagram by Adams (1862). The Tertiary Wheel was another fixture of Shillito student portfolios through to the end of Shillito’s teaching career, with some variation in the number of concentric bands and in the degree of differentiation of the two orders of radiating triangles.

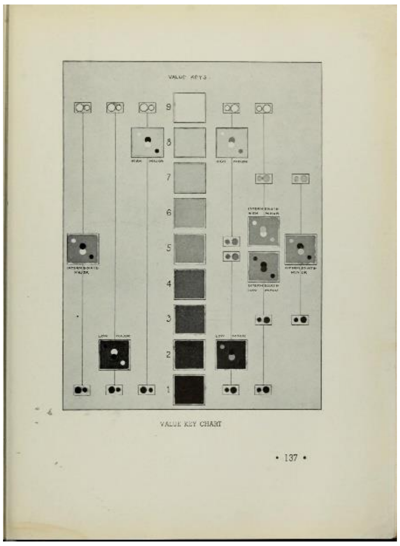


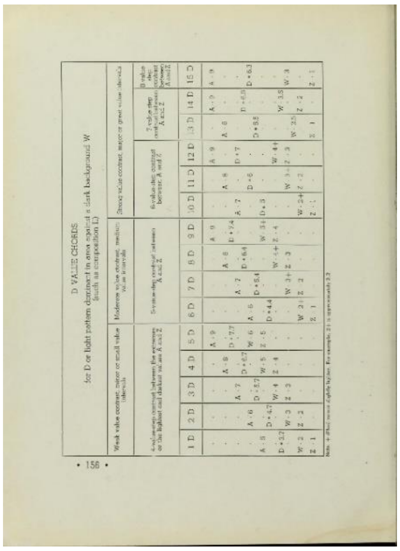


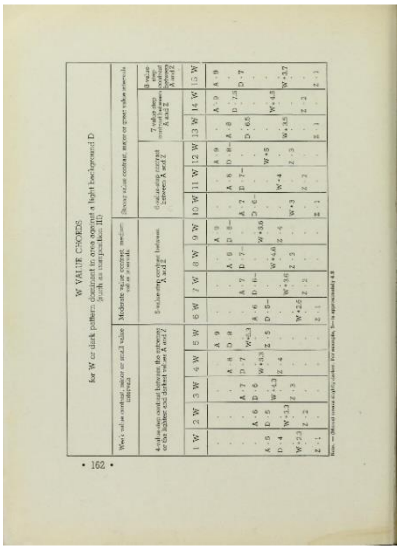
Left: “Diagram of mixed colours” from *Dyes and Dyeing* (Pellew, 1918, p. 79). Right: Plate 2 from *Die Farben-Harmonie in ihrer Anwendung auf die Damentoilette* (Adams, 1862).

The typed notes in the “Ostwald Theory” section include eighteen pages extracted with omissions from J. Scott Taylor’s *A simple explanation of the Ostwald Colour System* (Taylor, 1935), plus pages derived from Ostwald’s *Colour science* (Ostwald, 1931, 1933) and Judson’s *A handbook of colour* (Judson, 1935). The more elaborate plates in this section appear to derive from *Colour Science* and from Ostwald’s colour atlas *Der Farbkörper* (Ostwald, 1919).

The typed notes in the “Munsell Theory” section derive from T. M. Cleland’s *A practical description of the Munsell Color System* (Cleland, 1921), Maitland Graves’ *The Art of Color and Design* (Graves, 1941), and an article called *Color Organization* by De Forest Sackett in the 1938 edition of the journal *Printing Art*. The two double-hue-page Munsell plates (pls 31 and 32) do not match the corresponding plates in this format in the 1915 *Atlas of the Munsell Color System* or in “Opposite Hues” editions of the *Munsell Book of Color*, but one closely matches a Munsell chart by the Allcolor Co., Inc., New York City, illustrated in an article on colour science in [*Life Magazine* (**17** [1], July 3, 1944, p. 47)]. The “Munsell Theory” section also includes gouache renderings (Plates 33-35) of three pages from Graves' *The Art of Color and Design* (1941, pp. 137, 156, and 162 respectively), which had been published just a few years earlier. These pages illustrate Graves' concepts of "value keys" ("High Minor", "Low Major" etc.) and "value chords", which he devised as a means of systematically classifying tonal distributions in compositions in relation to the Munsell value scale. Graves’ textbook proved to be highly influential and his concepts of “value keys” and “value chords” still find application today in both fine art and design. Exercises rendering Graves’ "value key" and "value chord" diagrams (see below) and applying these concepts to design exercises were retained throughout Shillito’s teaching career (for examples, see Fay, 2021, pp. 37-38), and Eva Fay recall’s Graves’ book was present in some of the classes where his classification was discussed.







Three pages from Maitland Graves' *The Art of Color and Design* (1941, pp. 137, 156, and 162 respectively), viewable online at https://archive.org/details/artofcolordesign00grav/mode/2up Compare Plates 33-35 below.

Comparison of the Burgess portfolio of the mid 1940's with Shillito's colour exercises in the 1970's (discussed by O'Connor, 2013, and individually described and illustrated by Fay, 2021), suggests that throughout this period, Shillito's colour teaching emphasized the intimate grasp of colour relationships that can be obtained through many hours of meticulous practical colour manipulation in paints, whether in copying Ostwald and Munsell hue pages in the 1940's or in rendering more creative colour design exercises in the the 1970's. We hope that by making documents like this available we will assist future investigators in establishing the extent of comparable training temporally and regionally; certainly today it seems very rare outside realist painting ateliers.

Another aspect of the Shillito colour curriculum that compares very favourably to much colour education today was the level of attention paid to a systematic, three-dimensional understanding of colour organization. In the 1940's, this was presented in the context of the two major scientific colour order systems used in art and design at the time, alongside Shillito's own palette-based hue system. By the late 1970's the Ostwald system had declined in influence globally, and three-dimensional colour organization at the Shillito School was presented primarily in terms of the

Munsell paradigm of hue, lightness ("tone") and chroma ("intensity"), but we have little doubt that today Shillito would discuss both the Munsell and the NCS frameworks.

The concepts of Henry Barrett Carpenter set out in his book *Suggestions for the study of colour* evidently formed the backbone of the Shillito's colour theory classes from at least the mid 1940's to the late 1970's. In fact, given that Carpenter was headmaster of the Rochdale School of Art, Manchester, only a short distance from the Halifax Technical College in South West Yorkshire where Shillito studied and also taught classes before coming to Australia, it's likely that Shillito knew of Carpenter's book from the beginning of her teaching career. Carpenter's book was one of a number of popular texts for artists and designers that built on concepts derived from Ogden Rood's *Modern Chromatics* of 1879, which was in turn a popularization of the new scientific view of colour ushered in by Helmholtz, Maxwell and others beginning in the 1850's. Other such texts include Emily Vanderpoel's *Color Problems* of 1901 and Albert Munsell's *A Color Notation* of 1905, but Carpenter's approach to colour theory stands out for its emphasis on learning by exercises and experimentation. Carpenter expressed the hope that his key concepts, which were presented to Shillito students more or less *verbatim*, would be of use to students of fine art as well as design, and we are very pleased that this has been confirmed by an artist and art teacher of the standing of Jocelyn Maughan OAM (see Fay, 2021, Foreword). Like Carpenter, Shillito promoted experiential learning through practical exercises and experimentation presented in tandem with theory, rather than in advance of or even in place of theory, as in Albers.

> The experiments suggested in this chapter, and indeed throughout the whole book, are very far-reaching in their effect, and the student will discover a wealth of new ideas if he will but carry them out, but the casual reader who does not test the suggestions for himself will gain little. Words read are easily forgotten, but experience gained lasts a lifetime. Moreover, each experimenter brings his own personality to bear on the problem with the result that, however old the experiment, new beauties are constantly being discovered, and the joy of discovery is beyond price.

Concluding paragraph from Carpenter's *Suggestions for the Study of Colour* (2nd edn, 1923, pp. 98-99).

We'd like to emphasize that what we have been documenting here are only the sources of the colour theory component of Shillito's comprehensive curriculum, which spanned numerous design disciplines. Eva Fay recalls Shillito in the 1970's as a unique, motivating and inspirational educator, who knew how to guide her students to observe, experiment, discover, and search for alternative answers, to prepare them for the fine art field or the commercial world of both in 2D and 3D design. Shillito's mature method of teaching was unique in that apart from doing exercises in colour theory classes like those documented here, and having critical discussion at that point, the colour application to each design exercise was also followed up with further critiques in the design and design application section of the curriculum. Eva Fay recalls that even though the course was very structured, students were often given minimal instruction and learnt principles of colour application by experimentation, discovery, observation, and discussion. Gradually the students gained an informed colour confidence to solve challenging colour issues and an astute sensitivity to colour with a critical eye for nuances.

Dr David Briggs and Eva Fay, February 11, 2022 (updated June 15, 2022)

Acknowledgements

We thank Michael Lech, Curator of the Caroline Simpson Library & Research Collection in Sydney, for giving us permission to take and publish photographs of the portfolio.

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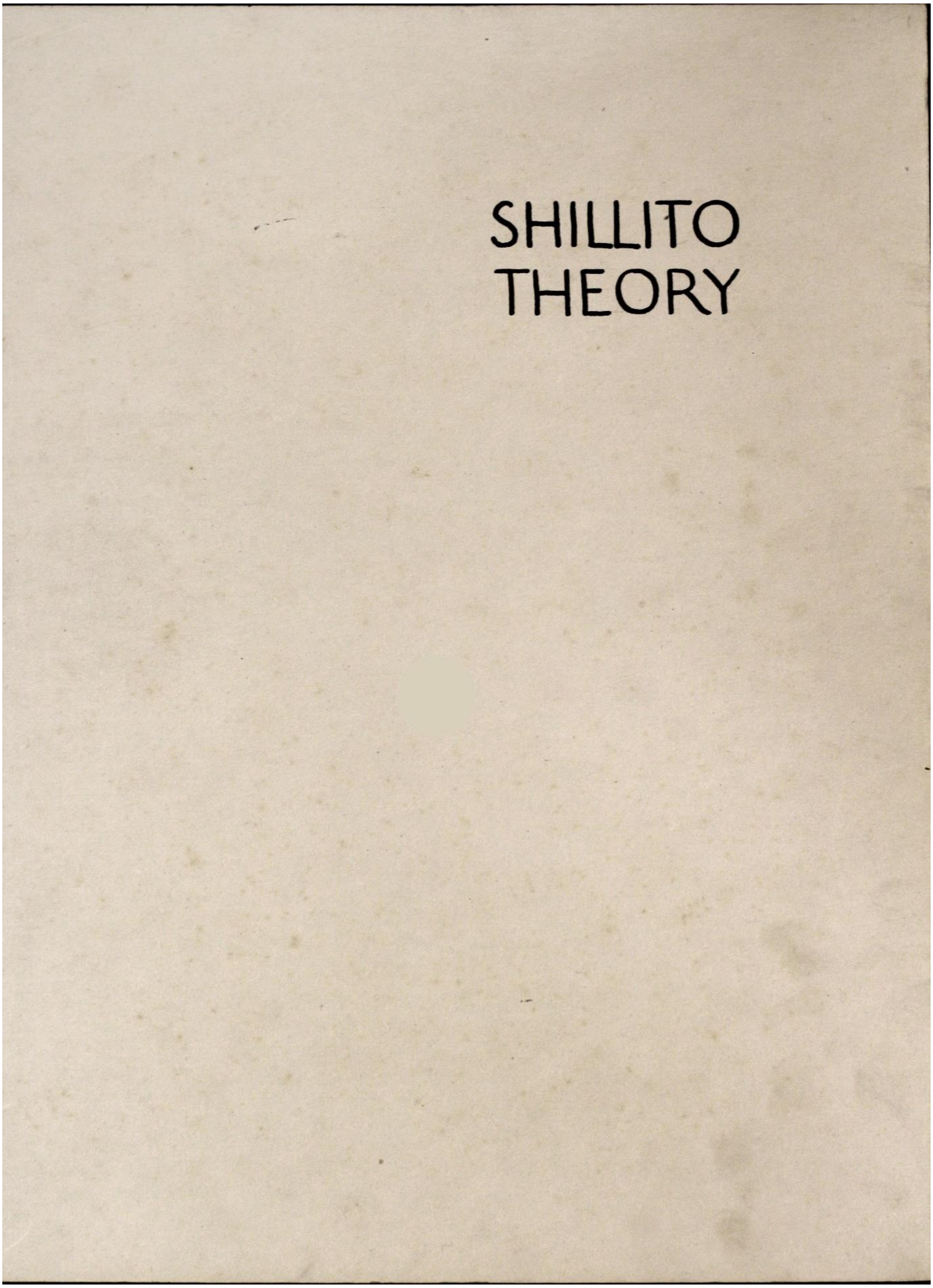
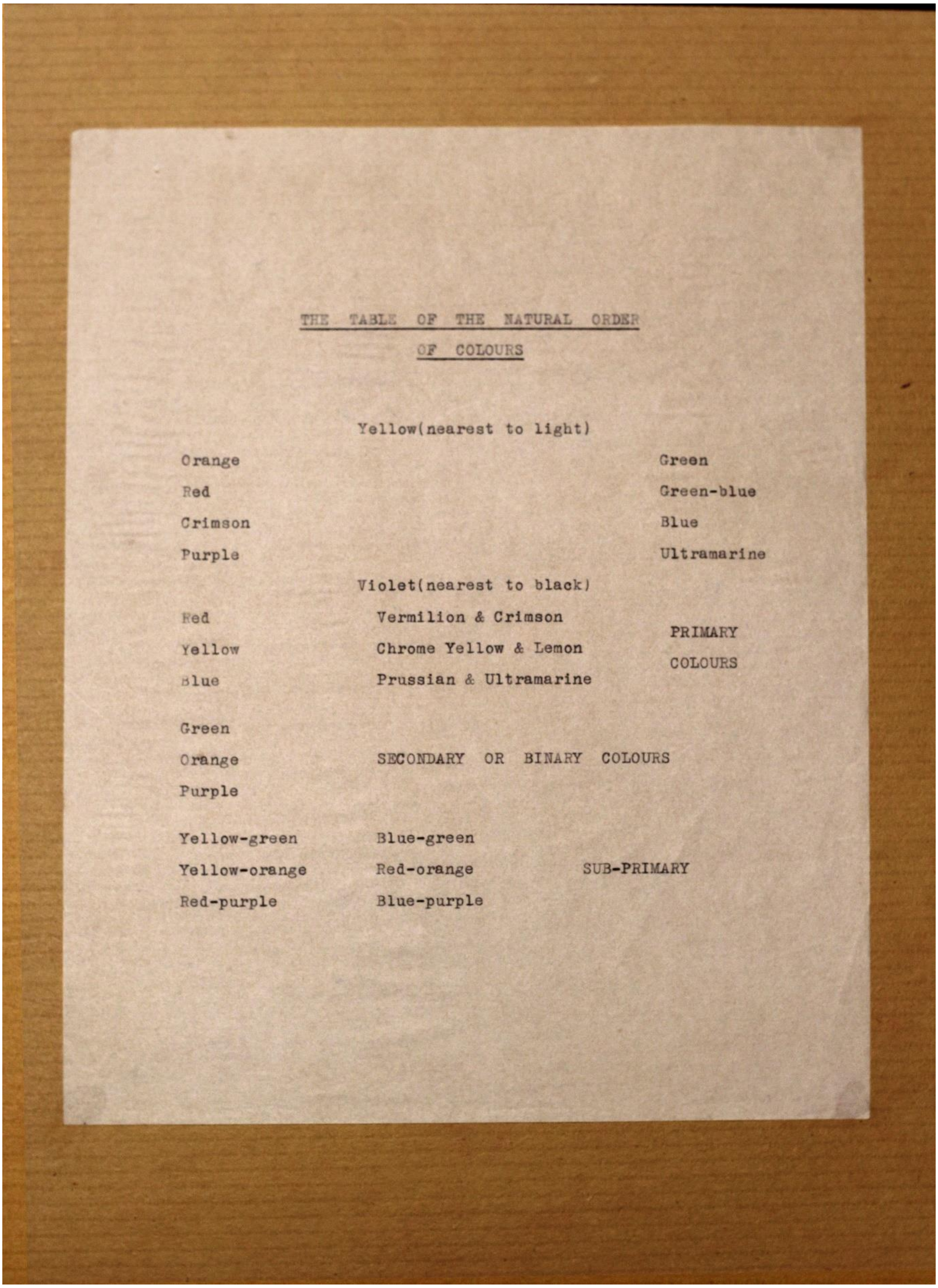

SHILLITO
THEORY

Plate 1

Facing Plate 2



THE TABLE OF THE NATURAL ORDER OF COLOURS

Yellow(nearest to light)

Orange	Green
Red	Green-blue
Crimson	Blue
Purple	Ultramarine

Violet(nearest to black)

Red	Vermilion & Crimson	PRIMARY COLOURS
Yellow	Chrome Yellow & Lemon	
Blue	Prussian & Ultramarine	
Green		
Orange	SECONDARY OR BINARY COLOURS	
Purple		
Yellow-green	Blue-green	
Yellow-orange	Red-orange	SUB-PRIMARY
Red-purple	Blue-purple	

Contrast “Rood’s Table of the Natural Order of Colours”, Carpenter, 1923, p. 11; 1932, p. 5.

Plate 2

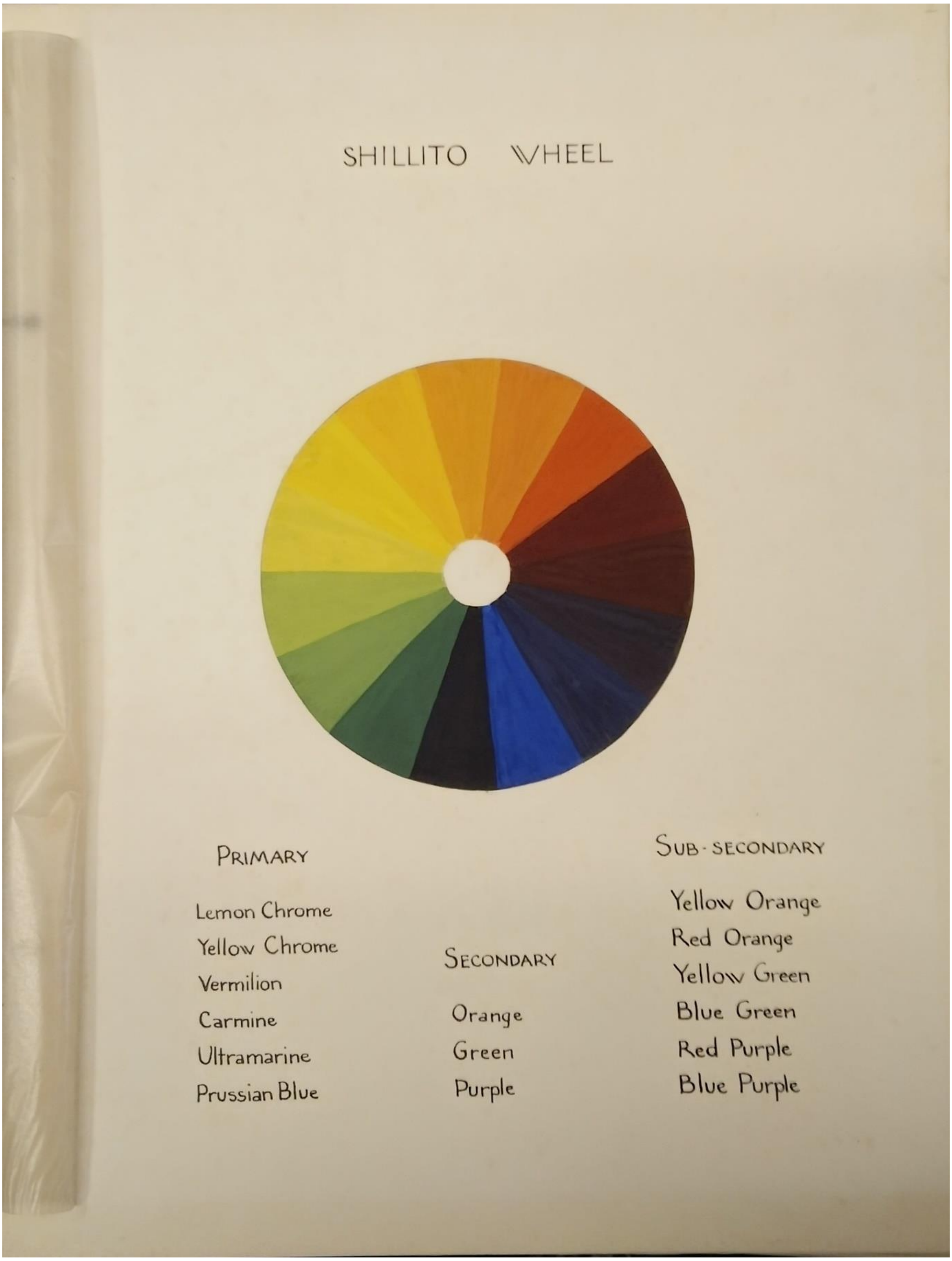


Plate 2

Contrast Carpenter, 1932, Plate II.

Plate 3

SIMPLE HARMONIES

A simple harmony is a combination of two or more colours which lie near together in the circle eg. orange & red, orange-red & purple, yellow-green & green, yellow-green, green & blue-green, green, blue-green & blue.

A simple harmony is the effect produced by using any colours together with its next neighbour or near neighbours in their natural order, for instance orange-yellow supported by yellow & orange, the yellow being lighter & orange darker will give a simple harmony, or red supported by orange-red or crimson-red or purple supported by red-purple & violet. The simplest form of harmony is obtained by the combination of two colours, yellow & green or orange & red or blue & purple. Any of these colours used in pairs or in threes in the natural order will not appear unpleasant. Many woven and printed fabrics are carried out in two colours (in simple harmonies) so that the result will give <u>one</u> note of colour in the scheme. These simple harmonies are frequently found in nature. In foliage you will often find a definite harmony in yellow-green, green & blue-green. In autumn such foliage will show a simple harmony in yellow-green, green, blue-green & purple, the purple adding a pleasing contrast to the simple harmony.

Facing Plate 4

Compare Carpenter, 1923, Chapter III, pp. 20-21.

Compare Carpenter, 1923, Ch.VI, “Suggestions for Exercises in the Use of Colour”, p. 46.

