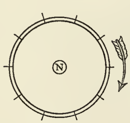
A PRACTICAL DESCRIPTION OF THE MUNSELL COLOR SYSTEM WITH SUGGESTIONS FOR ITS USE

By T. M. CLELAND

In the introductory text, written especially for this book by Professor Munsell, will be found a brief compendium of his theories upon the dimensions of color and color relations, which though generally scientific in form, is stated with such admirable simplicity and absence of scientific verbiage that it merits the careful study of all practical workers, who would understand the basic idea upon which the matter of this book is built.* It has been thought wise, however, by the publishers to augment this with a practical description with illustrations of the cardinal principles of the Munsell System, more especially with a view to its actual use in printing and advertising, or in what has come to be generally known as the Graphic Arts. In so doing, there must necessarily occur a reiteration of much that appears in Professor Munsell's introduction, but its being expressed in different form, may tend to assist the practical reader toward a clearer comprehension.

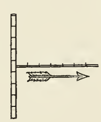
The first essential to the application of the Munsell System is a clear understanding of the three dimensions of color, and once having grasped the simple logic of these, the practical advantages of the System will be manifest. The reader should be warned at the outset against that fear of scientific perplexity which is ever present in the lay mind. The three dimensions of color are not involved in the mysteries of higher mathematics. There is nothing about them which should not be as readily comprehended by the average reader as the three dimensions of a box, or any other form which can be felt or seen. We have been unaccustomed to regarding color with any sense of order and it is this fact, rather than any complexity inherent in the idea itself, which will be the source of whatever difficulty may be encountered by the reader, who faces this conception of color for the first time.

On the second of the three gray sheets which precede the other color sheets of this book will be found a colored diagram, accompanied by an explanation which has been made especially to present the three dimensions concretely and to avoid the abstractions of written explanation. The idea of the three dimensions of color can be even more simply, though less completely, expressed thus:



HUE
Measurement around a circle

VALUE
Measurement up a vertical pole



CHROMA
Measurement on a horizontal away from a vertical pole

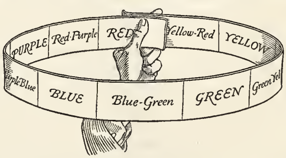
*It should also be borne in mind that this system does not deal with the pure science of color as wave lengths of light, but merely with color as manifested and commonly used in pigments.

With these three simple directions of measurement well in mind, and by reference to the diagram mentioned above, where actual colors are printed, there need be little confusion for even the least scientific mind in comprehending what is meant by color "measurement." In considering further the qualities of color, which are expressed by these three dimensions known as Hue, Value and Chroma, we will take each one of them separately in the order in which they are written, trusting that having done so we may pass to the subject of color balance or harmony and its application to every-day practice, equipped with a clear understanding of how it may be measured and noted.

I. HUE

This first dimension is defined by Professor Munsell as "The quality by which we distinguish one color from another, as a red from a yellow, a green, a blue or a purple," but this dimension does not tell us whether the color is dark or light, or strong or weak. It merely refers to some point in the spectrum of all colors, such as we have seen in the reflection of sunlight through a prism. Let us suppose now that we had such a spectrum cast by a prism, or a section taken out of a rainbow. We know it to be a scientific fact that it contains all possible hues, merging by indistinguishable degrees, one into the other, but always in a fixed order. Now let us imagine that we have such a spectrum fixed or printed on a band of paper, and that it begins at one end with red and going through all possible hues, it arrives back at red again at the other end. The hues are unevenly divided and they merge one into the other by indistinguishable degrees. But still preserving the order of these hues, let us divide them into equal steps as we do a ruler into inches, by selecting certain colors familiar to us in every-day use—red, yellow, green, blue and purple. These we will call the Simple Hues, but between each of them we will make another division where each merges into the other. These we will call yellow-red, green-yellow, blue-green, purple-blue and red-purple and they will be known as Compound Hues, because each of them is compounded of two Simple Hues.*