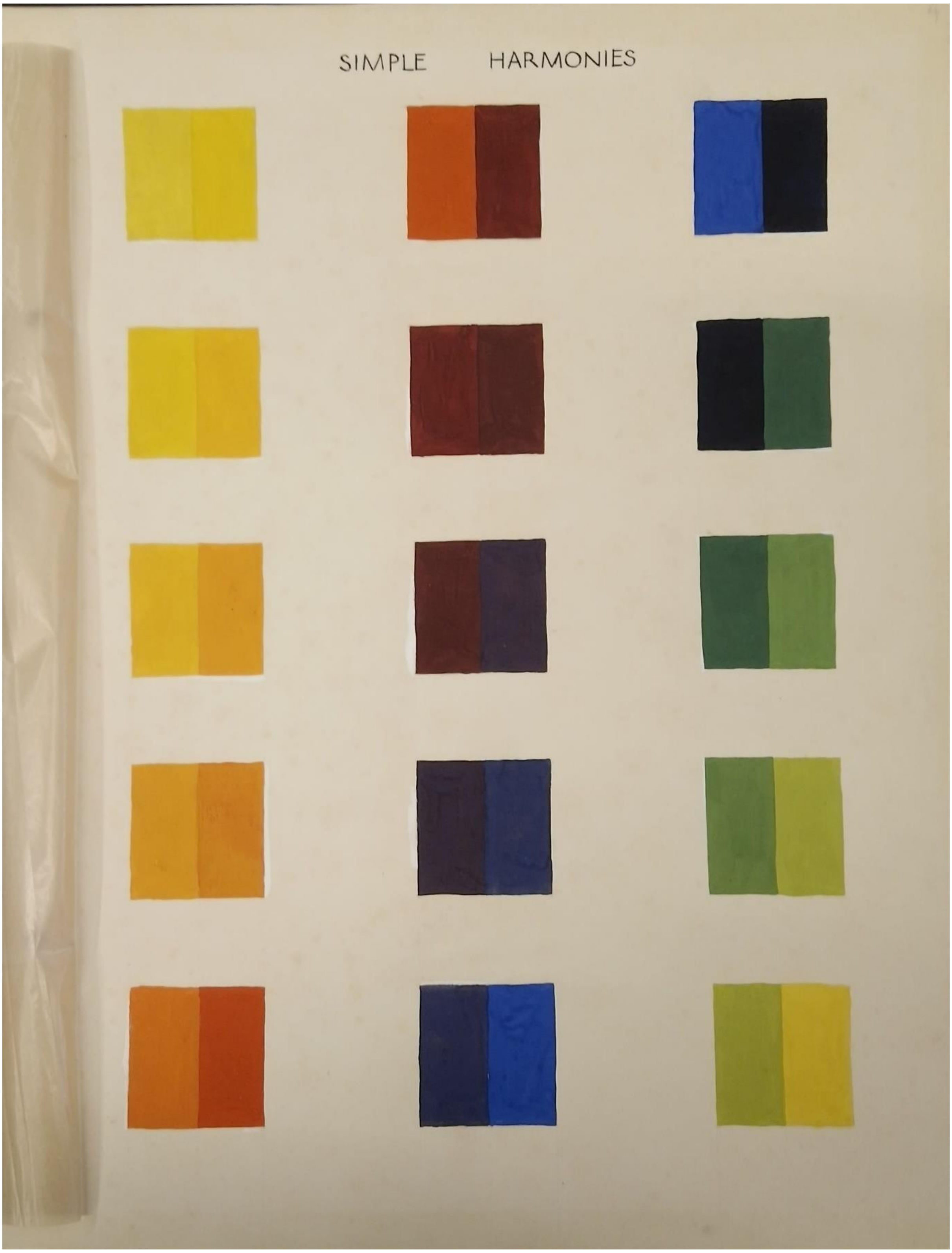
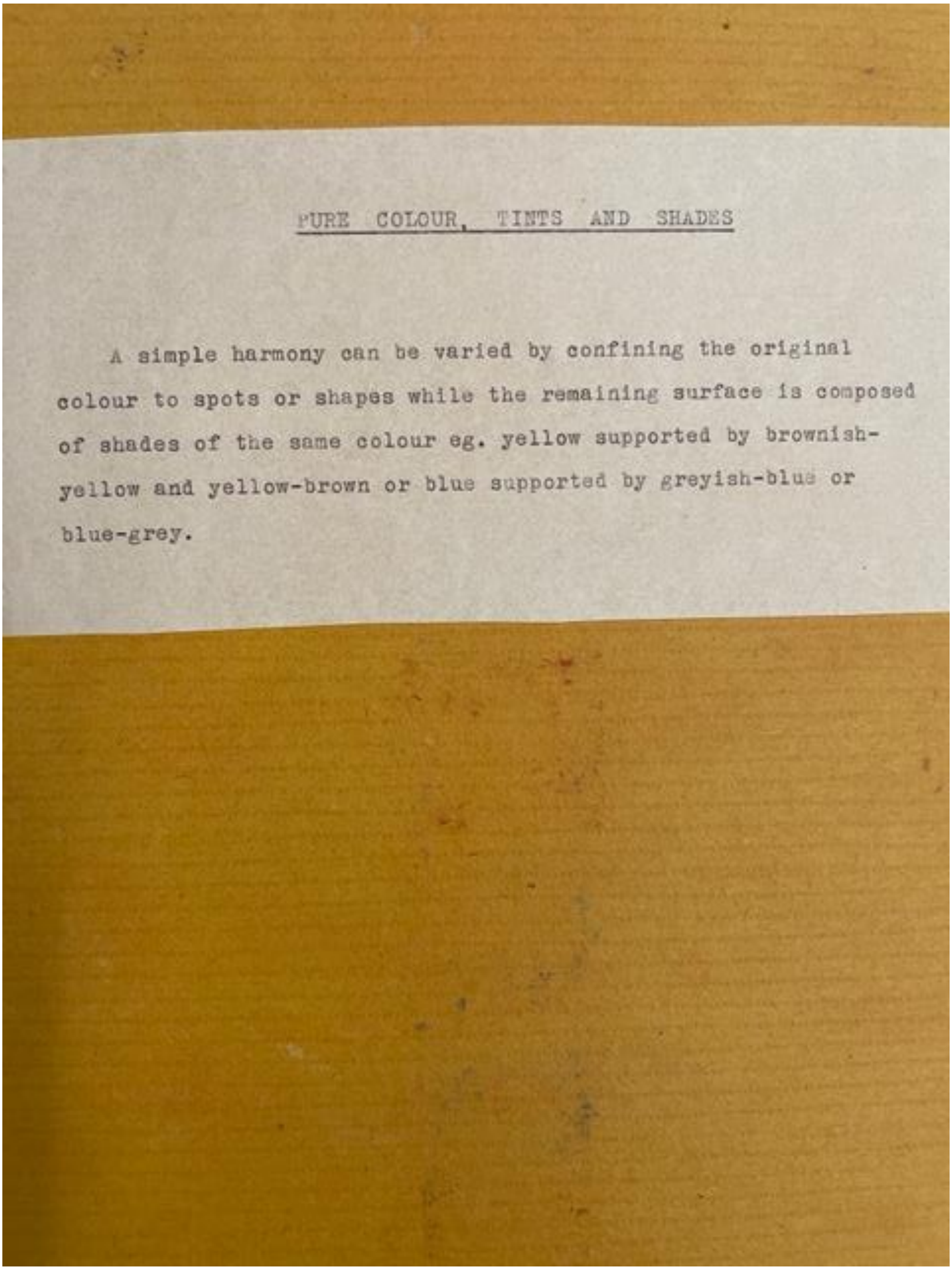


Plate 4

Compare Carpenter, 1923, Ch.VI, “Suggestions for Exercises in the Use of Colour”, p. 46.

Compare Carpenter, 1923, Chapter III, "Harmony", p. 23.



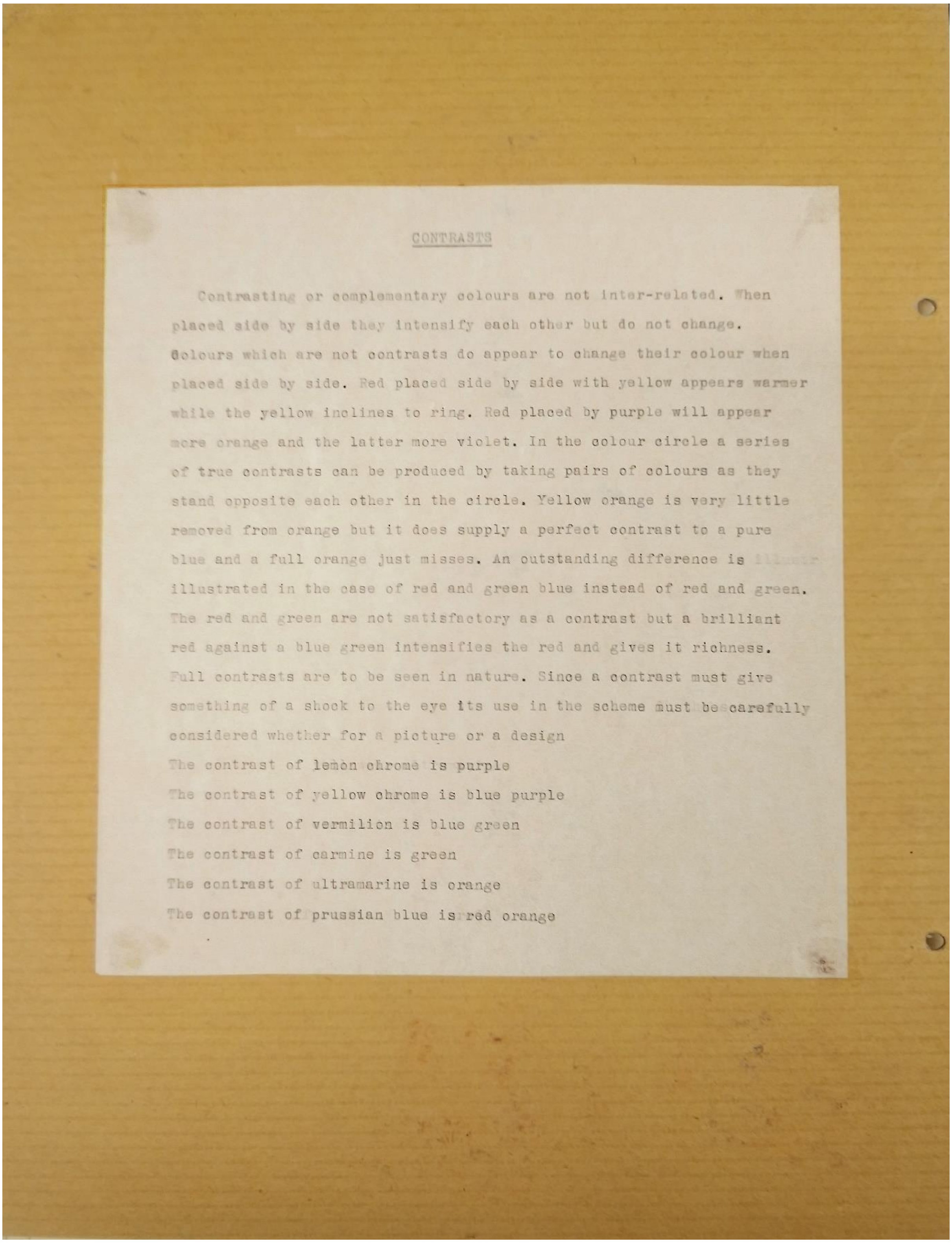
PURE COLOUR, TINTS AND SHADES

A simple harmony can be varied by confining the original colour to spots or shapes while the remaining surface is composed of shades of the same colour eg. yellow supported by brownish-yellow and yellow-brown or blue supported by greyish-blue or blue-grey.

Facing Plate 5

Compare Carpenter, 1923, Chapter III, "Harmony", p. 23.

Plate 5



CONTRASTS

Contrasting or complementary colours are not inter-related. When placed side by side they intensify each other but do not change. Colours which are not contrasts do appear to change their colour when placed side by side. Red placed side by side with yellow appears warmer while the yellow inclines to ring. Red placed by purple will appear more orange and the latter more violet. In the colour circle a series of true contrasts can be produced by taking pairs of colours as they stand opposite each other in the circle. Yellow orange is very little removed from orange but it does supply a perfect contrast to a pure blue and a full orange just misses. An outstanding difference is illustrated in the case of red and green blue instead of red and green. The red and green are not satisfactory as a contrast but a brilliant red against a blue green intensifies the red and gives it richness. Full contrasts are to be seen in nature. Since a contrast must give something of a shock to the eye its use in the scheme must be carefully considered whether for a picture or a design

The contrast of lemon chrome is purple

The contrast of yellow chrome is blue purple

The contrast of vermilion is blue green

The contrast of carmine is green

The contrast of ultramarine is orange

The contrast of prussian blue is red orange

Facing Plate 6

Compare Carpenter, 1923, Chapter 4, “Contrast”, pp. 30, 31, 34, 35.

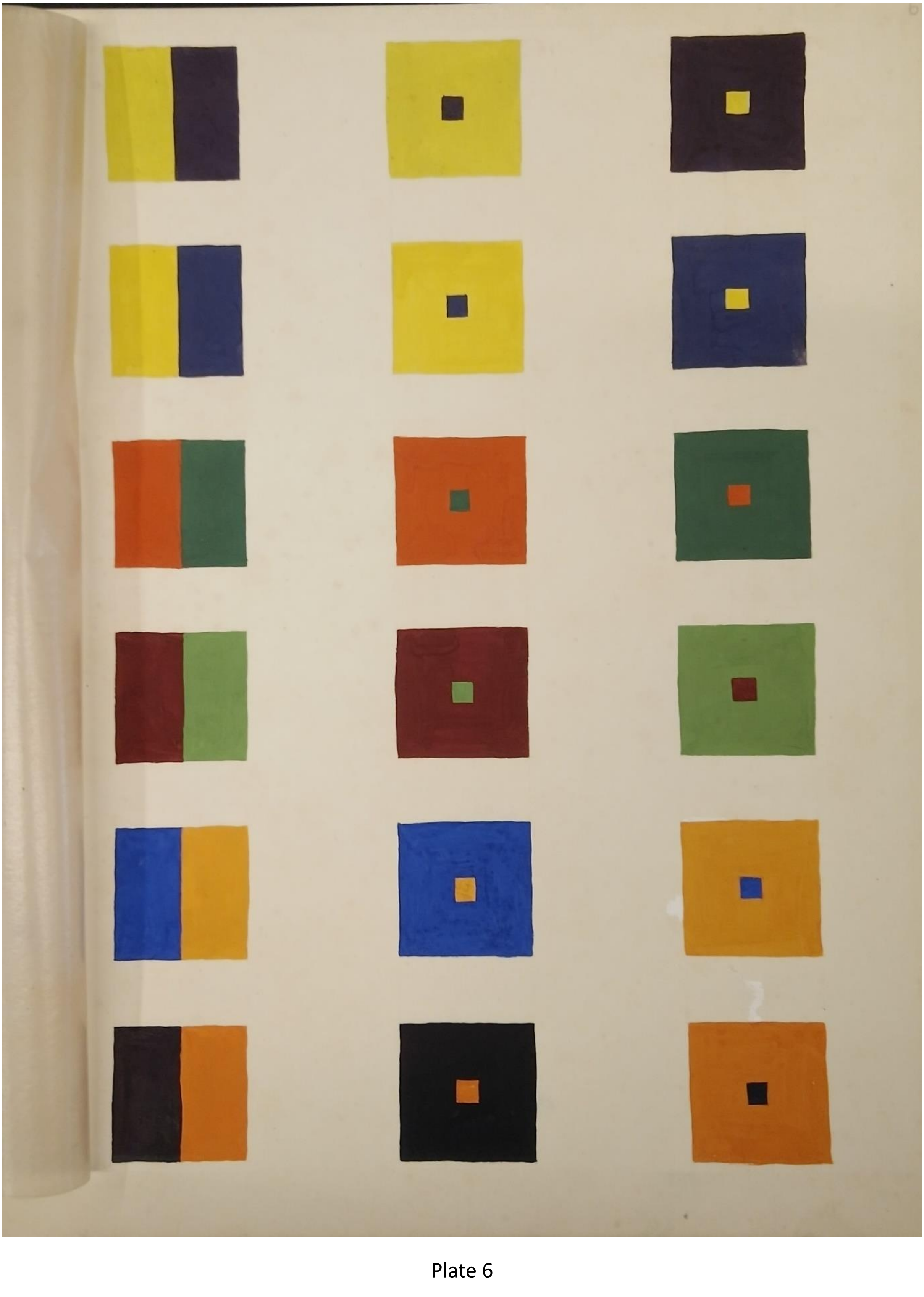


Plate 6

Plate 7

Plate 8

Plate 9

TERTIARY WHEEL

The breaking of a colour means the mixing with it of other colours, harmonious or contrasting or even both. Red may be mixed with yellow to make orange, but a little blue will take off the edge of the colour and dull it making it easier to work with. A colour broken in this way gives a wider range of tints than a clear pure colour, but what it gains in this direction it loses in brilliance. The weaver can employ this methodwith far less sacrifice of brilliance than the painter for the interweaving of colours will produce a brilliance where a mixture of paint will produce dullness.

Facing Plate 10

Compare Carpenter, 1923, Chapter III, “Harmony”, p. 25.

Plate 10

DISCORD

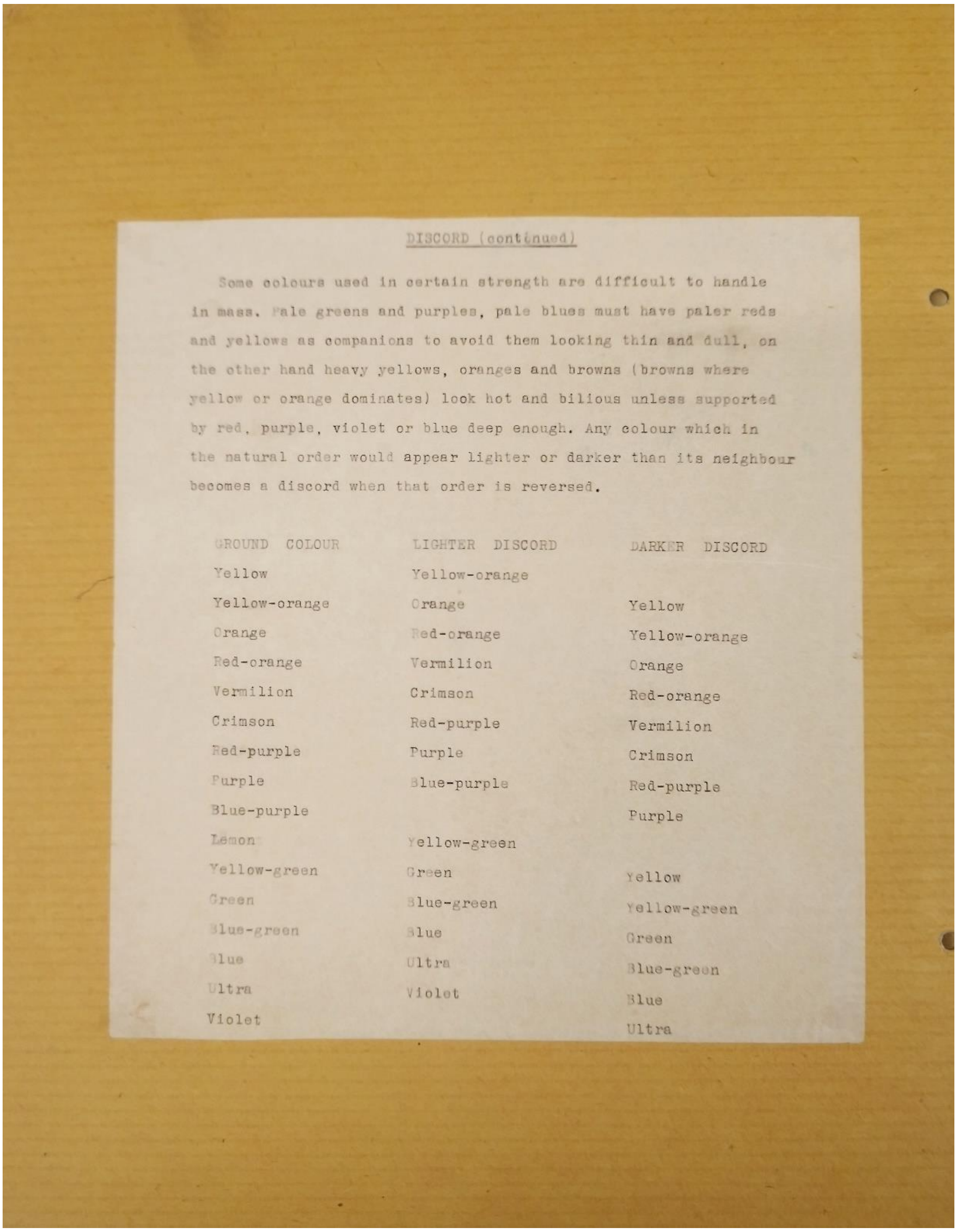
The natural order of colours seems often to be reversed, but only when the colours appear in small quantities. It is this reversal of the natural order to which the name discord is given. Discord in large masses are irritating but in small quantities they vibrate and add brilliance to the scheme. When harmonies tend to become too quiet and dull the use of a small discord will give the necessary vibration eg. full red supported by orange and crimson and with green-blue as a contrast could have a touch of light purple as a discord. A large quantity of light purple against full red is bad, but small touches do appear very lovely. Discords may be dark as well as light, for instance, a light scheme of blues may have lines or spots of dark red. A mass of dark red against a mass of light blue is nauseating, but used in small quantities the red becomes so dark that one fails to realise its colour or be hurt by it. Under such conditions the red will appear as a rich black.

Do not allow a discord to rule a scheme. It should only be used when an effect tends to become heavy with richness or dull from excessive harmony. In a textile design a narrow stripe or small spot may suffice. In a room, a simple touch, a vase, a few flowers, an ornament, a picture or a cushion may be enough.

Facing Plate 11

Compare Carpenter, 1923, Chapter V, “Discord”, pp. 36-37, 41.

Plate 11



DISCORD (continued)

Some colours used in certain strength are difficult to handle in mass. Pale greens and purples, pale blues must have paler reds and yellows as companions to avoid them looking thin and dull, on the other hand heavy yellows, oranges and browns (browns where yellow or orange dominates) look hot and bilious unless supported by red, purple, violet or blue deep enough. Any colour which in the natural order would appear lighter or darker than its neighbour becomes a discord when that order is reversed.

GROUND COLOUR	LIGHTER DISCORD	DARKER DISCORD
Yellow	Yellow-orange	
Yellow-orange	Orange	Yellow
Orange	Red-orange	Yellow-orange
Red-orange	Vermilion	Orange
Vermilion	Crimson	Red-orange
Crimson	Red-purple	Vermilion
Red-purple	Purple	Crimson
Purple	Blue-purple	Red-purple
Blue-purple		Purple
Lemon	Yellow-green	
Yellow-green	Green	Yellow
Green	Blue-green	Yellow-green
Blue-green	Blue	Green
Blue	Ultra	Blue-green
Ultra	Violet	Blue
Violet		Ultra

Facing Plate 12

Compare Carpenter, 1923, Chapter V, "Discord", pp. 42-44.

Plate 12

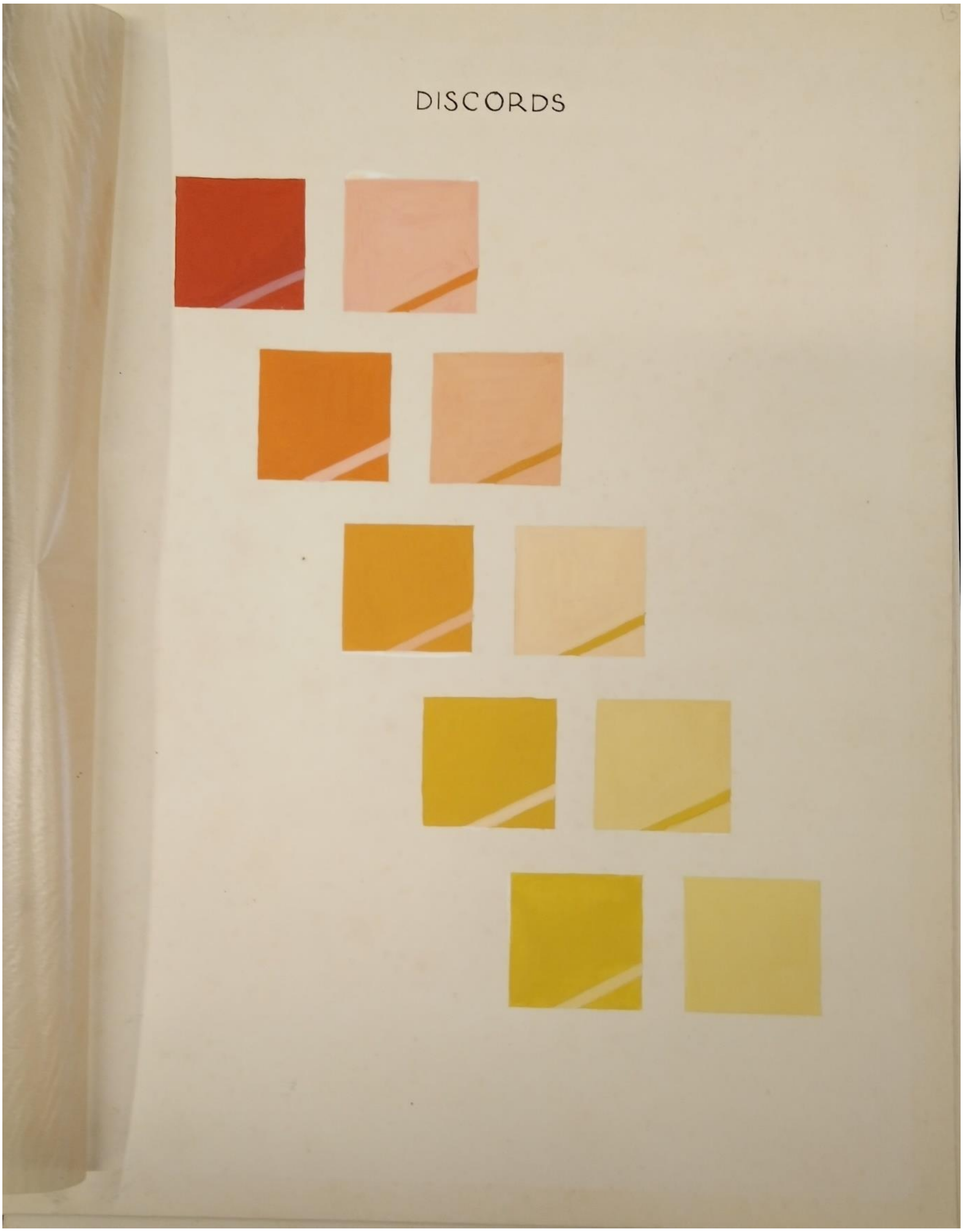
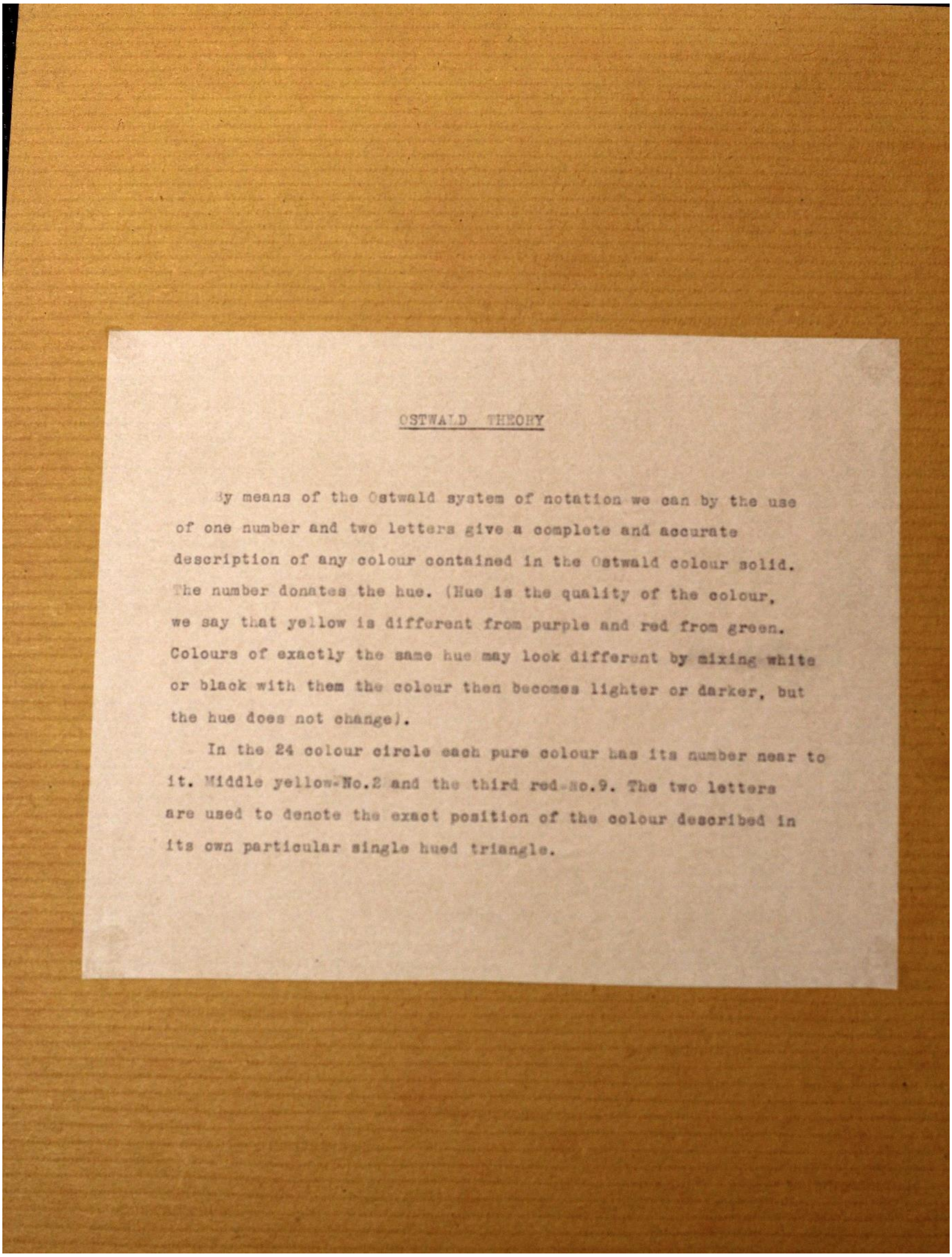


Plate 13

14

OSTWALD THEORY

Plate 14



OSTWALD THEORY

By means of the Ostwald system of notation we can by the use of one number and two letters give a complete and accurate description of any colour contained in the Ostwald colour solid. The number donates the hue. (Hue is the quality of the colour, we say that yellow is different from purple and red from green. Colours of exactly the same hue may look different by mixing white or black with them the colour then becomes lighter or darker, but the hue does not change).

In the 24 colour circle each pure colour has its number near to it. Middle yellow-No.2 and the third red-No.9. The two letters are used to denote the exact position of the colour described in its own particular single hued triangle.

Facing Plate 15

Compare Judson, 1935, p.77.

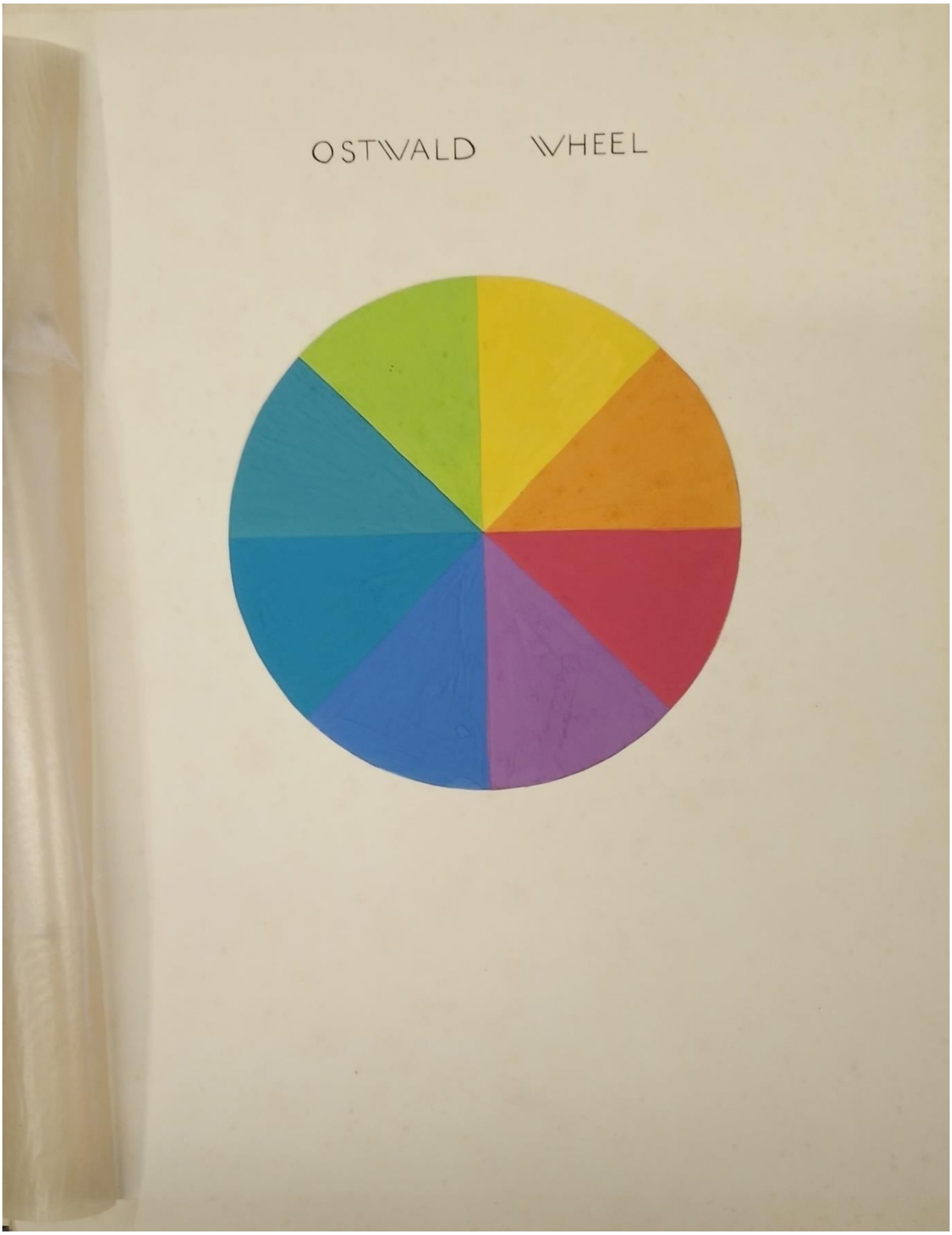


Plate 15

Very similar eight-hue Ostwald circles occur in several Ostwald-inspired educational texts including *Colour Practice in Schools* by O. J. Tonks (1935).

THE COLOUR SOLID

If we design single-hued triangles corresponding to each of the colours in the 24 colour circle and place them in colour circle order so that the neutral rows come together and the pure colour corners lie in a circle we obtain the skeleton of a double cone. This double cone is known as the colour solid and within it systematically placed are all the pure colours, tints, shades, greyed colours and neutrals. The neutrals form the axis or backbone to the solid and the pure colour circle forms a belt going round its widest girth. The surface of the upper cone is made up of a succession of equal tinted circles arranged one above the other and containing more white as they ascend towards pure white at the apex of the cone.

The surface of the lower cone consists of a succession of equal shade circles becoming darker and darker as they descend towards black. The interior of the cone consists of many circles of greyed colours which vary in lightness, darkness and pure colour content according to their exact position. Greyed colour circles close to the pure colour belt will be almost like the pure colour circle, but a little duller. Greyed colour circles near to the white apex will be very pale and slightly grey colours exhibiting little hue. Greyed colour circles near to the black point at the base of the solid will be very dark colours showing very little hue and greyed colour circles close to the centre of the solid will be almost middle grey and exhibit little hue.

Facing Plate 16, p. 1

Compare Judson, 1935, p. 39.

THE COLOUR SOLID (continued)

If our original colour is situated inside the triangle and not on one of the sides it will be a member of a colour circle and also of three rows of colours. These rows will be a vertical row of colours of equal pure colour content lying parallel to W B, a row of equal white content lying parallel to B P and a row of equal black content parallel to W P. These rows which form a sort of star are the rows from which we should select our colours. Harmonies formed in this manner, using the circle and star belonging to a given colour, were termed ring-star harmonies by Professor Ostwald. If our original colour lies in the tint row or shade row of its own particular triangle there will not be as wide a range of colours to choose from. Harmonies made on the ring-star principle may be quite simple orvery complicated, but the general method of constructing them is the same. We do not need to have a colour solid before us, but if we had a pure colour circle and four pairs of single-hued triangles the matter is very much simplified, for instance, suppose we start a colour pure blue and decide to have two hues only in our scheme we refer first to our colour circle and decide whether the second colour shall be complementary, analogist or one of the three step or four step colours. If we decide on a complementary harmony then we find the opposite colour yellow.

Facing Plate 16, p. 2

Compare Judson, 1935, pp. 41, 43.

Plate 16

Compare Ostwald, 1931, Vol. 1, Plate 2.

THE COLOUR SOLID(continued)

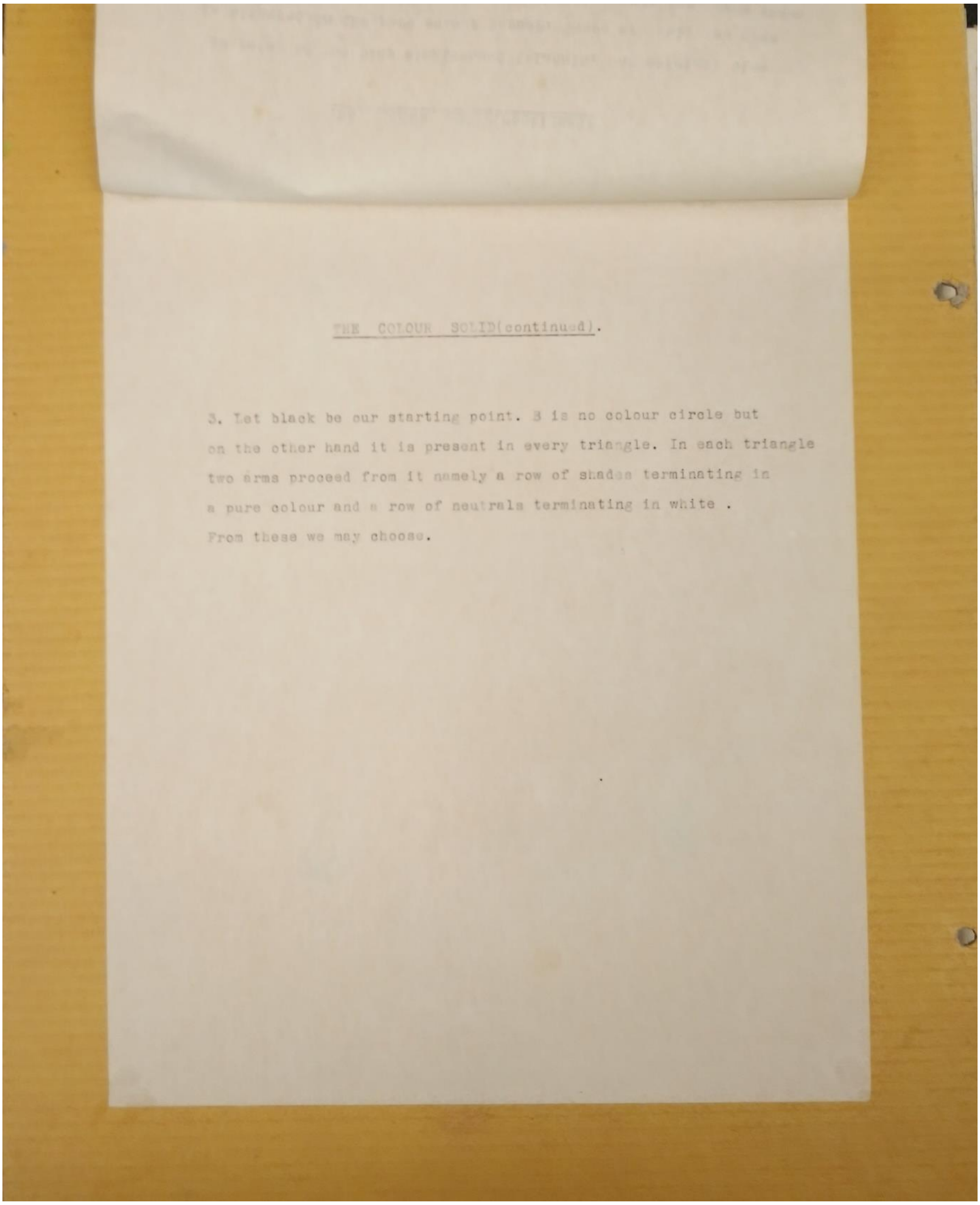
Now refer to the blue single-hued triangle. Our original blue is situated in the pure colour corner. There are only two arms of the star available, the tint row and the shade row. From these we may select as many colours as we like, but if we select more than one colour from the rows it is advisable to try colours at equal intervals on the row first. The principle of equal intervals needs to be kept in mind when working from the full Ostwald colour circle. It does not follow however that if two extra colours are taken the interval on each row should be the same because the two rows are really two entirely different scales and the colours do not change along each at quite the same rate. This may be verified by comparing the tint rows and shade rows in the various single-hued triangles.

1. If in the harmony we require more yellow colours these may be selected from the yellow triangle just as the additional blue colours were selected from the blue triangle.

2. Suppose we start from the first tint of red and decide on an analogist scheme the neighbouring colours on the circle are orange and the purple colours and we may choose one or two of these. Having located this colour on the orange single-hued triangle we maychoose additional colours from the star of which it forms the centre.

Facing Plate 17, p. 1

Compare Judson, 1935, pp. 43-44.



THE COLOUR SOLID(continued).

3. Let black be our starting point. B is no colour circle but on the other hand it is present in every triangle. In each triangle two arms proceed from it namely a row of shades terminating in a pure colour and a row of neutrals terminating in white . From these we may choose.

Facing Plate 17, p. 2

Compare Judson, 1935, pp. 43-44.

Plate 17

OSTWALD THEORY

1. Marking of the achromatic colours .

The panels on the grey axis bear the letters a c e g i l n p , each letter signifing definite percentages of white and black as per table below.

2. Marking of the chromatic colours.

The 28 chromatically coloured panels on each side of the axis are marked firstly with the number borne by the hue of their full colour on the chromatic circle and secondly with those two letters on the grey axis which cross in them. The <u>undermost letter being placed first</u> this triple symbol consisting of one number and two letters completely defines the colour in each panel for it expresses the percentages of white, black and full colour which it contains. If, for instance, the two complementary full colours are nos. 8 and 20 in the circle, then <u>8ne</u> signifies a derivative of the middle red containing 5·6% white, 65% black and by difference 29·4% of full colour. Similarly <u>20ea</u> is a derivative of middle sea green containing 35% white, 11% black and54% of full colour. Here the large percentage of full colour, so near to the white apex, shows how full colours resemble black in being rapidly extinguished by white. It will be noted that the extreme panels ap and pa contain only 89%, 96·5% and 85·5% of white, black and full colour respectively instead of 100%. This is an impression of the fact that white and full colour, free from black and white represent ideals which cannot be realised by any form of paint.

Facing Plate 18, p. 1

Compare Ostwald, 1931, Vol. 2, Plate 1.

COLOUR SYMBOLS

In the triangle as arranged the isotints run parallel to the underside and the isotints to the upper. An isotint and an isotone belong simultaneously to each compartment and cross in it a c e g i l n p are to signify the white as well as the black content of the respective grey colours. Since we have just decided in our triangle that the same amounts of white and black that are present in the achromatic standards are to be alloted to the colour standards the necessity arises of designating them by the same letters we shall thus allot the letters P to all colours of the undermost isotints. To the next series we shall allot the letter N, and so forth.

At the acromatic boundary each of these isotints ends with a grey of the same letter. Similarly all colours in the same isotone series will have a corresponding letter for black conferred upon them. The isotones therefore contain the letter A, the next C and so on.

Since every diamond belongs to an isotint as well as an isotone every standardised tint received two letters, one for the white and one for the black. With the acromatic colours this separated designation of the two constituents black and white is unnecessary because they are connected by the equation W+B=1 so that if the white value is known, that of the black follows from B=1-W. For the sake of symmetry one sometimes has the occasion to specify both and they must then be designated with the same letter; eg. ee or nn.

Facing Plate 18, p. 2

Compare Ostwald, 1931, Vol. 1, p. 102.

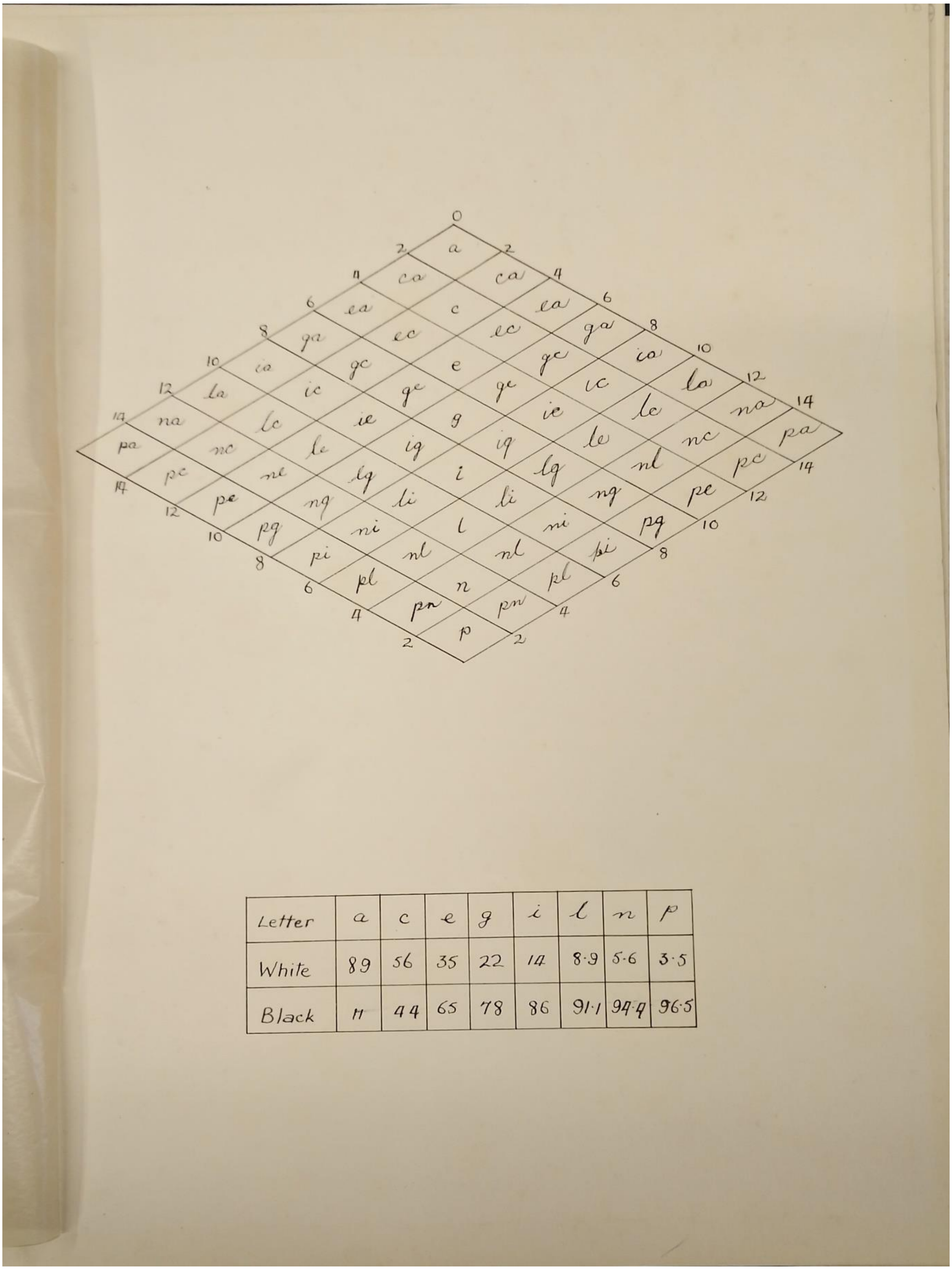


Plate 18

Compare Ostwald, 1931, Vol. 1, Plate 1.

DIAGRAM OF THE OSTWALD COLOUR SOLID

This solid which must be conceived as an arrangement embracing every known colour in the state of continuous transition into its neighbours has been standardised by splitting itup into 12 of the double triangles shown in the diagram. The chromatic circle of 24 saturated colours (1pa, 2pa and so forth) is situated on an equator each colour being located at the apex of the triangles. The grey colours lie on the axis with white at the north and black at the south pole of the double cone.

Facing Plate 19

Compare Ostwald, 1931, Vol. 2, opposite Plate 2.

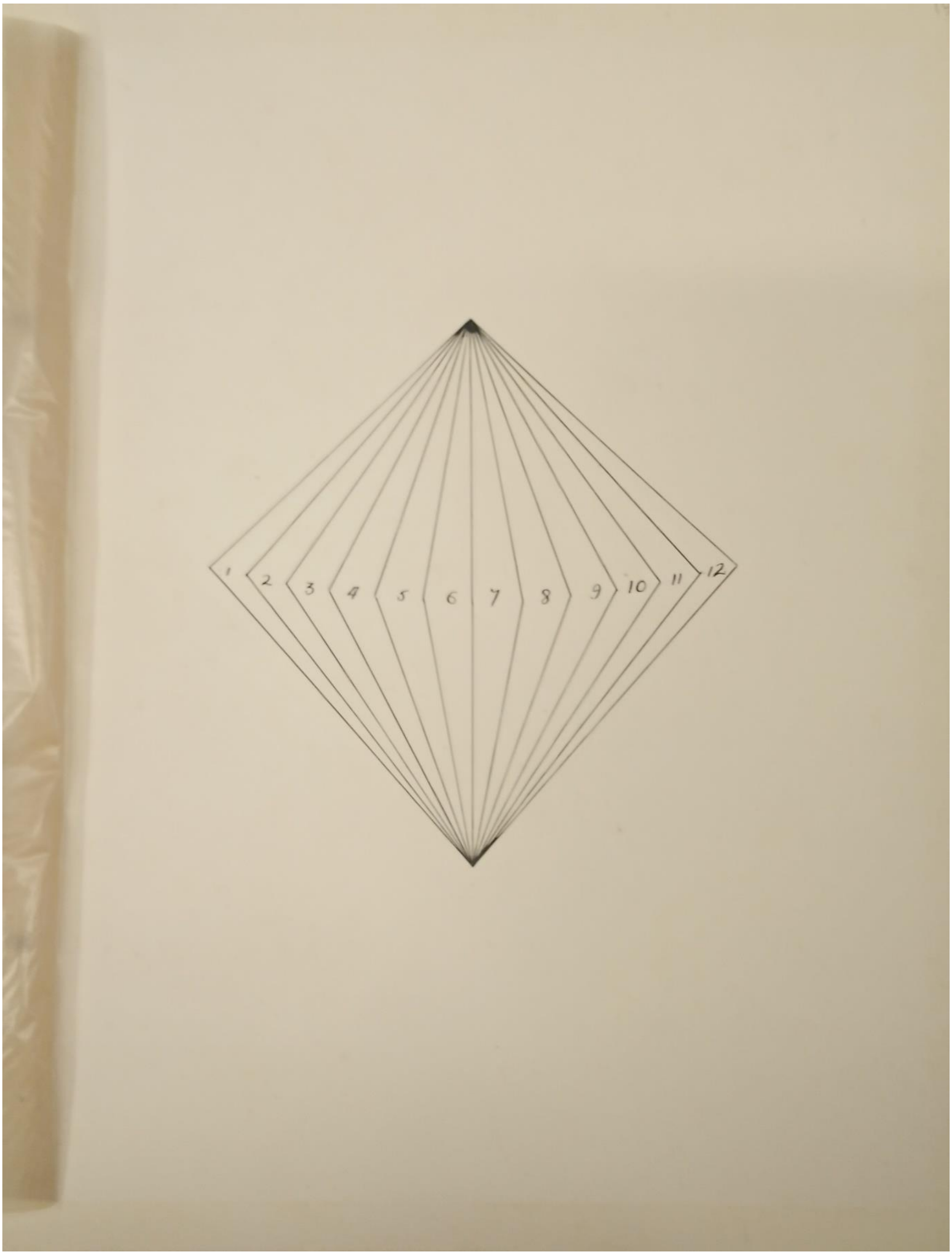


Plate 19

Compare Ostwald, 1931, Vol. 1, Fig. 16.