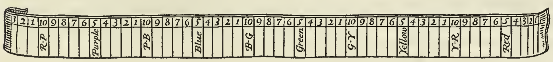
Thus we shall have 10 divisions upon our band. The reason for this number of divisions will be understood when we come to consider the question of Color Balance. It presents a sufficient variety of hues for purposes of demonstration, and for most practical uses. Now if we bend this band around into a circular hoop, so



*In the naming of these steps of Hue, Professor Munsell has wisely adopted a terminology which is commonly understood as referring only to color, and has avoided the use of such terms as orange, pink, violet, etc., which have other meanings and might lead to confusion. What is called *orange*, for example, he calls *yellow-red* because it is a mixture of these two hues.

that the red at one end meets and laps the red at the other end, we have a perfect scale of Hue in the circular form in which we shall always consider it. So it is that when we state the first dimension of a color we are merely referring to its position on this circle of hues. In writing a color formula this first dimension is expressed by the initial letter of the Hue—R for red, which is a Simple Hue, and B-G for blue-green, which is a Compound Hue.

These 10 steps being a decimal number, may, of course, be infinitely subdivided and it may frequently happen, as it does in the color areas printed in this book, that a given color does not fall exactly on any one of these 10 divisions of Hue, but somewhere between two of them. Allowance has been made for this by dividing each of the steps of the Simple Hues into 10 further divisions. These 10 subdivisions represent about as fine a variation of Hue as even a trained eye can distinguish, and it would be obviously futile, for practical purposes, to carry it further. If we uncurl our band again, in order to better see what we are doing and note these divisions upon it, they will appear in this order:



Reading from right to left, beginning at the left of a Compound Hue, the numerals run from 1 to 10, 5 always marking a Simple Hue and 10 falling always on a Compound Hue. Thus we have a series of numerals denoting any practical step or gradation between one hue and another and in writing a color formula, of which one of these intermediary hues is a part, we place the numeral, denoting the position of the hue on this scale, before the letter which stands for the nearest Simple Hue, thus 7 R, 2 Y, etc. If, for example, we wish to write the formula of a color, the hue of which is neither Red nor Yellow-Red, but about half way between the two, we would write it 7 R or 8 R, according as it was nearer to the Red or to the Yellow-Red.

II. VALUE

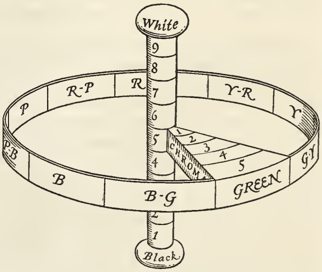
This is the second dimension and is possibly the simplest to understand. It is, according to Professor Munsell's definition, "The quality by which we distinguish a light color from a dark one." We noted that the first dimension did not tell us whether a color was light or dark. It told us, for example, that it was red and not green, but we know that there may be light red and dark red, and it is the function of this dimension of Value to tell us how light or how dark a given color may be. For this purpose we shall need a scale of Value, which we may conceive as a vertical pole, or axis to our circle of Hues, black at the lower end, representing total absence of light, and white at the top, representing pure light, and between these a number of divisions of gray, regularly graded between black and white. This gradation could also be infinite. Since pure black is unattainable, we will call that 0 and begin our scale with the darkest gray as 1, numbering the steps up to 9, which is the lightest gray. Pure white, which is also unattainable, we will call 10. In the practical use of the scale of Value, therefore, we shall have but 9 steps and the middle one of these will be 5—what is referred to as Middle Value. This scale of

Value, or neutral pole, is well represented on the colored diagram already referred to, where it is shown with the actual gradations printed. These steps of Value have been scientifically measured and registered by means of an instrument known as a Photometer.* In writing a color formula we express this dimension of Value by a numeral, which denotes at what step upon the scale of Value this color falls. This numeral is written above a line, as B6/ for example, by which we mean that this particular blue, regardless of its other qualities is as light or as dark as the 6th step upon the scale of Value. A color such as is commonly called *"maroon"* is an example of a red which is *low in Value,* because it is dark, and what is called *"pink"* is a red which is *high in Value* because it is light.