COLOUR SOLID

Let us now suppose that a complete set of triangles has now been prepared and that all these triangles are attached to a vertical axis which contains the achromatic series from A to P, in such a way that the achromatic side of every triangle forms the line of attachment. The individual triangles are then allowed to extend outwards into space and surround the axis at equal intervals while their free angles containing the various full colours make up the chromatic circle.

The complete form which arises in this manner is that of a double cone generated by turning an equilateral triangle round one of its sides as the axis of revolution. The upper apex contains white and the lower one black. The full colours lie on the equator. The upper surface bears all the clear pale colours or the tints containing all colour and white but no black, which run in series from full colour at the circumference to white at the apex. Similarly the under surface bears the clear dark colours or the tones containing full colour and black but no white. Finally all the dulled or broken colours occupy the interior of the double cone. The pale broken colours being collected near the upper apex, the darker broken colours near the lower apex and the deeper or purer broken colours near the circumference.

Facing Plate 20

Compare Ostwald, 1931, p. 106.

Plate 20

Compare Ostwald, 1919, Tafel 2.

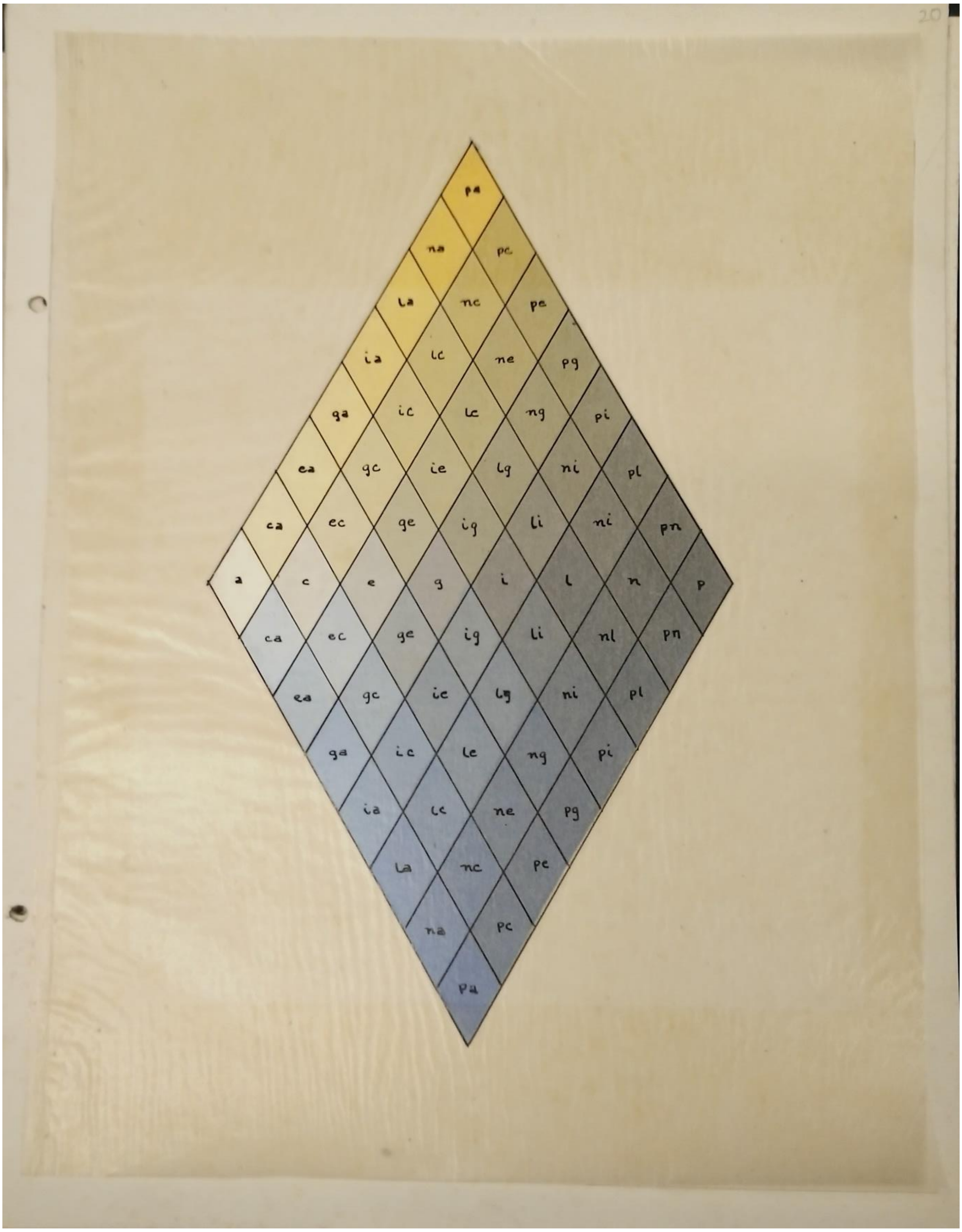


Plate 20, overlay

OSTWALD TRIANGLE

W-white, B-black, C-full colour.

All lines running parallel to CB the opposite side to white represent colours containing equal amounts of white, for the side parallels of all points in such a line which measure the amount of white are equal. We therefore call the colours on such lines isotints. The lowest isótint series is the side CB of the deep colours with white content zero.

All lines parallel to CW, the side opposite to black, represent colours containing equal amounts of black these are the isotones. The uppermost series of isotones is the side CW of the pale colours with black content zero.

All lines parallel to WB, the side opposite to C, represent colours possessing equal amounts of full colour or equal purity. These are called isochromes. The limit of the isochromes is the side BW with chromatic content zero.

All lines passing through the white point W represent colours in which the ratio of full colour to black is equal. All lines which pass through the black point B represent colours in which the ratio of full colour to white is equal and finally in all lines which pass through the point C of full colour the ratio of black to white is equal, for they are mixtures of full colour with the same grey.

Facing Plate 21

Compare Ostwald, 1931, Vol. 1, pp. 95-96.

Plate 21

Compare Ostwald, 1919, Tafel 5.

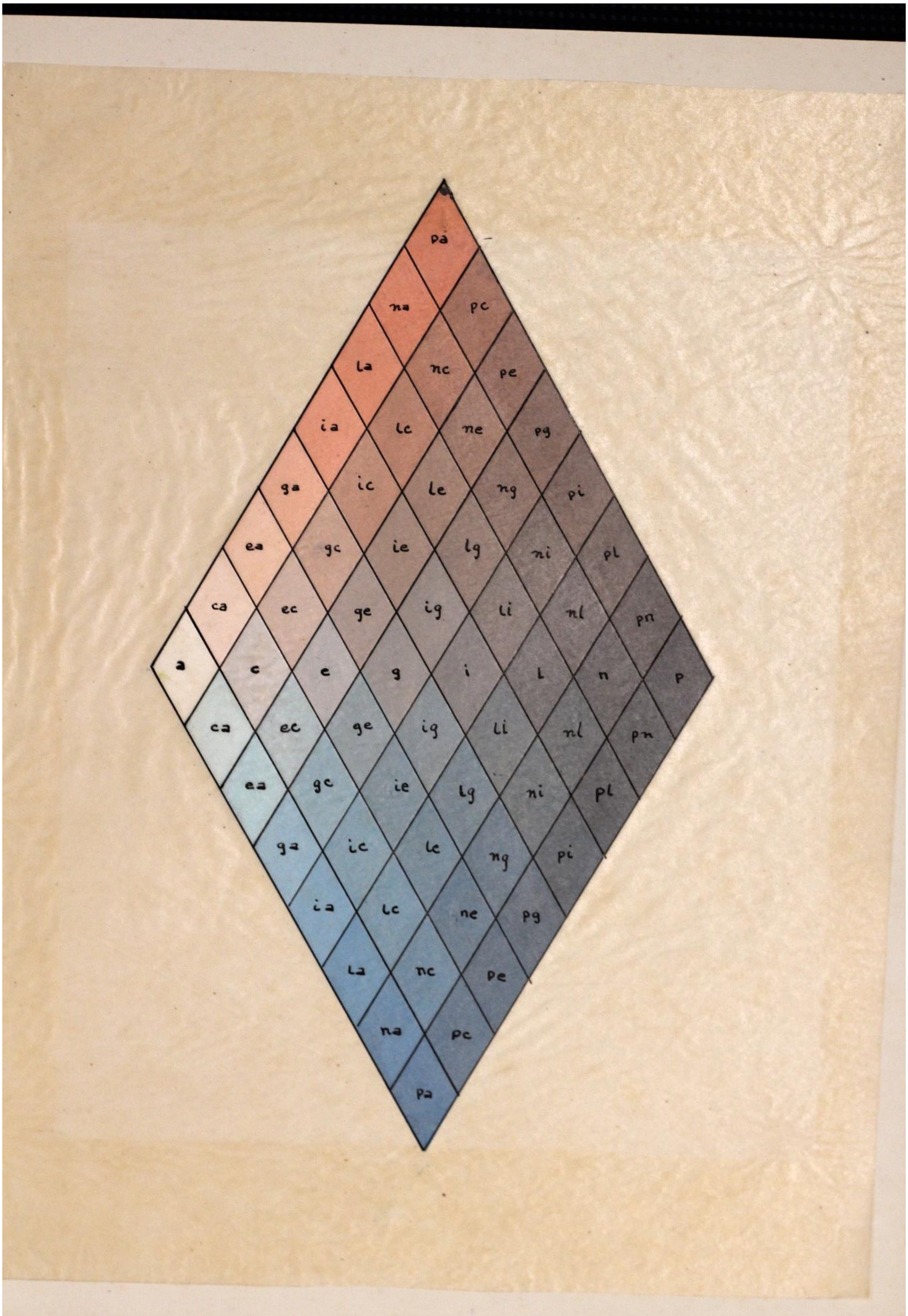


Plate 21 overlay

Plate 22

Compare Ostwald, 1919, Tafel 8.

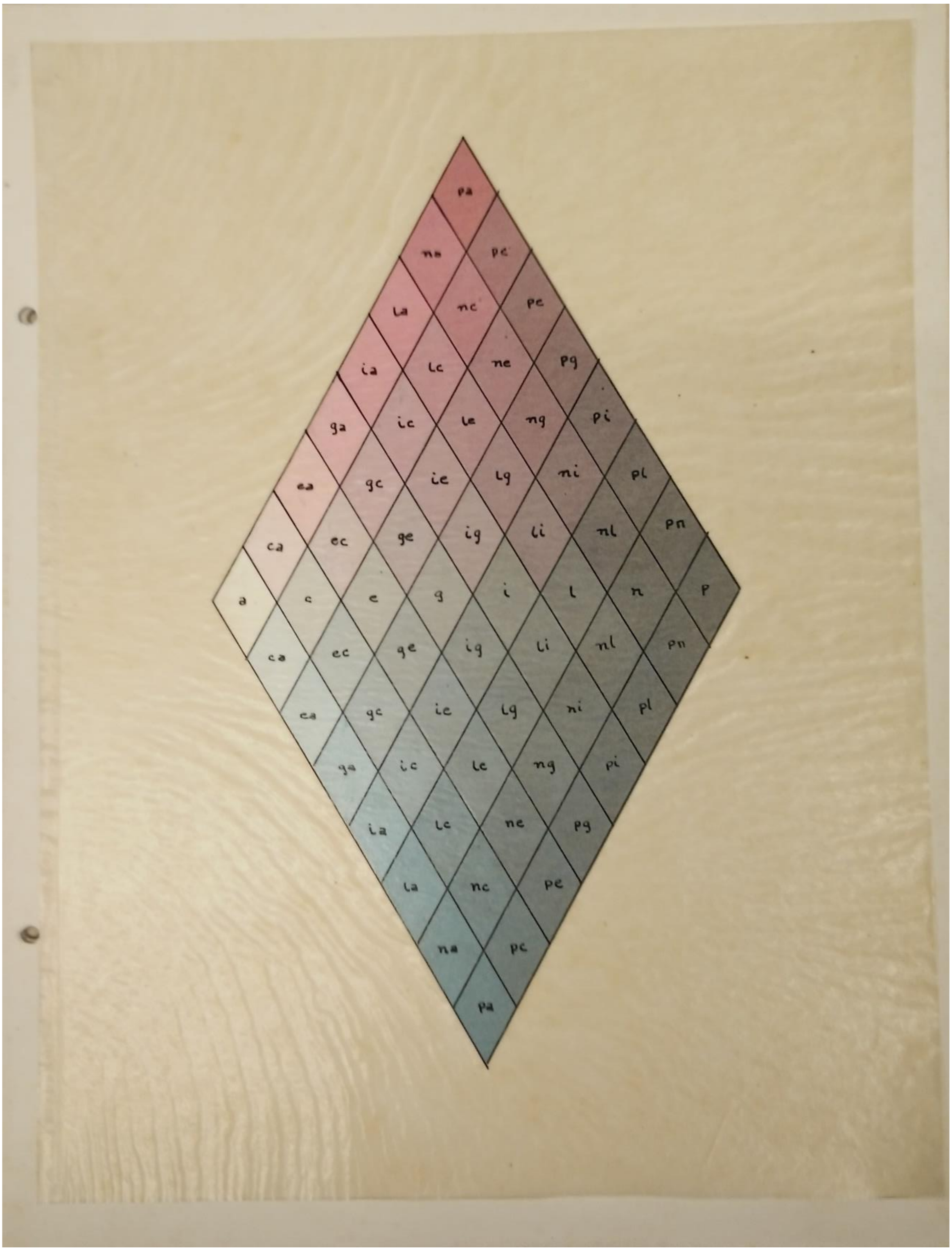


Plate 22 overlay

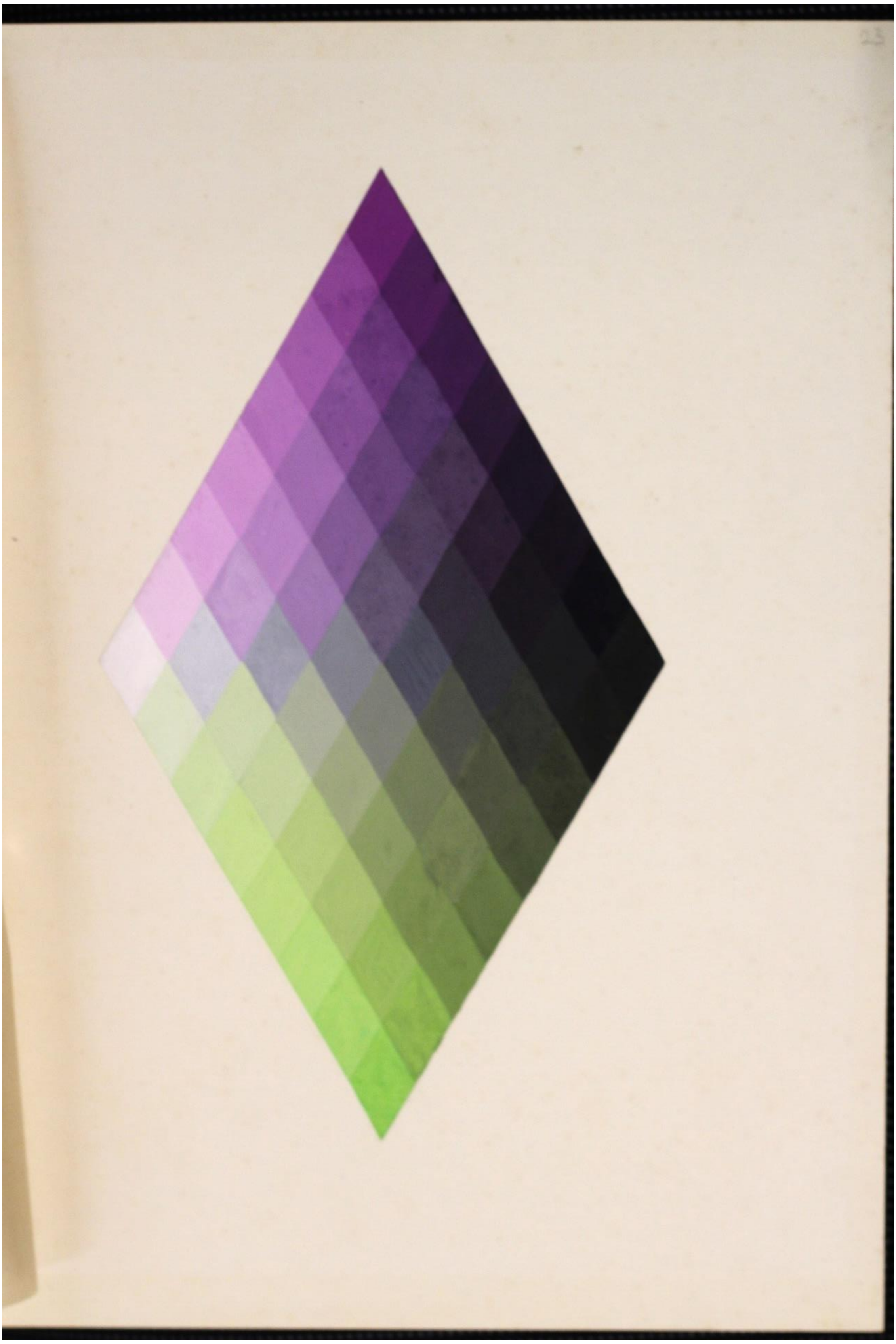


Plate 23

Compare Ostwald, 1919, Tafel 11.

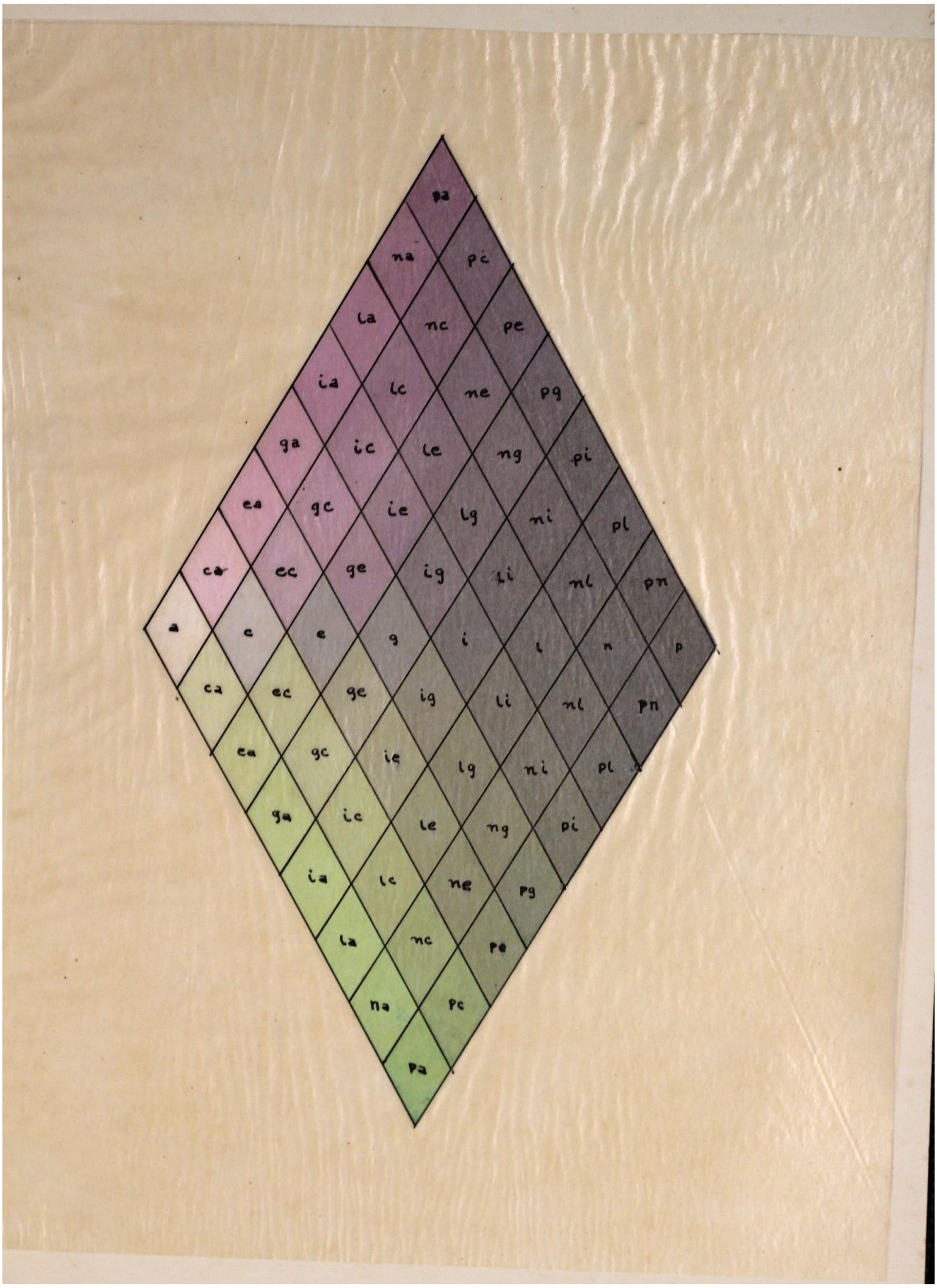


Plate 23 overlay

A SIMPLE EXPLANATION OF THE OSTWALD SYSTEM

The Ostwald colour system was devised with the object of facilitating the study of colour harmony by arranging and standardising the colours exhibited by the surfaces met with in our surroundings in such a way that the differences between the colours comprised in this system as judged by the eye, are perfectly regular and uniform.

At present the paint box used by the child at school or the artist may be likened to a piano provided with notes which have never been set at the proper musical intervals. The definite relationship between the fundamental components upon which colour harmony like musical harmony depends is absent from the contents of this receptacle, and so long as its heterogeneous assortment of colour representatives is merely used for imitating the various colours occurring in landscapes or interiors, this defect is perhaps no great matter, But, where as in all forms of decorative design and in fact in all the highest forms of art the artist has to fall back on his own originality the case is different and however well he may be endowed with an instinct for harmonious combinations the lack of properly adjusted colouring materials is a heavy handicap.

Facing Plate 24, p. 1

Compare Taylor, 1935, p.5.

Let us consider the case of the musical genius, who, if provided with any normal sort of piano quickly learns to play by ear without a teacher and imagine how he would progress with the kind of insteument described above.

It is sometimes said by people who have not taken the trouble to understand the Ostwald system or who do not like it because it upsets their preconceived idea that its main object to teach colour harmony by hard and fast rules - in reality it is nothing of the sort - its main object is to supply the user, whether child, craftsman or artist, with what in the study of colour harmony corresponds to the tuned piano in music. It is true that Dr. Ostwald gives certain rules for securing harmonious combinations of the standardised colours belonging to his system just as the text books on musical harmony give them. But these rules are merely intended for those less gifted individuals, who, without having the instinct of colour harmony born in them are able to acquire reasonable efficiency by dint of study and practise. The, genius, given his tuned instrument can do without the rules.

The Ostwald colour system as already indicated is merely concerned with the colours of <u>surfaces</u>, or to speak more precisely, the colours of surfaces as seen by ordinary day light of the diffused character that passes through windows with a south aspect in the middle of the day. The colours of self-luminous bodies and the immaterial colours of the sky, the rainbow and the spectrum find no place in this purely materialistic scheme, materialistic that is to say that it deals only with the colours of tangible things.

Facing Plate 24, p. 2

Compare Taylor, 1935, pp. 6-7.

The methods by which Dr. Ostwald endeavours to obtain the object explained are

1. By the arrangement of all conceivable surface colours in the form of a solid their positions within or on the exterior of this solid being fixed in such a way that the transitions from one colour to another are psychologically uniform.

2. By the standardisation of a fairely comprehensive set of colours and selected from the enormous number that such a system must contain. These colours being disposed like those from which they are chosen from equal distances apart from the point of view of sensation.

3. By the provision of a set of painted papers representing these standardised colours for use in the study of colour harmony and incidentally as general reference standards for defining the various colours met with in art and industry.

Every surface colour we meet with in our daily lives whether a flower or a leaf or a dyed fabric or a book cover or a brick or a paving stone, everything, in fact, that can be represented by the paints of the artist or the cottons, silks and wools of the textile industries has its place in the Ostwald system and can be defined by some Ostwald symbol that belongs to no other colour. Why, it may be asked, is it necessary to use a solid to represent a colour system? Why is it not possible to represent it of a sufficiently large flat surface?

Facing Plate 24, p. 3

Compare Taylor, 1935, pp. 7-8.

The answer to this is, that while it is quite possible to represent all colours in space of two dimensions it is not possible exhibit all their relations to one another in this manner. We should merely obtain a collection of colours and not a colour system for colours,like solids require three dimensions for their complete definition. Just as in the case of the box, for instance, we require to know its length, breadth and depth before we can give a complete statement of its nature, and so in the case of colours we require to know three things- 1. the amount of its neutral constituent, 2. the amount of its chromatic constituent, 3. the hue of its chromatic constituent, before we can define it. If then, among all the colours we are able to distinguish from one another, each individual colour differs from every other in respect of one or more of these three things and we wish to arrange them in such a way that all their relations to one another are exhibited we shall necessaryily require three dimensions of space.

An example will make this clear. Let us construct a colour chart by dividing a square into 81 smaller squares we will then fill in eight squares on the left hand side with the eight principal colours of the Ostwald chromatic colours and eight of the top squares with the black and white series, the upper left hand square beinf left blank. The remaining squares are then filled up with colours made by mixing each of the hues at the side with an equal amount of black, white or grey ot the head of the vertical columns.

Facing Plate 24, p. 4

Compare Taylor, 1935, pp. 8-9.

And as the number of hues and neutrals may be increased indefinitely we have now realised the nearest approach to a complete colour system that can be obtained on a flat surface. Obviously, however this arrangement includes only a small fraction of all possible colours for we have merely mixed the hues and neutrals in one proportion, namely 50% and if we wish to make the system complete so that every proportion of these two components say from 1% to 99% is represented and the transitions between these percentages exhibited by placing the consecutive colours in contiguity we shall be obliged to prepare 98 more charts and pile them one over the other in regular sequence with the 50% chart in the centre. We thus obtain a solid which, if the thickness of each chart measures 1/99th of the side of our square, will take the form of a cube. It is not however a satisfactory colour solid because, for one thing, the hues and the neutrals are incessantly repeated and for another, the essential continuity of the hue series is disregarded by separating yellow from yellowish green.

The attempt to represent the colour in the form of a solid is no new thing and in the past all sorts of solids have been proposed. by scientific-minded people as suitable for this purpose. Pyramids, cones, spheres, cubes, etc. have in turn played their part in these proposals according to the taste and fancy of the particular inventor, but where the methods of procedure adopted in constructing these solids differ from those used by Dr. Ostwald is that in the first place they have been based upon some arbituary assumption about the nature of the three so called primaries and usually also on the additional assumption that the three selected colours should be placed at equal distances apart.

Facing Plate 24, p. 5

Compare Taylor, 1935, pp. 9-10.

A further important difference is that in all the more recent and scientific examples of these systems the positions of the various colours are made to depend on measurement of the waves of light that give rise to the sensations and not on the measurement of sensations and not on the measurement of sensations themselves. Dr. Ostwald was the first man that ever measured colour sensations and who established the fact which again sharply differentiates his system from all the more modern ones founded on the study of the spectrum that in any rational colour system, black must be regarded as a positive sensation which can be measured and not as a mere negative experience due to the absense of light, for the sensation of black to arise as the partial or total constituent of a colour, it is absolutely essential that this colour should be seen under the normal conditions of ordinary and artificial illumination, for its production is due to reaction which takes place in the retuna between the general light received from the surface of the object viewed. All surface colours seen under natural conditions contain black as one of their constituents although sometimes only in a small amount. Ostwald calls them <u>related colours</u>.

<u>FAILURE OF COLOUR SYSTEMS BASED ON THE SPECTRUM.</u>

1. The colours of the spectrum are, Ostwald tells us, unrelated colours and contain no black for the simple reason that since a dark room is required for their display, the luminous environment necessary for their production is not in evidence. The result of this is that the duller colours, brown, olive green, etc., which figure so largely in our surroundings cannot be obtained from any mixture of the spectral colours.

Facing Plate 24, p. 6

Compare Taylor, 1935, pp. 10-13.

2. Colours like crimson and magenta, which are excited by red and violet rays, but which are, nevertheless, quite as simple as the regular spectral hues are not to be found in the spectrum.

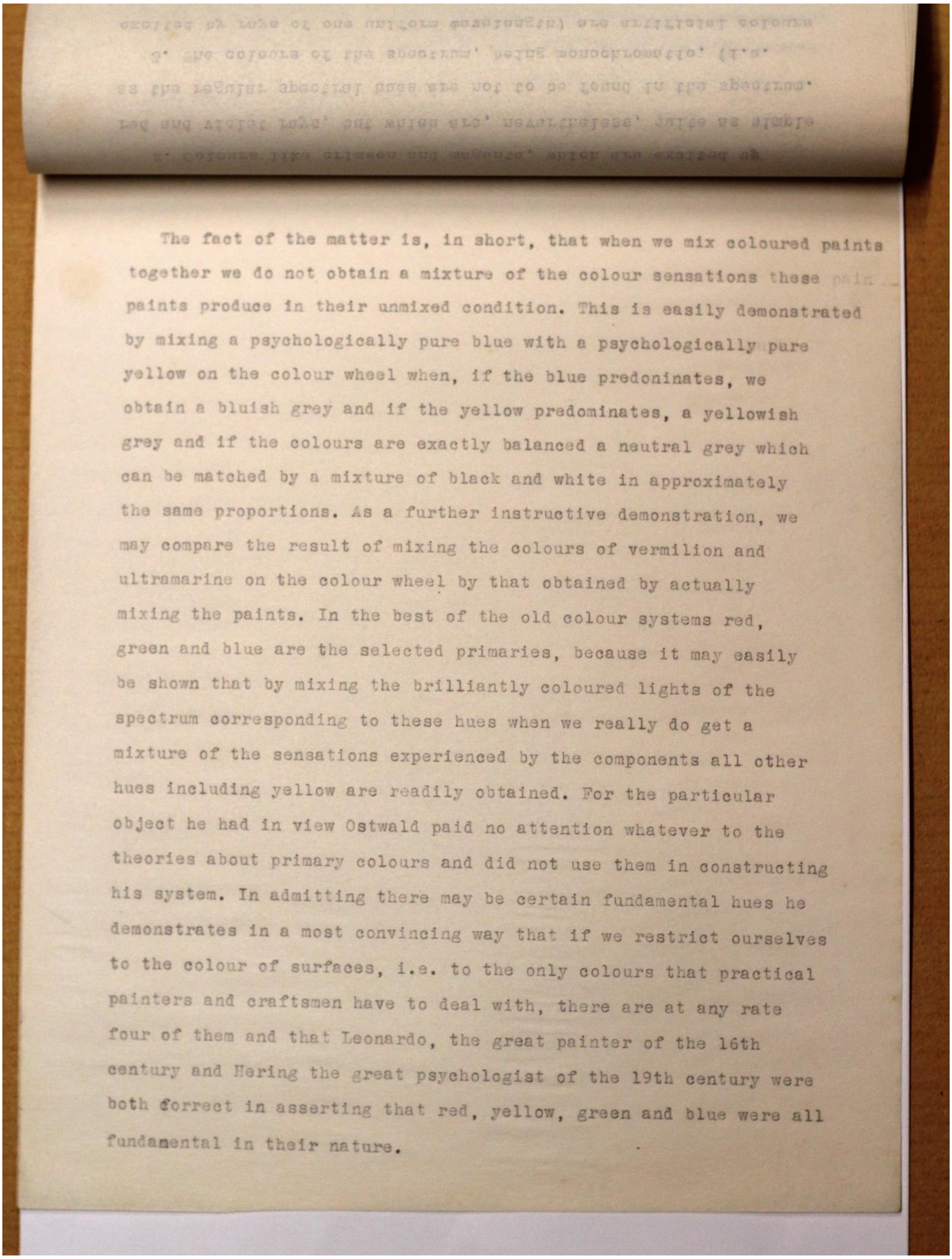
3. The colours of the spectrum, being monochromatic, (i.e. excited by rays of one uniform wavelength) are artificial colours and quite different in quality from the natural colours of ordinary surfaces excited by rays with wide ranges of wavelength.

4. Not only is there no regular relation between the hues and wavelengths of the spectral colours but in some cases the change in wavelength is not accompianied by any change in hue.

In the formation of a psychological colour system embracing our everyday colours the spectrum is a useless guide. The primary colours in the older colour systems have always been three in number. Red, yellow and blue were chosen in most of them on account of the well known fact that by mixing paints of these three hues all other hues may be produced in some form or other and that the same result cannot be obtained by three paints of any other colours. This result is however more or less accidentally. It is found for instance, that in the ordinary three colour printing process that if we select a fairly pure yellow it is necessary to depart from these hues of red and blue which appear to be simple and unmixed sensatioss and to choose a bluish red and a greenish blue in order that tolerable all round success may be achieved.

Facing Plate 24, p. 7

Compare Taylor, 1935, pp. 13-15.



The fact of the matter is, in short, that when we mix coloured paints together we do not obtain a mixture of the colour sensations these pain paints produce in their unmixed condition. This is easily demonstrated by mixing a psychologically pure blue with a psychologically pure yellow on the colour wheel when, if the blue predoninates, we obtain a bluish grey and if the yellow predominates, a yellowish grey and if the colours are exactly balanced a neutral grey which can be matched by a mixture of black and white in approximately the same proportions. As a further instructive demonstration, we may compare the result of mixing the colours of vermilion and ultramarine on the colour wheel by that obtained by actually mixing the paints. In the best of the old colour systems red, green and blue are the selected primaries, because it may easily be shown that by mixing the brilliantly coloured lights of the spectrum corresponding to these hues when we really do get a mixture of the sensations experienced by the components all other hues including yellow are readily obtained. For the particular object he had in view Ostwald paid no attention whatever to the theories about primary colours and did not use them in constructing his system. In admitting there may be certain fundamental hues he demonstrates in a most convincing way that if we restrict ourselves to the colour of surfaces, i.e. to the only colours that practical painters and craftsmen have to deal with, there are at any rate four of them and that Leonardo, the great painter of the 16th century and Hering the great psychologist of the 19th century were both forrect in asserting that red, yellow, green and blue were all fundamental in their nature.

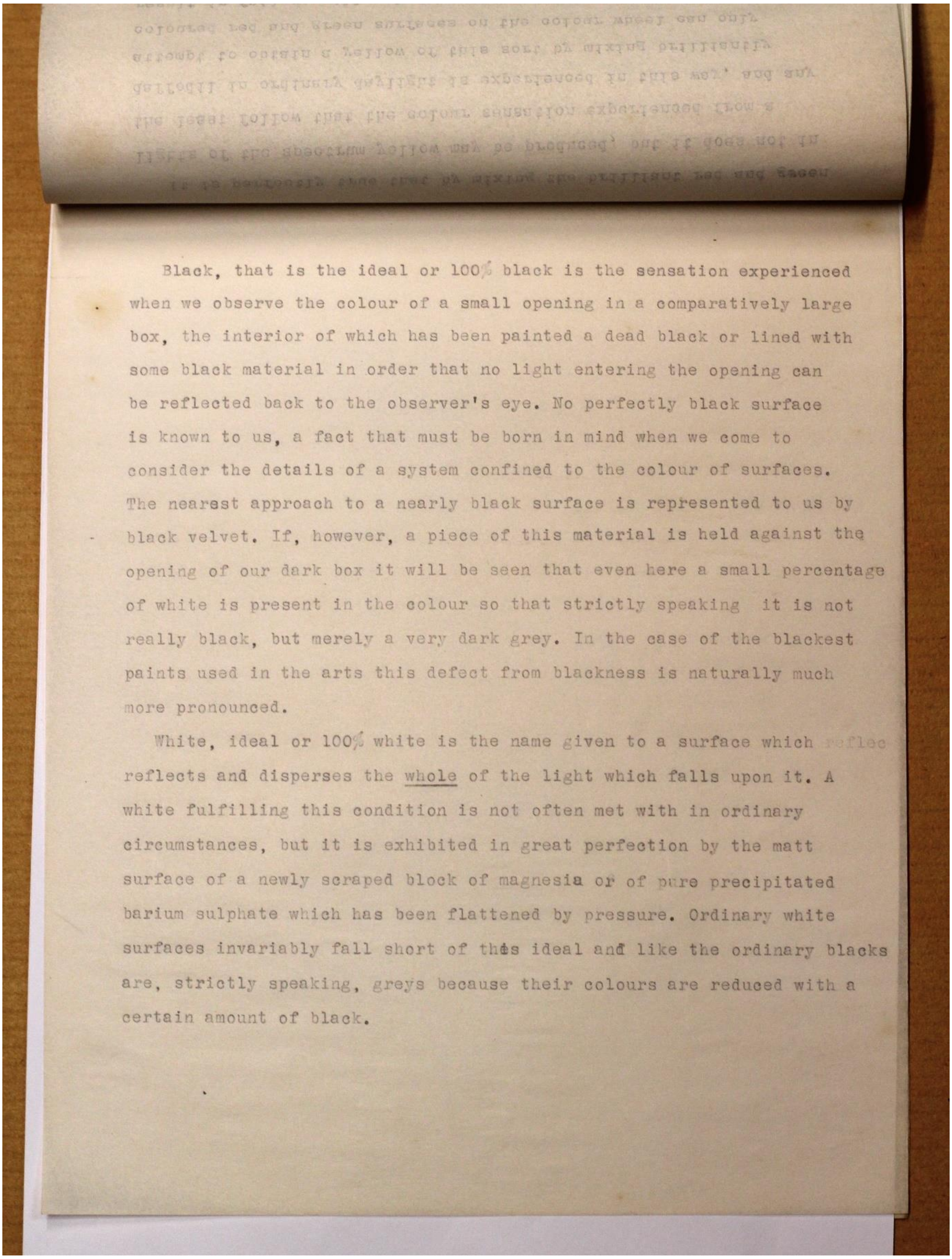
Facing Plate 24, p. 8

Compare Taylor, 1935, pp. 15-16.

It is perfectly true that by mixing the brilliant red and green lights of the spectrum yellow may be produced, but it does not in the least follow that the colour sensation experienced from a daffodil in ordinary daylight is experienced in this way, and any attempt to obtain a yellow of this sort by mixing brilliantly coloured red and green surfaces on the colour wheel can only result in failure. All colours however infinite their variety may be divided into three classes - in the first place we have the neutral colours, those which are without the chromatic element called hue, black, white and the mixtures of black and white called greys belong to this class and according to biologists these are the only colours which human beings are able to distinguish in the early stages of their existence or which many animals are able to see to-day. Then we have the word hues, or colours in the narrower sense of the word. These hue of full colours when pure contain no black or white in their constitution. Then last of all we have the mixed colours, namely, those which are mixtures of hues with black and white singly or in combination in all colceivable proportions and which constitute the majority of colours we meet with in our everyday life. It is obvious from this explanation that in order to construct a colour system the best plan is to arrange the neutral colours, then we must arrange the hues and finally we muct provide an arrangement for all possible hues with neutral colours. But before we describe the methods by which these arrangements can be effected, the pricise meaning of the term black, white and full colour as employed in colour measzrement must be clearly defined.

Facing Plate 24, p. 9

Compare Taylor, 1935, pp. 16-18.



Black, that is the ideal or 100% black is the sensation experienced when we observe the colour of a small opening in a comparatively large box, the interior of which has been painted a dead black or lined with some black material in order that no light entering the opening can be reflected back to the observer's eye. No perfectly black surface is known to us, a fact that must be born in mind when we come to consider the details of a system confined to the colour of surfaces. The nearest approach to a nearly black surface is represented to us by black velvet. If, however, a piece of this material is held against the opening of our dark box it will be seen that even here a small percentage of white is present in the colour so that strictly speaking it is not really black, but merely a very dark grey. In the case of the blackest paints used in the arts this defect from blackness is naturally much more pronounced.

White, ideal or 100% white is the name given to a surface which reflects and disperses the <u>whole</u> of the light which falls upon it. A white fulfilling this condition is not often met with in ordinary circumstances, but it is exhibited in great perfection by the matt surface of a newly scraped block of magnesia or of pure precipitated barium sulphate which has been flattened by pressure. Ordinary white surfaces invariably fall short of this ideal and like the ordinary blacks are, strictly speaking, greys because their colours are reduced with a certain amount of black.

Facing Plate 24, p. 10

Compare Taylor, 1935, pp. 18-19.

There is however this difference between the colours of ordinary white and black surfaces that whereas the former may contain fairly large percentages of black and still give one the impression of being perfectly good white, the latter will only preserve their typical appearancewhen comparatively small percentages of white are present. Larger amounts convert them into very palpable greys. This point which is of great psychological importance will be dealt with later.

Full Colours. The ideal or 100% full or chromatic colour differs from ideal black and ideal white in being absolutely unobtainable under ordinary conditions. The colours of the more vivid flowers or coal tar dyes, which represent the nearest approximation to the ideal condition, invariably contain admixtures of black and white, i.e. grey in their composition. Probably the only way in which such colours may be momentarily realised is by viewing their approximate representatives after temporarily exhorsting the eye of its sensitiveness to the grey sensation by a prolonged fixation of a grey surface. The reason why, even in the solar spectrum saturated hues of 100% purity are not to be found is usually explained on the Young-Helmholtz theory of primary colours by the supposition that although each of the three sets of nearest in the retina responds to a pure primary colour it is in practise impossible for any kind of light to stimulate any one set without, to some extent also affecting the other two. As a result of this the spectral hues even those which correspond to the so-called primaries are always mixed with white light. When one considers that pure full colours fitted to serve as standards of comparison are quite unobtainable, it may seem difficult to understand how the proportion of full colour in any given specimen can be determined.

Facing Plate 24, p. 11

Compare Taylor, 1935, pp. 19-20.

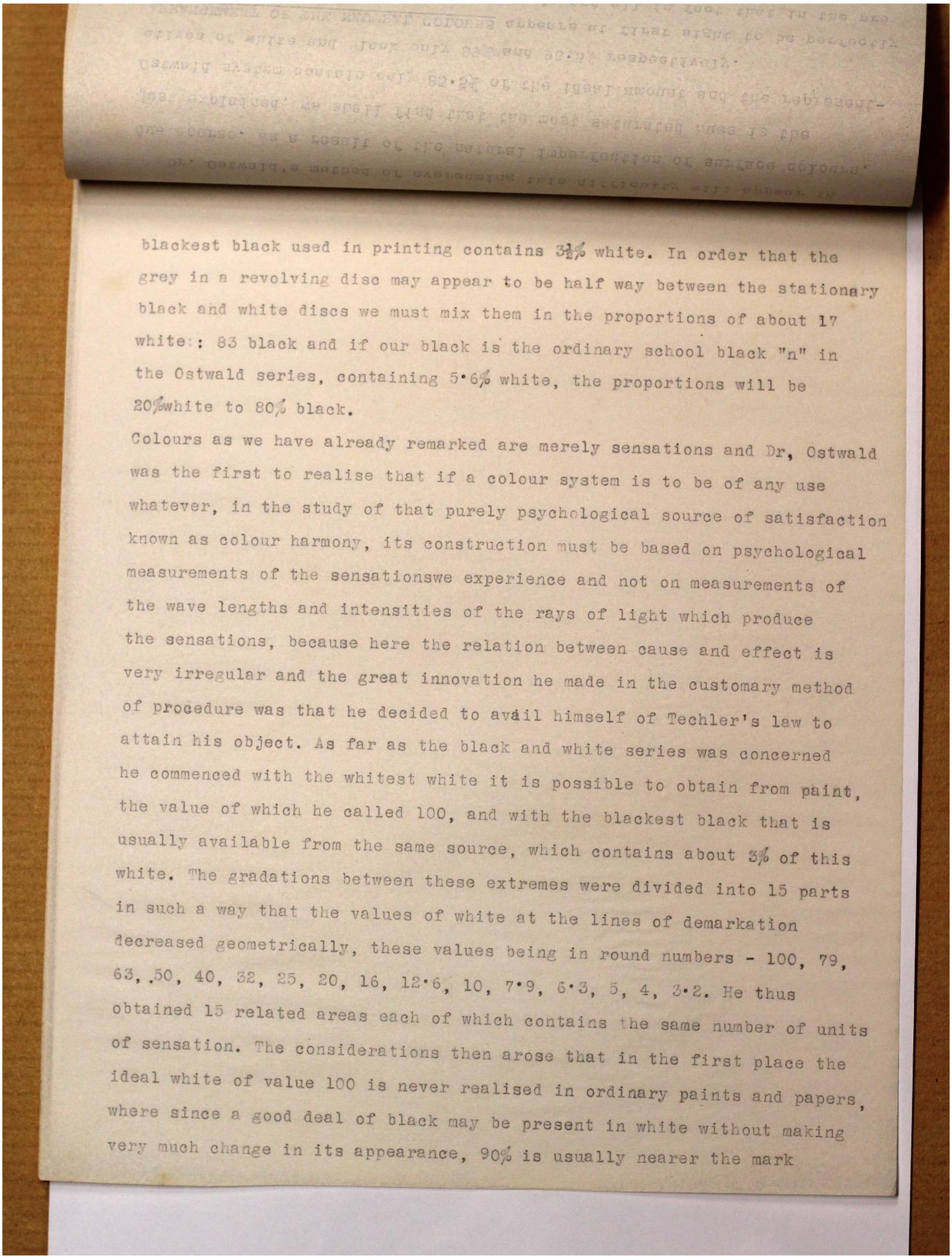
Dr. Ostwald's method of overcoming this difficulty will appear in due course. As a result of the natural imperfection of surface colours, just explained, we shall find that the most saturated hues is the Ostwald system contain only 85·5% of the ideal amount and the representatives of white and black only 89% and 96·5% respectively.

ARRANGEMENT OF THE NEUTRAL COLOURS appears at first sight to be perfectly simple, for apparently all we have to do and all in fact that in the pre Ostwald systems was done was to place black at one end of a straight line, white at the other and arrange the greys between them in such a way that the grey in the middle of the line contains 50% each of black and white. The grey at ¼ the distance from black will then contain 75% black and 25% white and so on all through the line. Here, however, we come upon what at first sight appears to be rather a curious fact, best illustrated by a simple experiment on the colour wheel. We will take three circular discs of the same diameter and paint one of them pure black and the second half black and half white and the third pure white. We then place them in a row in this order and set the middle one in rapid rotation. Now, while according to the arrangement described this middle disc should appear to be exactly half way between black and white. We find that it appears very much closer to the white than the black, so much so that at a guess four parts of white to one of black might be taken to represent the proportions of the sections used.

If as is very frequently the case with the black and white discs used in colour wheel experiments the white has approximately the value "a" in the Ostwald system, i.e. it has only 89% of the maximum whiteness that it is possible to obtain from an ideally white surface under the given illumination and black is the fairly deep "p", which like the

Facing Plate 24, p. 12

Compare Taylor, 1935, pp. 20-22.



blackest black used in printing contains 3½% white. In order that the grey in a revolving disc may appear to be half way between the stationary black and white discs we must mix them in the proportions of about 17 white : 83 black and if our black is the ordinary school black "n" in the Ostwald series, containing 5·6% white, the proportions will be 20% white to 80% black.

Colours as we have already remarked are merely sensations and Dr, Ostwald was the first to realise that if a colour system is to be of any use whatever, in the study of that purely psychological source of satisfaction known as colour harmony, its construction must be based on psychological measurements of the sensationswe experience and not on measurements of the wave lengths and intensities of the rays of light which produce the sensations, because here the relation between cause and effect is very irregular and the great innovation he made in the customary method of procedure was that he decided to avail himself of Techler's law to attain his object. As far as the black and white series was concerned he commenced with the whitest white it is possible to obtain from paint, the value of which he called 100, and with the blackest black that is usually available from the same source, which contains about 3% of this white. The gradations between these extremes were divided into 15 parts in such a way that the values of white at the lines of demarkation decreased geometrically, these values being in round numbers - 100, 79, 63, 50, 40, 32, 25, 20, 16, 12·6, 10, 7·9, 6·3, 5, 4, 3·2. He thus obtained 15 related areas each of which contains the same number of units of sensation. The considerations then arose that in the first place the ideal white of value 100 is never realised in ordinary paints and papers, where since a good deal of black may be present in white without making very much change in its appearance, 90% is usually nearer the mark

Facing Plate 24, p. 13

Compare Taylor, 1935, pp. 22, 26-27.

and secondly, that although these 15 gradated areas are psychologically equal we do not want gradated greys for our standards, but a set of uniform greys of fixed value.