Now having familiarized ourselves with these two dimensions, and understanding what qualities of a color they express, we may proceed to consider the third dimension, without which our description of any given color is incomplete.

III. CHROMA

When we have stated that the color is blue or yellow or green and that it is dark or light, we have indicated two of its important qualities—its Hue and its Value, but we have by no means described it completely. We may say of an emerald that it is green and that it is light, but we can say that certain grapes are green and also light, and yet there is a decided difference between their respective colors, if we place them side by side. Both may be green and of the same Value of light, but the emerald is *strong* in color and the grape is *weak* in color or *grayer*. It is this difference which is measured on the dimension of Chroma. The scale of Value has been referred to in the convenient and easily understood form of a vertical pole, which represents a neutral axis to all the circle of hues and is, itself, of no color, but is pure gray. Around this pole we may place our band representing the scale of Hue and then if we imagine any one of these hues on the circumference of the band to grow inward toward the gray pole in the center, growing grayer or weaker in color strength until it reaches this center pole and loses its color entirely, we have grasped

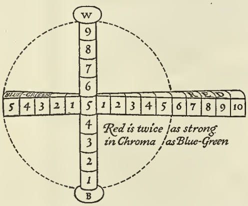


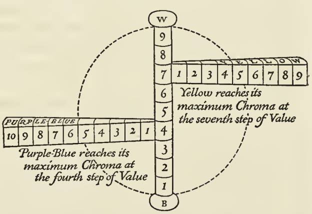
*The Munsell Photometer and the readings of Value made with it have been accepted as scientifically correct. This instrument is described in Professor Munsell's book "A Color Notation."

the idea of the dimension known as Chroma. By dividing this into regular measured steps, we have a scale upon which the strength of color may be measured. This is clearly illustrated on the colored diagram already referred to, where several steps of Yellow are shown printed on the scale of Chroma. This dimension of Chroma is written in a color formula by means of a numeral *below* a line, which denotes the step upon the Chroma scale at which it falls, thus /5, /8, /9, etc.

Needless to say, all of the hues may be thus measured on this dimension at right angles to the vertical pole and grading from gray, step by step away from the pole to greater and greater strength of color.

Professor Munsell has devoted a part of his introduction to a description of what he calls "The Color Sphere." This is a general form which aids the orderly consideration of color and within which all color balances, as will be shown later; but in the actual measurement of pigment colors, such as we use in printing or painting, all of the paths of Chroma would not be of the same length nor would they all be comprised within a sphere. Certain of them would extend to points outside of it. Nor would all of the paths of Chroma reach their greatest length at the equator of the sphere, that is the level of Middle Value. There are two reasons governing this which it is important to understand: first, *Colors differ by nature in their Chroma Strength, some being much more powerful than others*. The strongest red pigment used, for example, is twice as powerful as the strongest blue-green pigment and will require a correspondingly greater number of steps on a longer path to reach gray. The Chroma path of Red is the longest and extends far outside the sphere, being ten measured steps from the neutral pole;* while Blue-Green is the shortest, being only five steps. The sphere is limited in size to this shortest axis for reasons which will appear when we take up the question of Balance or harmony of color. The second reason is: *That all colors do not reach their maximum Chroma Strength at the same level of Value*. It can be readily comprehended, for example, that the strongest yellow pigment is by nature much lighter, or higher in Value, than the strongest blue pigment and, therefore, that the complete Chroma paths of these two colors will each touch the neutral pole at different levels.