Dr. Ostwald therefore took the geometric mean value of each step and considered the particuler grey at this point to be spread uniformly over its whole area. Omitting decimal points the chromatic mean of 100 and 79 is 89, that of 79 and 63 is 71, that 63 and 50 is 56 and so on, and since these numbers again form a geometric series a psychologically equidistant set of 15 uniform shades was obtained. As these shades represent equal amounts of sensation they occupy equal spaces. For ordinary purposes 15 shades are not really required. For one thing the number of colours in the Ostwald system depends on the number of neutrals it is based upôn. If 15 are used the number of colours amounts to 2,535. The commercial production of 2,535 exactly standardised papers to illustrte the system is hardly practicable; for school teaching a set of five shades, manely black, white and three intermediates - "a" "d" "g" "k" "n" is quite sufficient. This affords a system of 245 colours and for technical purposes a set of eight equidistant shades which Dr. Ostwald calls his practical grey scale - namely "a" "c" "e" "g" "i" "l" "n" "p", giving a system of 680 colours is ample for most requirements.

ARRANGEMENT OF THE HUES

The first point to note is that if we make a series of all known hues commencing, say, with yellow, the brightest of them and proceed through orange, scarlet, crimson, purple, blue, turquoise, sea green, leaf green, and citron, we find that after blue is passed the numbers of this series return on each other until we arrive once more at our starting point.

Facing Plate 24, p. 14

Compare Taylor, 1935, pp. 27-31.

The sequence of hues must be arranged in a closed line which usually, and most conveniently takes the form of a circle, but whereas in the other systems this circle is subdivided in accordance with preconvieved ideas so called primary colours and is thus arranged in a arbituary manner. Dr. Ostwald has chosen the natural method of arranging it psychologically in order that it may conform to regular changes in the sensations of hue experienced by the observation of coloured surfaces.

<u>ARRANGEMENT OF THE MIXED COLOURS</u>

The arrangement of the neutral colours and the hues, having been satisfactorily completed, the only remaining problem was that of welding these two series into a system in such a way that all possible combinations of the hues with the natural colours should be embodied in a suitable solid form, i.e. a form in which no colour shall occupy more than one position. There are two methods of attacking this problem, the method in each case being that of first arranging a chart in space of two dimensions and then developing it into a solid as already described. We may, for instance; construct a chart containing all the combinations of every hue in the chromatic circle with <u>one</u> of the neutrals, say black, and convert this into a solid exhibiting combinations of these hues with <u>every</u> neutral or on the other hand we may make a chart showing mixtures of every neutral with <u>one</u> of the hues and treat this in a similar manner so that mixtures with every hue shall be incorporated. In the older forms of colour solid method no.1 is the method adopted. Dr. Ostwald, however, chose method no.2 for a reason we will now explain.

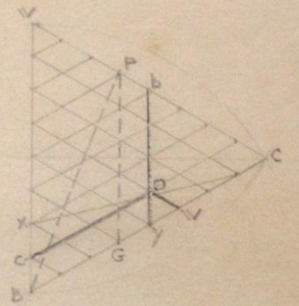
Facing Plate 24, p. 15

Compare Taylor, 1935, pp. 31-33.

Dr, Ostwald adopted the theory that under the same light and the same accommodation of the eyes the amount of colour sensation experienced from the observation of coloured surfaces is always the same, that is to say, that from the fundamental sensations of two or three of these elements we can only increase or decrease one of them at the expense or by the gain of some other.

THE ANALYTICAL TRIANGLE

In order to express this relation in geometrical form Dr. Ostwald had recourse to a well known property of equilateral triangle, namely that if, from any point O within a triahgle,of this sort with sides which are say one foot long, three lines are drawn parallel to the sides, the total length of these three lines will always be equal to one foot.



That this is so may be readily seen from the diagram for OC is evidently equal to BY, OW to YW and OB to WC. If then we place black at one corner of the triangle, white at another and any one full colour or Hue at the third. All possible combinations of these three elements will be found at some point in its interior and their amounts i.e. the proportions in which they are mixed will be represented by the length of the three lines drawn from this point parallel to the sides.

Facing Plate 24, p. 16

Compare Taylor, 1935, pp. 33-37.

Thus in the diagram, OW, which may be worked upon as travelling away from W represents the amount of white; OB travelling away from B the amount of black, and OC travelling away from C, the amount of full colour present at the point O. This state of affairs is embodied in Dr. Ostwald's well known colour equation C+W+B=1, but to obtain percentages instead of fractions it can be more conveniently written C+W+B=100.

It remains to be added that those colours belonging to the triangle which are not situated in its interior, but lie on its outer lines are mixtures of the two colours joined by these lines and that in the case of the colours like these and colours located at the angles when only one of the colour elements is involved the amount of sensation is precisely the same as if all three are present so that the above equation may be written- W+B=100, W+C=100, B+C=100, W=100, B=100, C=100 as the case may be. A further point to be noted is that all colours in a line parallel to WC contain the same amount of black and are called isotones. All colours on lines parallel to BC contain the same amount of white and are called isotints, and all colours on lines parallel to WB contain the same amount of full colour and are called isochromes.

THE PSYCHOLOGICAL TRIANGLE

Having adopted this triangle arranged in accordance with the simplest methods of colour mixture as the two dimension starting point of his system, Dr. Ostwald had next to consider how all the mixtures of the three pairs of colour elements should be arranged along the outer lines of the triangle i.e. at what rates they really do pass each other for, when this has been settled the arrangement of the interior will follow as a matter of course.

Facing Plate 24, p. 17

Compare Taylor, 1935, pp. 37-39.

In the case of the line WB this is at once evident, for we know from our previous experience that owing to the manner in which white dominates black, the quantities of white in the various mixtures along this line must be determined by the quantity decided upon in the system.

In the case of the other lines WC and BC it may easily shown on the colour wheel that the condidtion of affairs is very similar for we find that white overpowers the full colours the same way that it overpowers black and in admixture with black, the full colours play the part of the more active stimulus and overprint it in much the same way as white does.

FORMATION OF THE PSYCHOLOGICAL COLOUR SOLID

The Ostwald colour system is now complete for the only remaining step that of converting the representation of all possible combinations with every pure colour on a flat surface into a representation of these colour combinations with every pure colour in the form of a solid is to consider the line WB as an axis upon which the triangle revolves.

A double cone with black and white at the two poles and the chromatic circle at its equator is then produced and may be standardised by dividing it into any convenient number of double triangles, arranged in such a way that the equilateral intervals are the same. For ordinary mortals Dr. Ostwald's twelve double triangles with twenty-four intervals is found to meet most requirements.

Facing Plate 24, p. 18

Compare Taylor, 1935, pp. 39-40, 44.

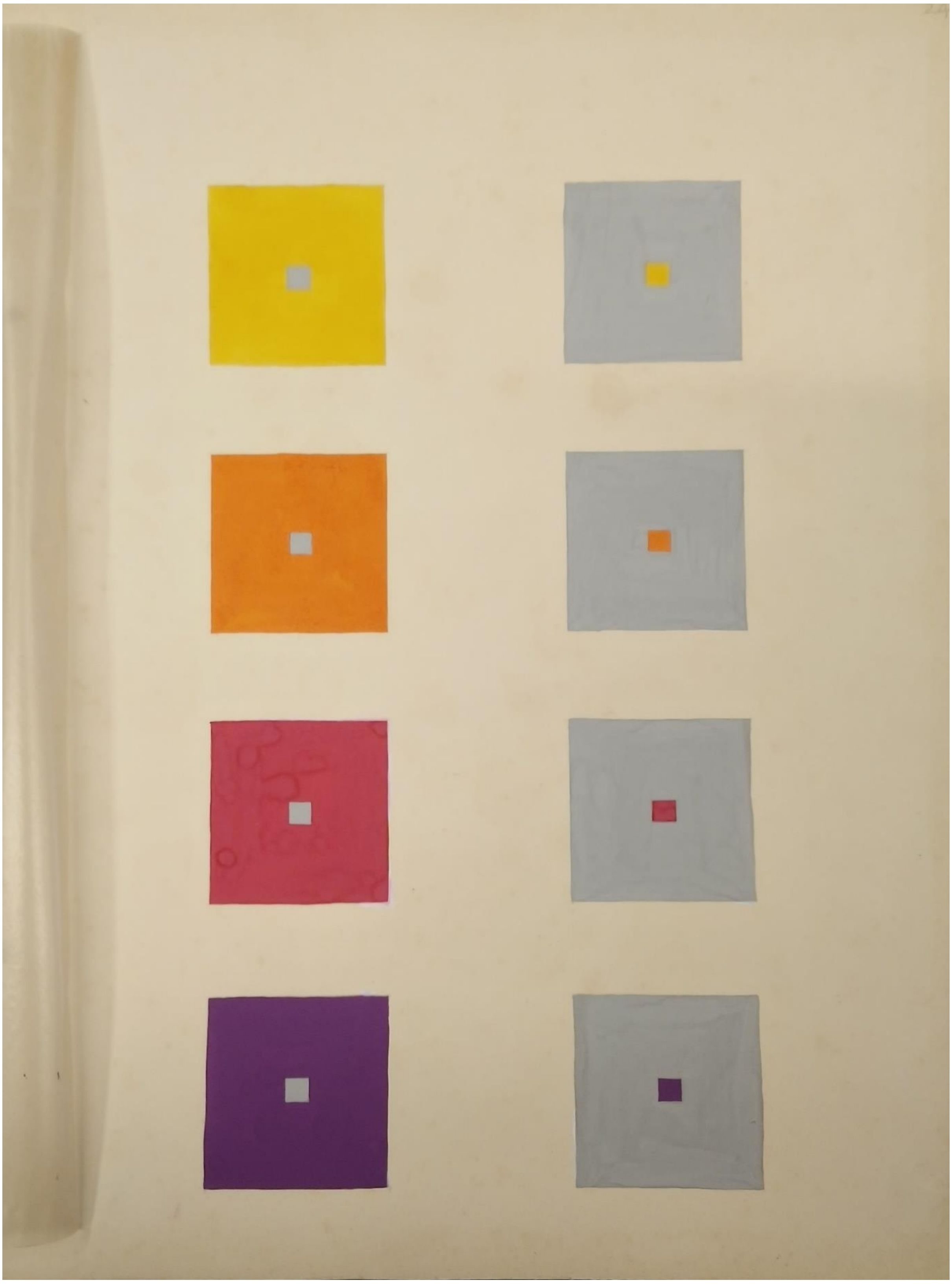


Plate 24

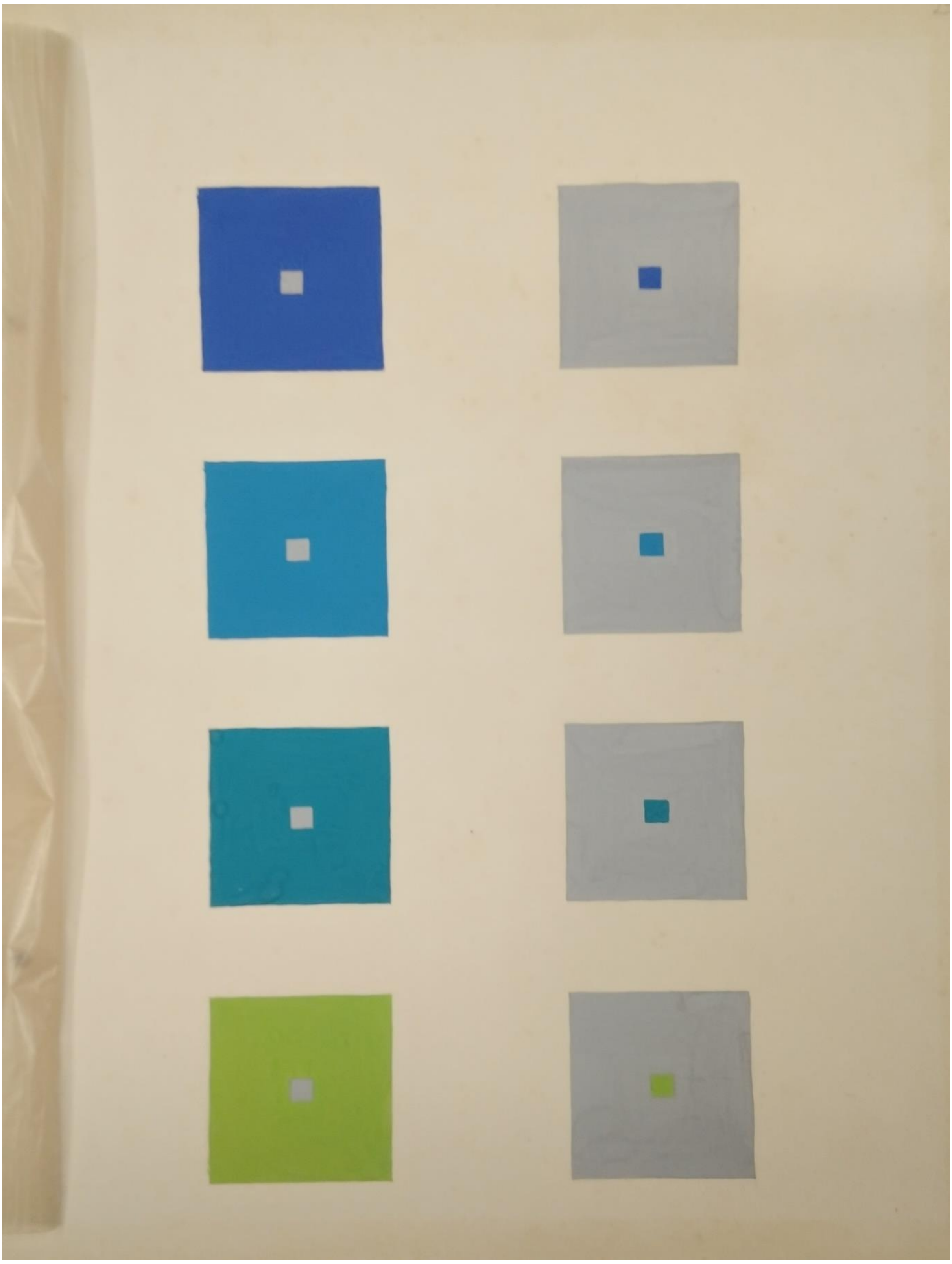


Plate 25

MUNSELL THEORY

Plate 26

MUNSELL SYSTEM

Colour systems are nesessary for either of two purposes first as a means of specification to provide a means of identifying, measuring and specifying colours, to provide a name or notation for them, secondly as a means for study or obtaining harmony which is simply a word that describes the good, bad or indifferent appearance of a combination of colours. This is purely a psychological consideration and only psychological systems attemps to provide a framework on which an artist can erect laws and formulae to reach that elusive goal, the perfect colour scheme. All the various systems are made up of exactly the same colours. It is only in details of the relationship of the colours to each other that they vary.

It is possible to prove by any system the reason for the success of a particular harmony but often quite another thing to reverse the process and through the system produce a successful harmony. Studying organised colour harmonies increases creative ability. Any colour scheme if it is a good one will fit into a colour system. The outstanding feature of Munsell is a simple system of notation based on Munsell's three visual attributes-hue, value and chroma by which the reasonably exact visual identity of any colour can be recorded.

In a single hue there are of coarse endless variations of colours that differ in respect to value (relation to a scale of neutral greys from white to black) and chroma (steps of purity ranging from neutral grey to the cleanest purest variation of the hue obtainable). The changes of value and chroma are carefully worked out in visually equal steps. As these steps of value and chroma are very obvious, easy to visualise and identical in every hue it is comparatively a simple matter for the average person to master Munsell's systems, organisation and notation.

Facing Plate 27

Compare Sackett, 1938, pp. 27-28.

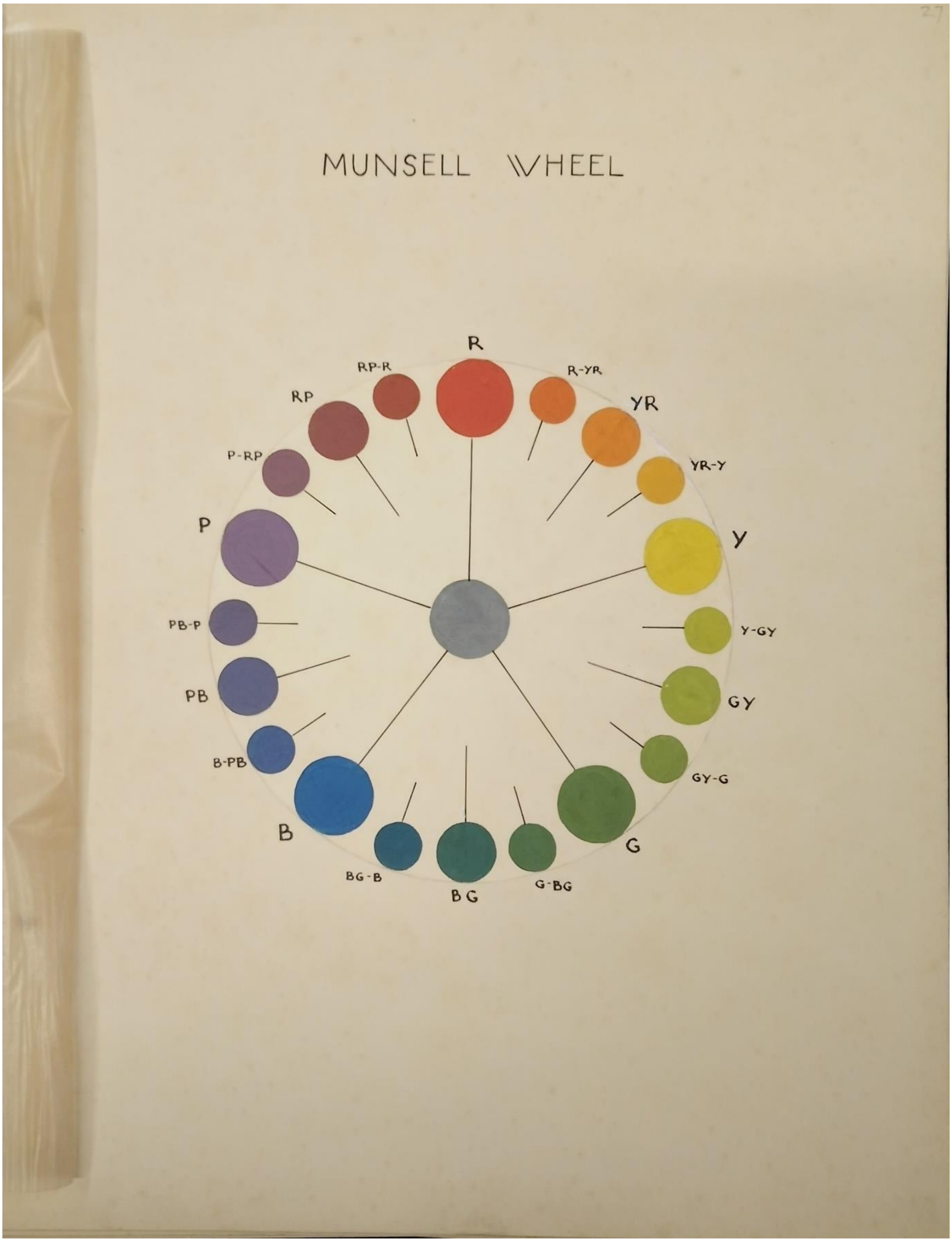
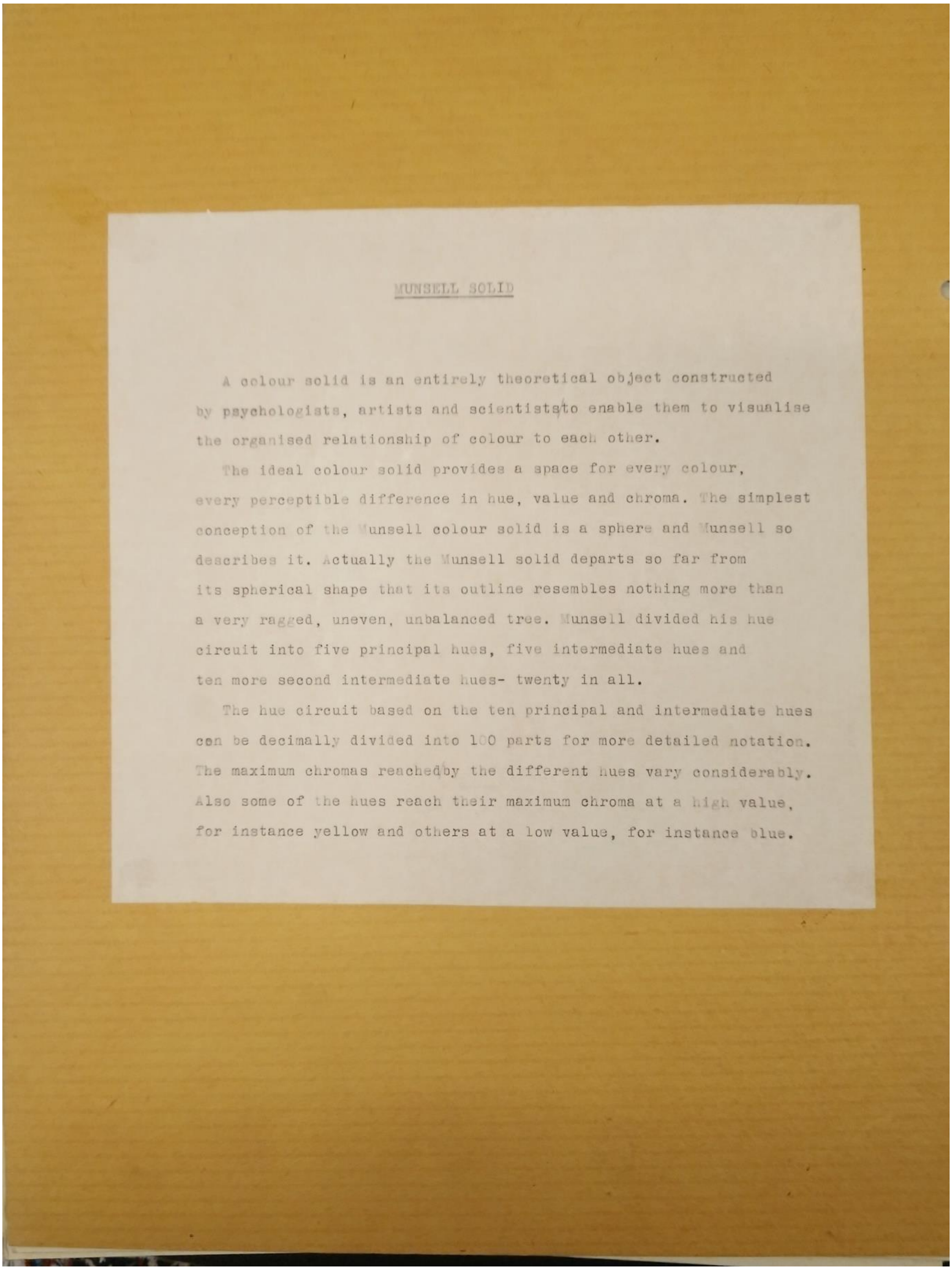


Plate 27

Compare related diagram, *Munsell Book of Color*, 1929, p. 13.



MUNSELL SOLID

A colour solid is an entirely theoretical object constructed by psychologists, artists and scientists to enable them to visualise the organised relationship of colour to each other.

The ideal colour solid provides a space for every colour, every perceptible difference in hue, value and chroma. The simplest conception of the Munsell colour solid is a sphere and Munsell so describes it. Actually the Munsell solid departs so far from its spherical shape that its outline resembles nothing more than a very ragged, uneven, unbalanced tree. Munsell divided his hue circuit into five principal hues, five intermediate hues and ten more second intermediate hues- twenty in all.

The hue circuit based on the ten principal and intermediate hues can be decimally divided into 100 parts for more detailed notation. The maximum chromas reached by the different hues vary considerably. Also some of the hues reach their maximum chroma at a high value, for instance yellow and others at a low value, for instance blue.

Facing Plate 28

Compare Sackett, 1938, pp. 27-28.

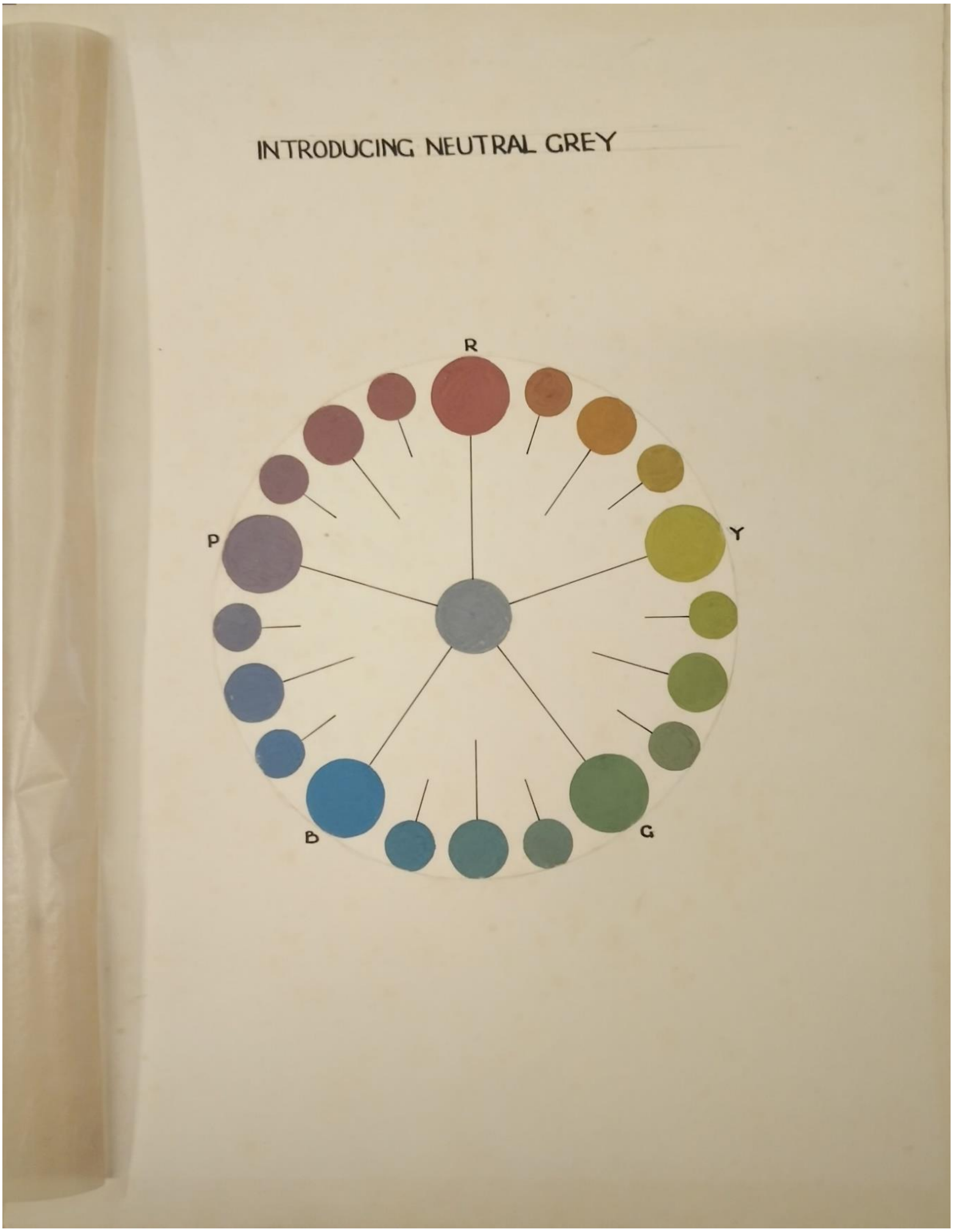
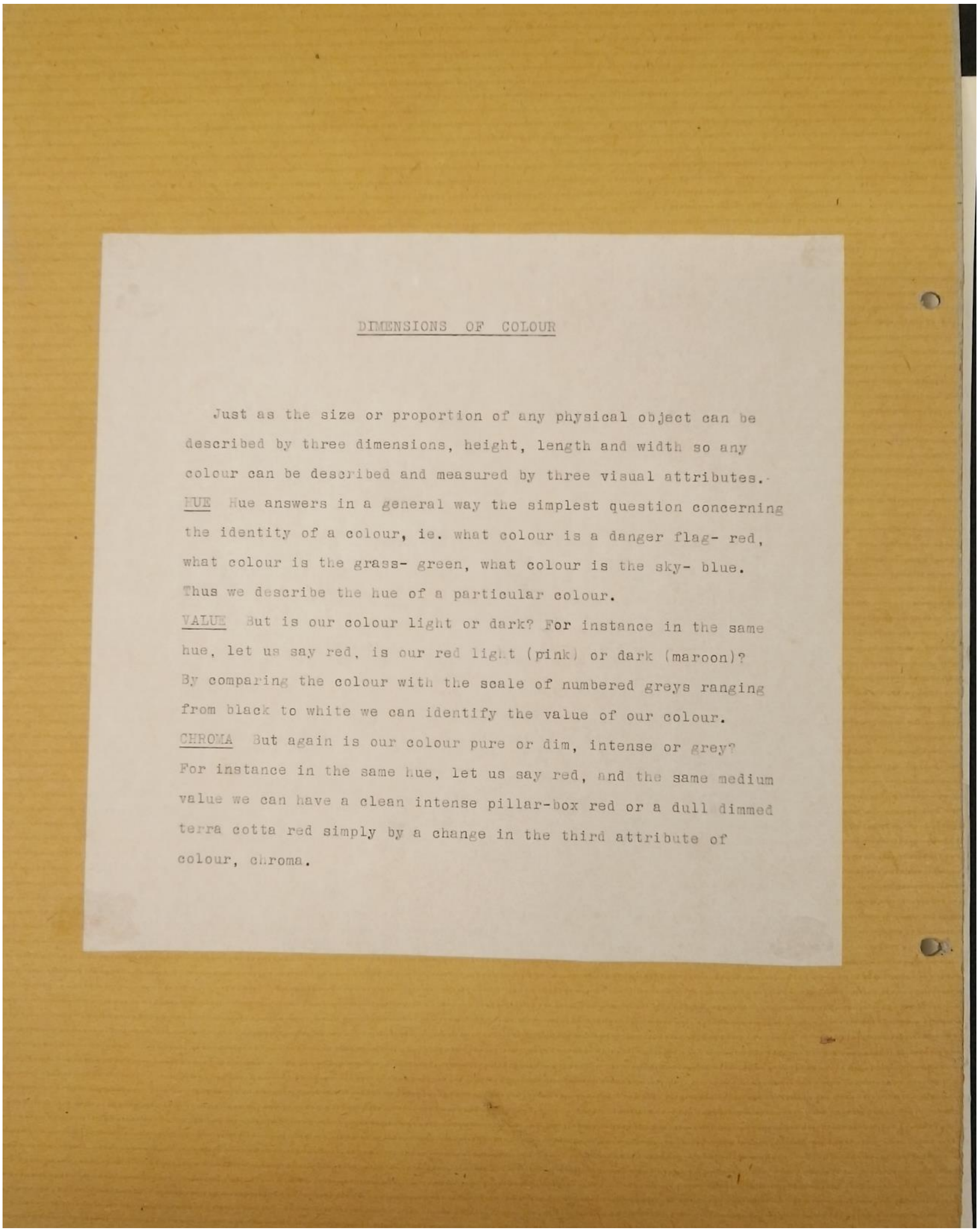


Plate 28

Compare related diagram, *Munsell Book of Color*, 1929, p. 13.



DIMENSIONS OF COLOUR

Just as the size or proportion of any physical object can be described by three dimensions, height, length and width so any colour can be described and measured by three visual attributes.

HUE Hue answers in a general way the simplest question concerning the identity of a colour, ie. what colour is a danger flag- red, what colour is the grass- green, what colour is the sky- blue. Thus we describe the hue of a particular colour.

VALUE But is our colour light or dark? For instance in the same hue, let us say red, is our red light (pink) or dark (maroon)? By comparing the colour with the scale of numbered greys ranging from black to white we can identify the value of our colour.

CHROMA But again is our colour pure or dim, intense or grey? For instance in the same hue, let us say red, and the same medium value we can have a clean intense pillar-box red or a dull dimmed terra cotta red simply by a change in the third attribute of colour, chroma.

Facing Plate 29

Compare Sackett, 1938, p.27.

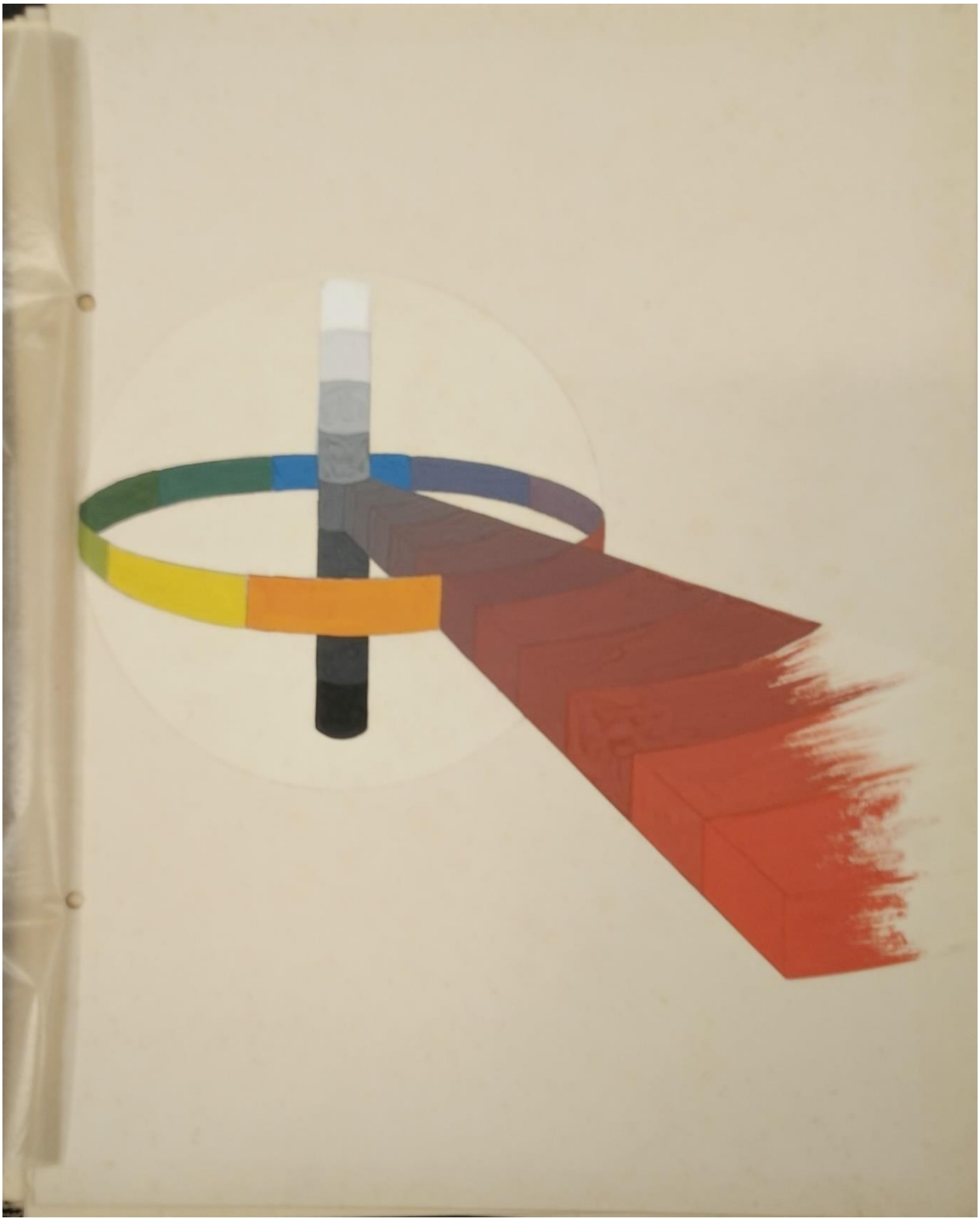


Plate 29

Compare related diagram, Cleland, 1921, p. 16.

MUNSELL NOTATION

The five principal hues are described as follows - red, yellow, green, blue and purple, their symbols being R, Y, G, B, and P. In between are the intermediate hues- yellow red, green yellow, blue green, purple blue and red purple, their symbols being YR, GY, BG, PB, and RP respectively. Between the principal and intermediate hues are the second intermediate hues which are described by these obvious combination names red-yellow red, yellow red-yellow, yellow-green yellow, green yellow-green, green-blue green, blue green-blue, blue-purple blue, purple blue-purple, purple-red purple, and red purple-red, their symbols being R-YR, YR-Y, Y-GY, GY-G, G-BG, BG-B, B-PB, PB-P, P-RP, RP-R.

VALUE NOTATION

Value is measured according to the nine steps of value on the neutral grey scale of values and is described by the corresponding numbers written over a diagonal line 1/, 2/, 3/, 4/, going up from dark to light.

CHROMA NOTATION

Chroma is measured by the chroma steps from the weakest chroma closest to the neutral grey axis of the sphere outward to the strongest chroma increasing in number as the chroma increases. The chroma of a colour is described by the number corresponding to its chroma step placed under the diagonal line /2, /4, 6/.

A COMPLETE NOTATION

Thus any colour can be described by startling precision by this simple numerical system of notation hue, value and chroma. R8/4(pink), R2/6(maroon), R5/14(pillar-box red).

In terms of H:V&C remember this arrangement Hv/c

Facing Plate 30

Compare Sackett, 1938, pp. 28-29.

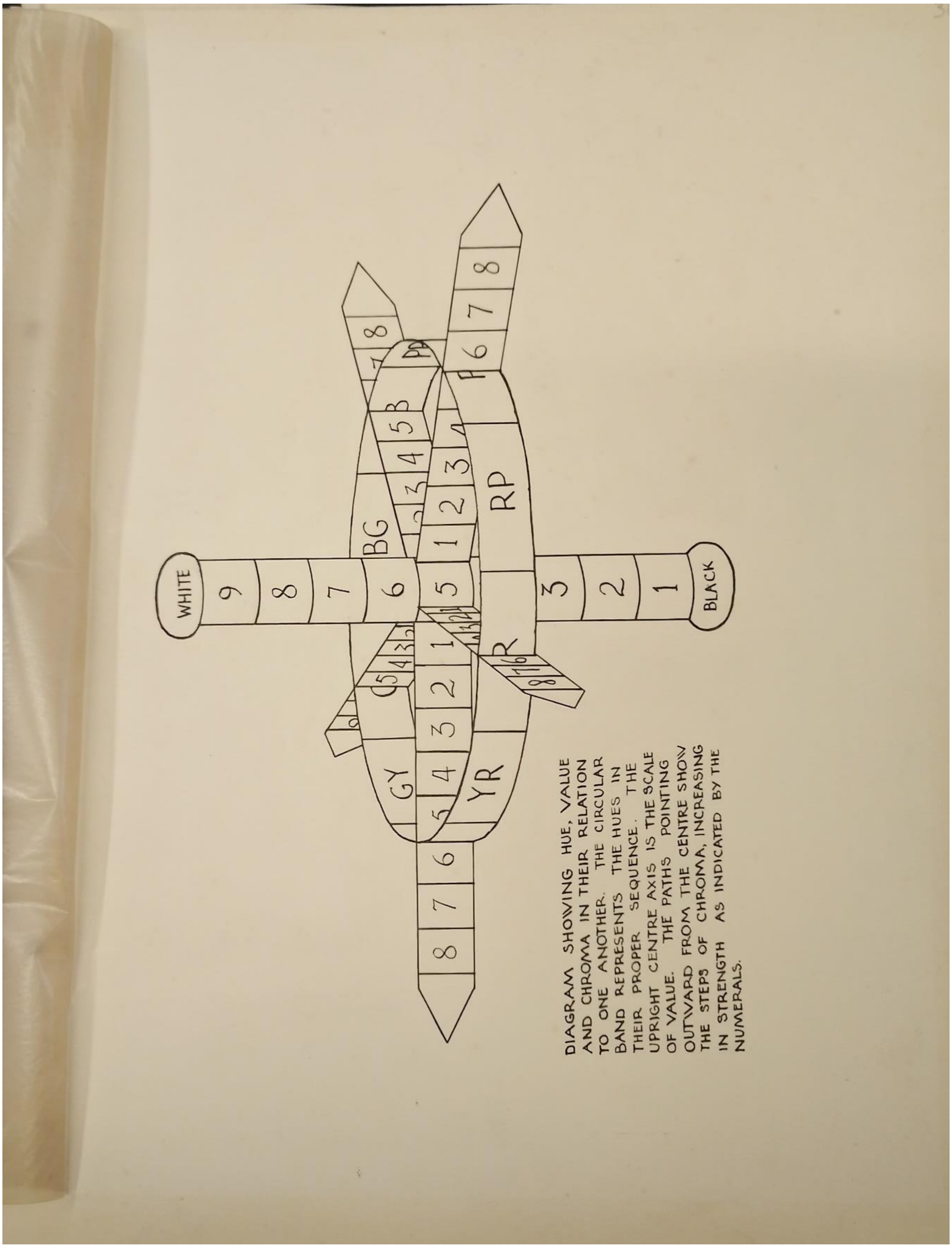


Plate 30

Compare *Munsell Book of Color*, 1929, p. 10.

BALANCE

In describing thedimension known as chroma we noted the fact that certain of the hues were much more powerful than others. We found that red, for example, on any step of value is more powerful and requires a longer path than its opposite blue green and that yellow is longer than its opposite purple blue on the steps of high value but shorter on the lower steps of value.

This brings us to the question of balance of colour, the vital question in all applications of colour to practise. If we mixed equal parts of red in its pure state with its opposite blue green in its pure state, we would not get a perfectly neutral grey, but one in which the red predominated very decidedly. It would be somewhat like a tug-o-war in which there were ten men, each representing a chroma, on one side, and only five on the other. If however instead of taking equal amounts of the two colours, that is to say, equal quantities of paint, we take what would correspond to an equal number of steps upon the scale of chroma, we find that they do balance and produce a perfectly neutral grey in which neither one hue or other predominates.

Within the sphere ~~of~~ all opposite colours will balance because being of all equal length at each level of value no chroma path can be longer than another of outbalance it.

Facing Plate 31

Compare Cleland, 1921, “Balance”, pp. 20-21.

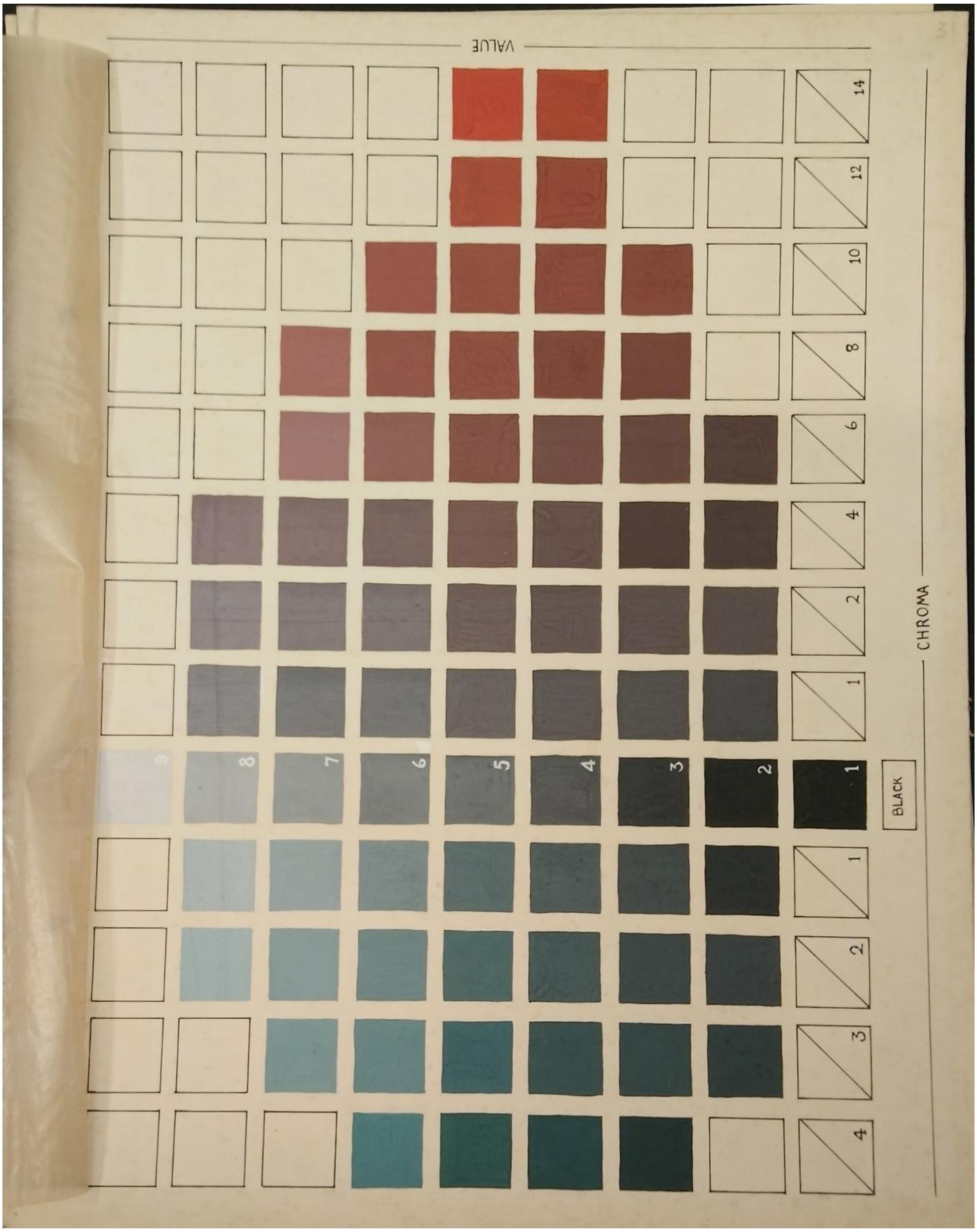


Plate 31

Matches a Munsell chart produced by the Allcolor Co., Inc., New York City, and illustrated in *The Science of Color*, *Life Magazine*, **17** (1), July 3, 1944, p. 47.

BALANCE (continued)

Thus we see how two opposite colours may be balanced by employing only equal chroma steps of each on the same level of value that R 5/5 will balance BG 5/5 or G 5/3 will balance RP 5/3. But in practice we may wish to employ a weak chroma of one hue with a strong chroma of its opposite. In this case we cannot chop off the excess strength of one colour on one end of the line but must obtain the desired balance by other means. If our purpose be merely to make a perfect grey we would use a greater amount of the weaker colour but if, as in general practice we wish to produce a balanced or harmonious colour design we should employ a larger area of the weaker colour than of the stronger. If we do this in correct proportions relative to the strength of chroma in each of the colours we will obtain balance.

The important element in any scheme is the value key. It is the first impression received and immediately registers an emotional action irrespective of all the material in the scheme. Subsequent reactions to the latter may intensify or perhaps neutralise this first impression, but they cannot change it fundamentally. The key of our scheme should be the first consideration since it will largely determine the other elements, colour particularly. We may use values without considering colour, but not colour without considering values. Values are basic. Every colour scheme requires a value key as well as a certain colour key which will best fit the situation.

Facing Plate 32

First paragraph: compare Cleland, 1921, pp. 20-21. Second paragraph: Graves, 1941, pp. 129-130.

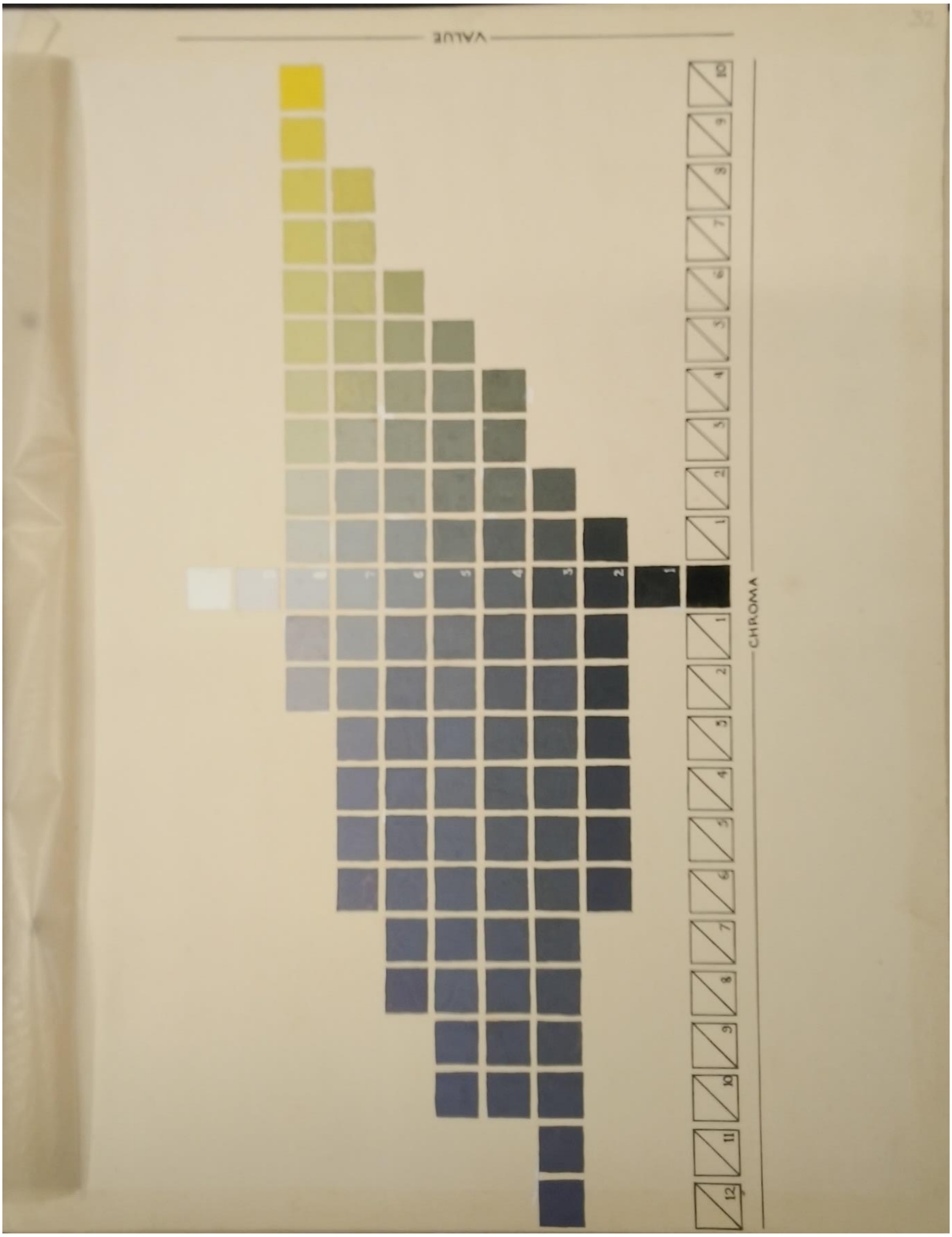


Plate 32

BALANCE (continued)

KEY- A system or series of tones or values based on their relation to a dominant value or general tonality of the scheme.