Thus it is evident that a complete image of all pigment colors cannot be comprised within the sphere; and we are led to seek another form which will convey

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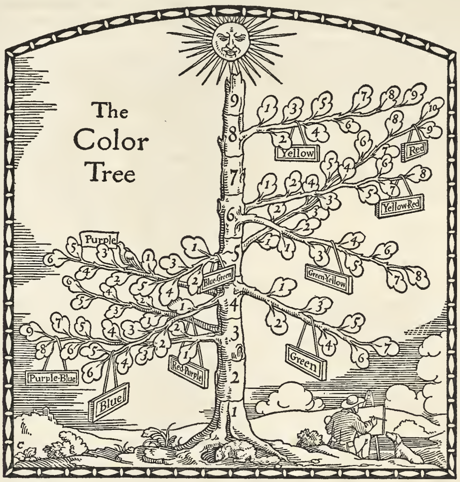
*This is the Chroma of vermillion in dry form. Red printing inks are now made which are considerably stronger than ten steps of Chroma.

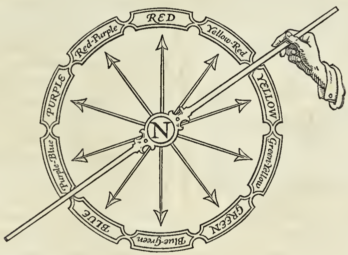
more completely the character of color qualities and dimensions governing the range of pigments in regular use. Professor Munsell has conceived this as a "Color Tree" with a vertical trunk for the scale of Value and branches representing the different Hues, these branches varying in length with the Chroma Strength of each Hue. In the appended illustration the leaves of the tree represent the measured steps of Chroma upon each branch.



Upon the scale of Chroma the number of steps is limited only by the strength of pigments. The strongest yellow pigment in dry form, for example, will reach nine steps away from the neutral pole; but certain dyes on silk, or even printing inks and some unreliable pigments, may go one or more steps beyond this. As new and more powerful pigments may be discovered, they will add further steps to the scale of Chroma.

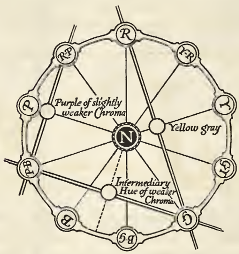
We have described each of the three dimensions by which any color may be measured, and noted how each is written in a color formula. It remains only to put these separate notations together and to write a complete color formula embodying all three dimensions. For example, we are given a certain color to measure and define and we find that upon the scale of Hue it is Purple-Blue. Upon comparing it with the scale of Value, we find it is but three steps from the bottom, and that it is only two steps away from the neutral gray pole upon the scale of Chroma. A complete formula for this color would, therefore, be written P-B 3/2. It is scarcely necessary to point out the practical advantages of such a system of definite measurement and notation over the vague and variable terms in general use, borrowed from the vegetable and animal kingdoms, such as plum, olive, fawn, mouse, etc., of which no two persons ever have quite the same idea.

It is hoped that the foregoing explanation of the three dimensions of color will have been sufficiently clear to convey to the reader a distinct mental image of what is meant by the terms, Hue, Value and Chroma, in order that we may proceed to the study of certain principles of order for the intelligent and harmonious use of color, which grow out of this simple and logical system of measurement



OPPOSITE OR COMPLEMENTARY COLORS

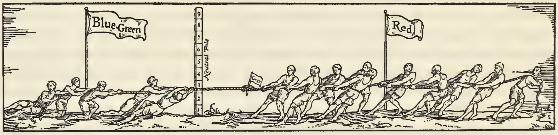
The above diagram, displaying a circle of the ten regular Hues arranged in the immutable order imposed by the spectrum, and reading clockwise, beginning with Red at the top, will serve, with but little explanation, to illustrate what is meant by "opposite," or the possibly more familiar word "complementary," colors. The term opposite is used preferably in the Munsell System because it is simple and is self-explanatory, as will be seen by reference to the above diagram, where each Hue on the circle will be found directly opposite to another Hue. Thus a straight line drawn from Red on the circle of Hues through the neutral pole will pass through Blue-Green, its opposite or complementary color. A line from Blue through the neutral pole will pass through Yellow-Red and so on throughout the whole circle. It should be noted that each of the simple Hues, Red, Purple, Blue, Green and Yellow falls opposite a compound Hue, Blue-Green, Green-Yellow, Yellow-Red, etc. Now two colors which are thus opposite to one another are not only farthest apart upon the diagram, but are in actual use the most strongly contrasting. It does not matter at what point we draw the line, whether it is from one of the regular Hues or from a point between two Hues, if it passes through the center it will fall upon the Hue or intermediary Hue which is its strongest contrast. This may be more readily visualized if we imagine the spindle indicated on the diagram as pivoted on the neutral pole and movable to any point on the circle. The question may be asked as to how it is determined that these colors, which fall opposite to one another on the scale of Hue, are, in fact, the most strongly contrasting colors. The answer to this question will serve to demonstrate the logical foundation of the Munsell System. When any two colors are truly opposite or at the point of strongest contrast, their admixture will produce a perfectly neutral gray. Though this may be accepted as axiomatic, it can be easily proven with scientific accuracy by arranging two opposite colors on a disc in proportions relative to the Chroma strength of each and revolving them with such rapidity that we cannot see them separately and they are mixed, when if they are truly opposite, they will unite in a perfect gray.* Therefore working back from this fact, the scale of Hue has been so composed that those colors which thus mixed with each other do actually make gray, are placed directly opposite on a line running through the neutral gray pole. Another question which may arise is



what will take place if we draw a straight line between two Hues which are not opposites; and what would be the result of the admixture of these. This can best be answered by the accompanying diagram, where three different lines have been drawn, no one of them through the neutral center. These lines, it will at once be seen, cross points which are not neutral, but nearer to one or another of the Hues lying between the ones from which the lines are drawn; and the result of the admixture obtained is noted on the diagram. This will be sufficient to further demonstrate the simplicity and logic of the System and to suggest to the reader other interesting examples of it.

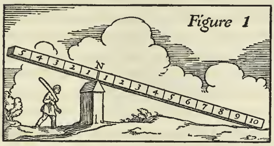
BALANCE

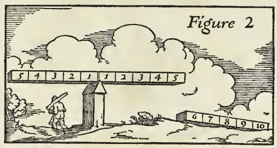
In describing the dimension known as Chroma, we noted the fact that certain of the Hues were much more powerful than others, in this regard, and were only to be represented by lines or paths extending beyond the others and outside of the sphere. We found that Red, for example, on any step of Value is more powerful and requires a longer path than its opposite, Blue-Green; and that Yellow is longer than its opposite, Purple-Blue, on the high steps of Value, but shorter on the lower steps of Value. This brings us naturally to the question of Balance of Color, the *vital* question in all applications of color to practice. Now if we mixed equal parts of Red at its maximum Chroma with its opposite, Blue-Green, at its maximum, we would not get a perfectly neutral gray, but one in which the Red predominated very decidedly. It would be somewhat like a tug-of-war in which



*The same experiment may be tried with the actual admixture of pigments; but in this case the result is dependent upon the nature of the pigment, itself, that is upon properties other than those of its color, and is, therefore, not scientifically accurate.

there were ten men, each representing a step of Chroma, on one side and only five on the other. The resulting color would be pulled well over on to the Red side, because of the fact already stated that Red at its maximum Chroma is so much stronger than Blue-Green at its maximum Chroma. If, however, instead of taking equal amounts of the two colors, that is to say equal quantities of pigment or equal printed areas of each, 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 gray, in which neither the one Hue nor the other predominates. Let us glance for a moment at these two diagrams, in which a bar represents the line of Red and Blue-Green, with five steps of Chroma for Blue-Green and ten steps of Chroma for Red, as is the case with these two Hues at Middle Value. The bar rests upon a