MAJOR KEY- Large or greater intervals, strong contrast.

MINOR KEY- Small intervalz or subdued contrast;

Values 1, 2 & 3, black being 1, are in the low key; 4,5 & 6, the intermediate key; 7, 8 & 9, in the high key.

If the darkest and lightest values in the scheme are three steps apart or less such as 3 & 7 it may be called a minor key. If there is a greater interval between the darkest and the lightest values and they are 5, 6 or 7 steps apart, strong contrasts result and it may be called a major key. Any painting or design may be thus classified. Each key in the scheme as in a painting has a distinctive emotional character. The luminous high major key stimulates; the high minor key has a delicate feminine quality and is more pensive; the intermediate major key is strong and rich with a masculine quality; subdued intermediate minor key is dreamy; the low major key is dignified; the low minor is funerial.

In European painting prior to the Impressionists the intermediate low major keys were generally used. The tendency in the past decade has been towards the use of the intermediate and high major key in both painting, dress design and interior decoration. Small compact houses and flats are a contributing factor to the latter case.

The higher keyed walls, ceilings and furnishings together with cool receding colours create a feeling of airy spaciousness. A striking contrast to the low keyed reds and browns of the Victorian rule. It is unwise to have colour or value areas equal. One colour and one value should be dominant.

Facing Plate 33

Compare Graves, 1941, pp. 131-133.

Compare [Graves, 1941, p. 137](https://archive.org/details/artofcolordesign00grav/page/136/mode/2up).

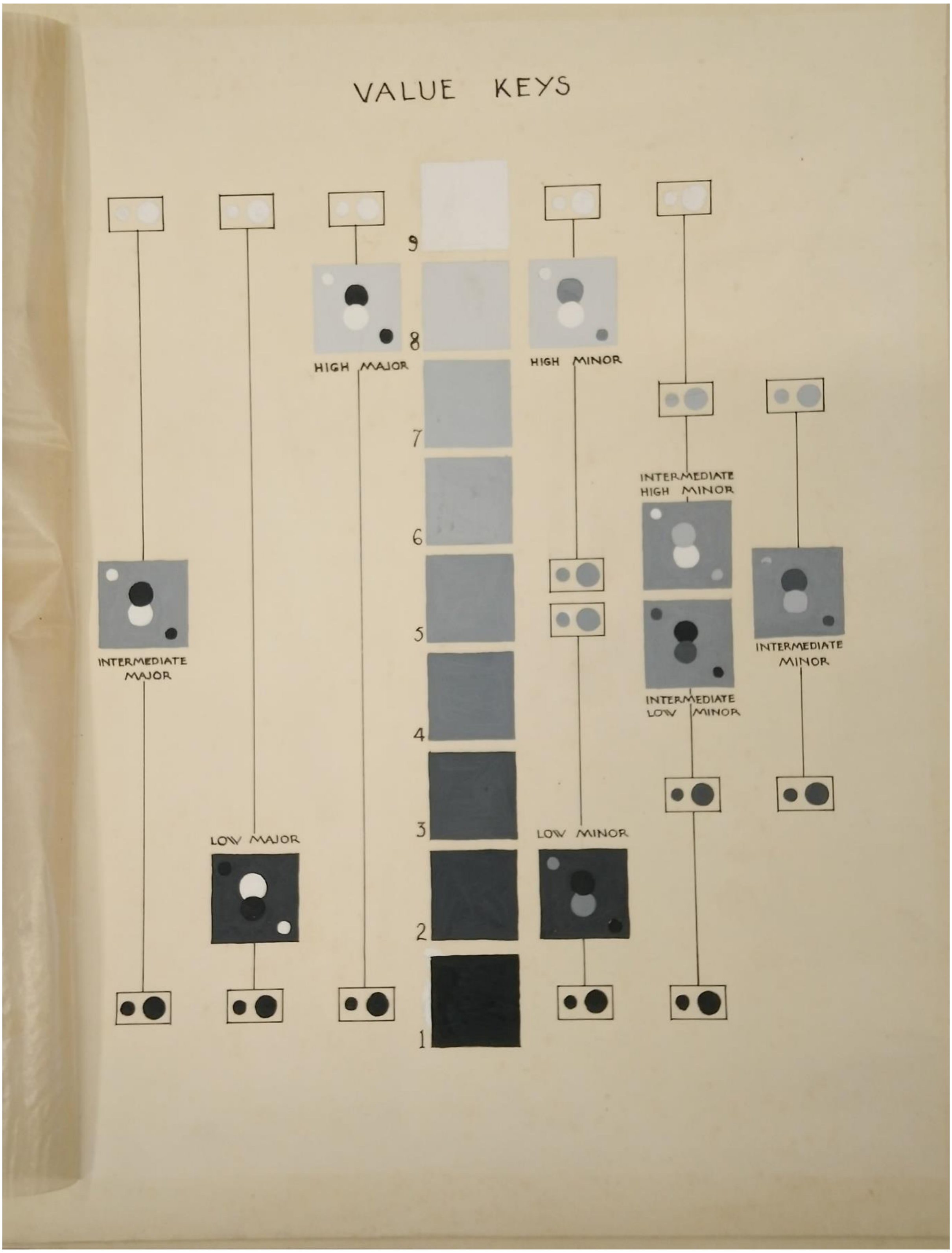


Plate 33

Compare Graves, 1941, p. 137.

VALUE ORGANISATION

Success in working out an interior scheme or any colour scheme depends largely upon experience and practice. Without experience and practice the chart will be inane.

A satisfactory value plan is one that is (1) appropriate for its purpose (2) possesses unity and (3) has variety or interest.

The first is determined by the character of its design and its function. The second is organised through the basic principles of design.

RHYTHM Rhythm means measured proportioned intervals. Value rhythm therefore means measured proportioned valued intervals. The value rhythm consists of a series of plan value intervals or contrasts as illustrated A: light, Z: dark, D: dominant, and W: weak value. Each of the value chords in the accompanying diagram is a variation of the basic value rhythm. Each value chord is composed of four values- A D W Z.

A is the lightest value, D the next lightest, W the next and Z the darkest.

The aim of design is to create an interesting unit. Interest is the result of variety. Unity is created by dominance. The value chords are organised to produce these two results. They are created as follows:

INTEREST Interest is created by the variety of value intervals. Equal intervals make a monotonous rhythm. Unequal intervals create an interesting rhythm. Therefore the four values A D W Z are not equidistant.

UNITY In any combination the unity is impossible unless there is dominance. In any scheme a unity necessitates that one value will be dominant or largest in area. The dominant value partly determines the value key of the scheme. It may be either high, intermediate or low. The emotional quality of a design or composition is modified considerably by its value key.

Facing Plate 34

Compare Graves 1941, “5. Value Organization”, pp. 148-149, “Value Chords”, p. 152, “The Plan of Value Areas or Quantities”, pp. 154-155.

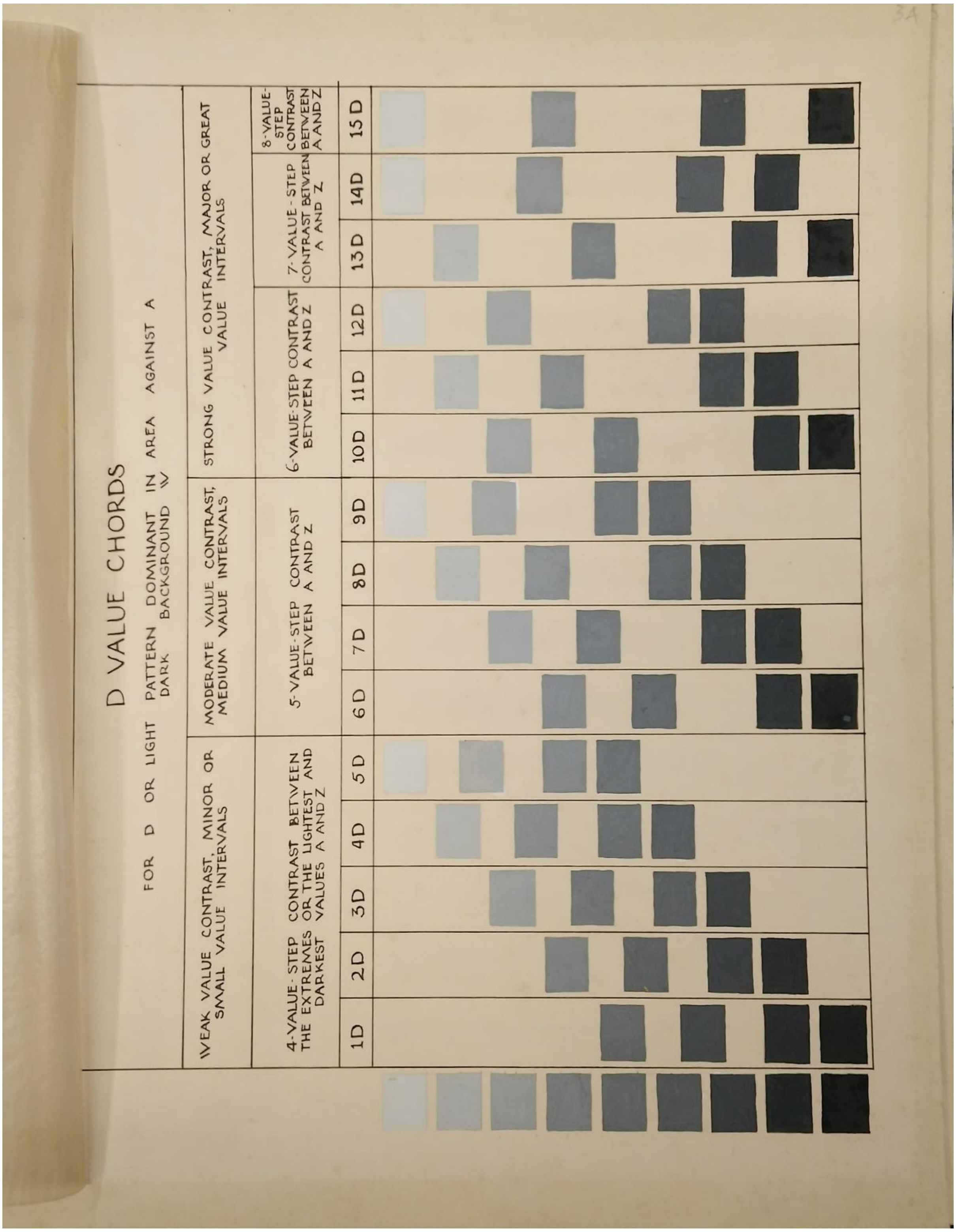


Plate 34

Compare Graves, 1941, p. 156.

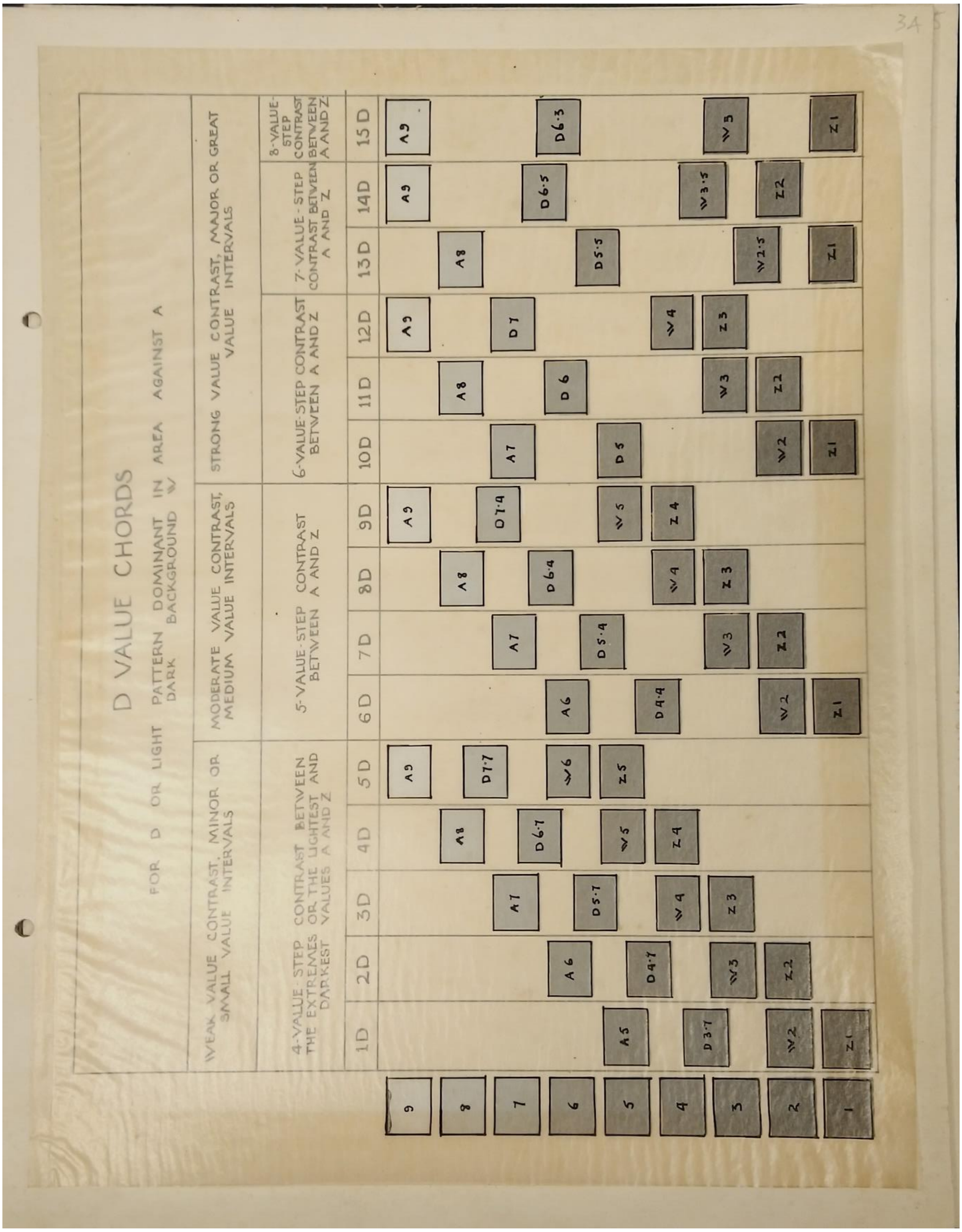


Plate 34 overlay

Compare Graves, 1941, p. 156.

VALUE ORGANISATION (continued)

The purpose of the two charts is to offer you the choice of thirty value chords that are planned according to the basic principles of design. These charts will help in finding easily and rapidly the value chord you want; but you must first decide the effect you wish to create. The choice of a value chord by the character of the design and the purpose for which it is intended. Character and function therefore decide the questions that may be considered in the following order.

Let us assume that we have chosen a light design against a dark background, in that case the chart of D value chord will be used. Do you wish (a) the weak value contrast produced by value chords 1D to 5D, or (b) the moderate contrast of value chords 6D to 9D, or (c) the strong contrast of value chords 10D to 15D.

If we decide on weak value contrast we have a choice of the five value chords 1D to 5D, although each of these value chords has a weak contrast the effect produced by each is different ranging from 1D, which encompasses the lower or darker half of the value scale with value 3·7 as the largest area , to 5D, which spans the upper or lighter half with value 7·7 as the largest area. After a little practice one becomes familiar with the distinctive character of each value chord and will know in advance the effect each will produce.

Facing Plate 35

Compare Graves, 1941, “Selecting a value chord”, pp. 163-164.

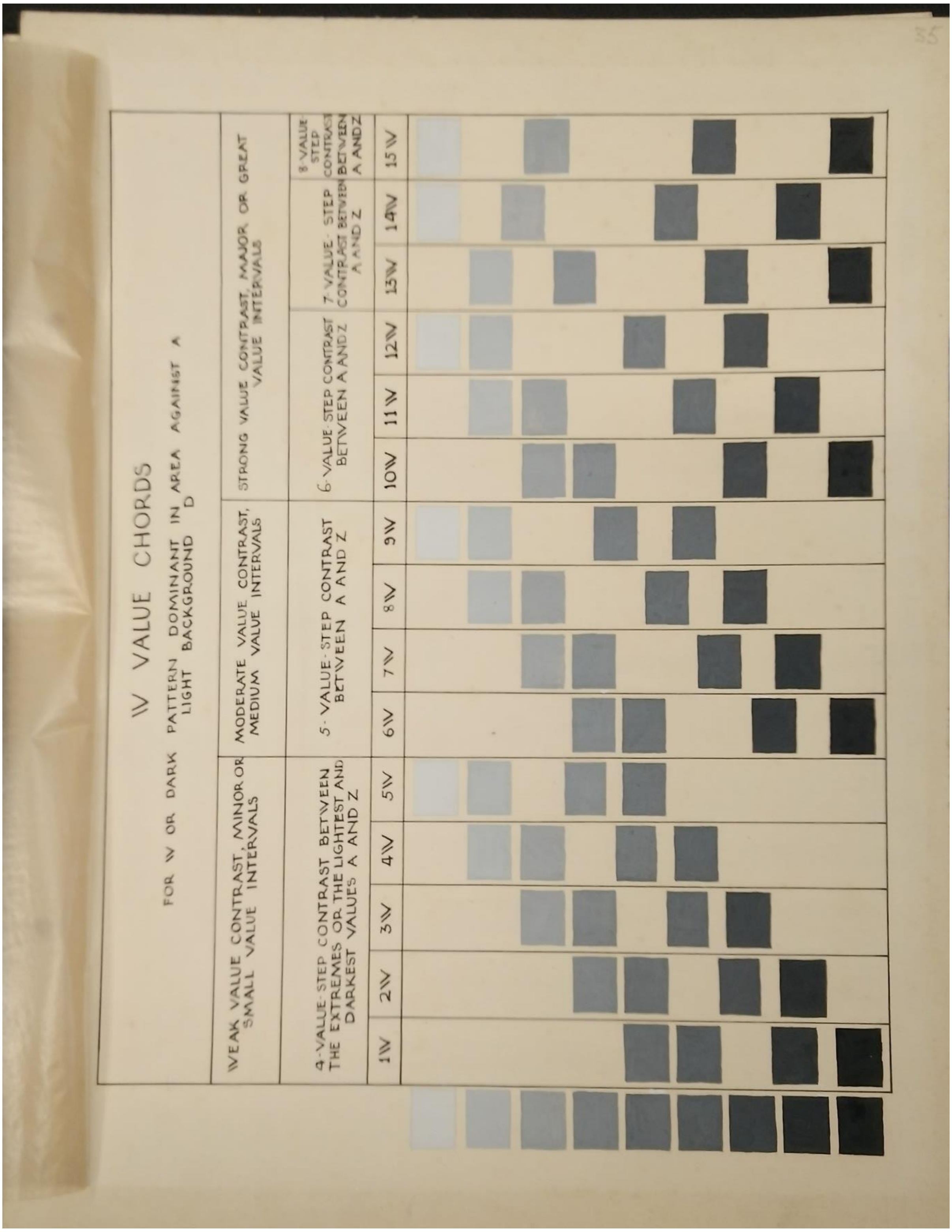


Plate 35

Compare Graves, 1941, p. 162.

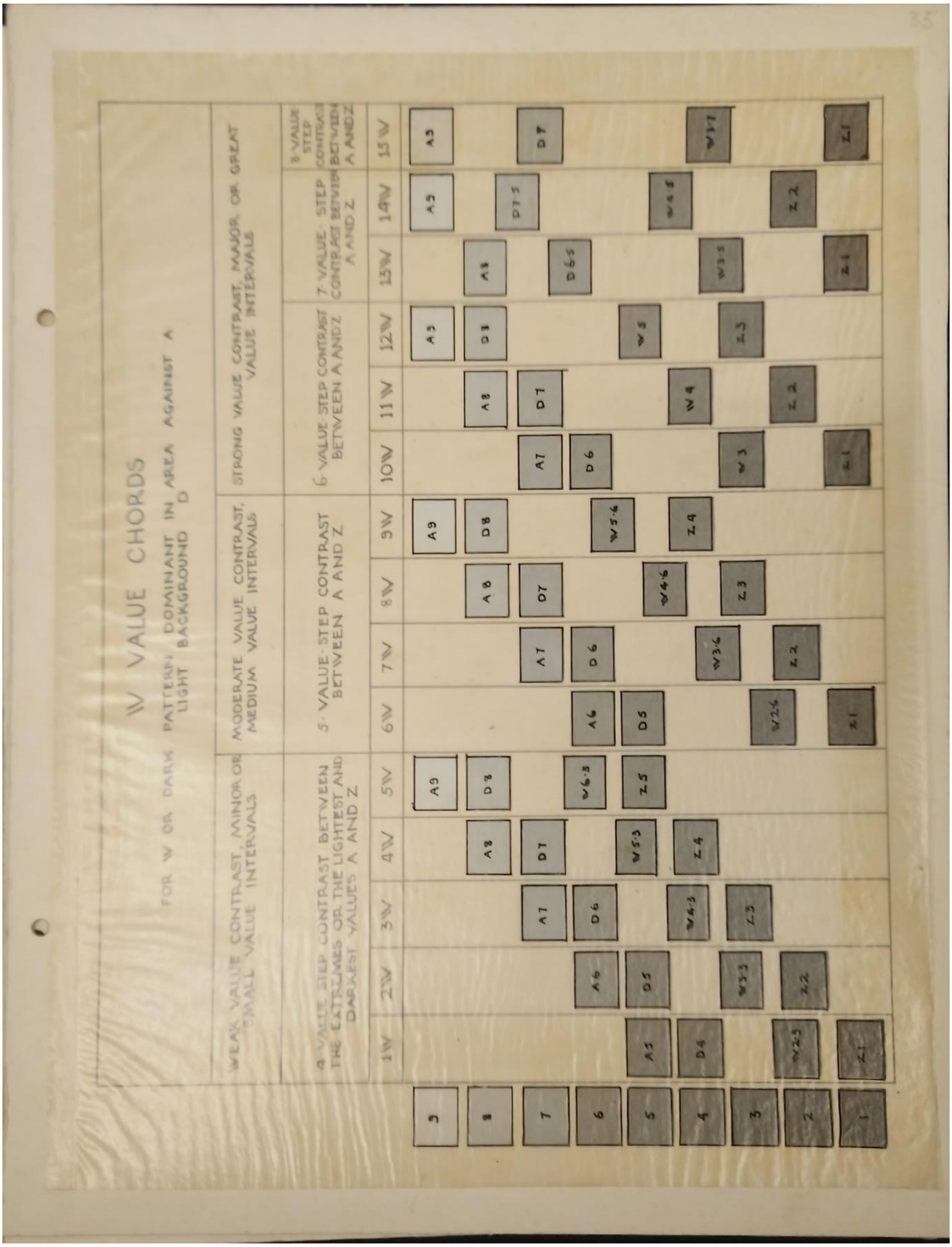


Plate 35 overlay

Compare Graves, 1941, p. 162.

Compare Graves, 1941, p. 180.

VALUE ORGANISATION (continued)

If we would intelligently relate colours we must consider all their qualities or dimensions. It is not sufficient to describe a colour as the dark red or light green. Such a description as Munsell says is equivalent to a map of Switzerland with mountains left out. It is like describing a box by saying it is 2' wide and 9' long. The box has still another dimension, depth which, if not specified, might be imagined to be anything from 1" to 30 or more feet. Like the box colour has qualities or dimensions: they are hue, value and chroma. Before colour can be rationally organised these three colour dimensions must be thoroughly understood.

Hue is the name of a colour.

Value is the brightness or luminosity of a colour.

Chroma is the strength, intensity or purity of a colour.

Facing Plate 36

Plate 36

Similarly organized but not identical plates are found in the *Atlas of the Munsell System* (1915, Chart H) and the 1929 edition of the *Munsell Book of Color* (last two plates).