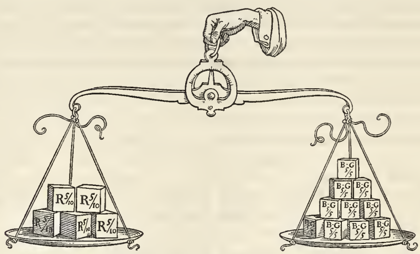


fulcrum at the neutral point and obviously it will not balance, but will fall to the Red side, as in Figure 1. But if we cut off steps 6, 7, 8, 9 and 10 from the Red side of the bar, it will balance upon the neutral gray, as in Figure 2. This will doubtless strike the reader as so simple and obvious that it scarcely merits statement; but it is just this simplicity which is characteristic of the Munsell System throughout, if approached from the same point of view. This, too, will explain why the diameter of our Color Sphere is limited to the shortest Chroma path at Middle Value. It will at once be apparent that within a sphere thus limited, all opposite colors will balance because being all of equal length at each level of Value no Chroma path can be longer than another or outbalance it.

Thus we see how two opposite colors may be balanced by employing only equal Chroma steps of each on the same level of Value, that R 5/5 will balance B-G 5/5 or G 5/3 will balance R-P 5/3 and so on throughout all of the Hues.* 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 resort to the simple expedient of chopping off the excess strength of color on one end of the line, but must attain the desired Balance by another means. If our purpose is merely to make a perfect gray, we would use a greater amount of the weaker color; but if, as in general practice, we wish to produce a balanced or harmonius color design, we would employ a larger area of the weaker color than of the stronger. If we do this in correct proportions, relative to the strength of Chroma in each of the colors, we will attain Balance. We may prove that we have attained Balance by the fact that everything in our design, thus apportioned as to area and strength of Chroma, if mixed together, would produce a perfect gray. Let us suppose, for example, that we wish to employ in our design the maximum of Red and Blue-Green at Middle

*Examples of this will be found on the first three color sheets, where all of the Hues are shown thus simply balanced with their opposites, each sheet showing them at a different step of Value.

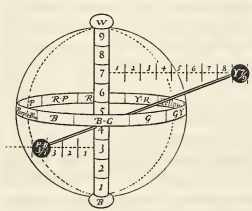
Value. Since we are speaking of Balance a pair of scales is an apt figure with which to illustrate the point. Into the pan on one side we will put *five* blocks of Red 5/10, its maximum Chroma. In order to balance this we must put into the other pan *ten* blocks of the strongest Blue-Green, which is only 5/5.



So we find that in order to balance two colors of unequal Chroma, but of the same Value, we use a larger area of the weaker Chroma with a lesser area of the stronger, and that the proportions are simply in inverse ratio to the strength of Chroma of each. That is, we use ten parts of Blue-Green at /5 Chroma with five parts of Red at /10 Chroma, or let us say six parts of Yellow-Red 3/4 with four parts of Blue 3/6, etc.

Thus far we have considered only Balance of opposite Hues on the same level of Value; but more often than not it will occur that we wish to print a design in colors which are not only different in Chroma strength but also on different levels of Value, and this difference of Value will also affect the question of Balance and of the amount of area which each color should occupy in order to attain it. Let us assume that we wish to print a design in Yellow of a high Value and strong Chroma, say Y 7/9, with its opposite, Purple-Blue, at low value and weak Chroma, say P-B 3/4. The path formed by a line drawn between these colors, passing through the neutral pole would not be horizontal in this case, since they are at different levels of Value, but would appear as in this diagram.

We now have to take the Value into account in determining the amount of area of each of these two colors to be used if we are to arrive at a perfectly balanced color design; and this is done by the simple process of multiplying the Chroma by the Value of each of the colors. Multiplying the Chroma by the Value of Yellow 7/9, 7x9=63, and doing the same with Purple-Blue 3/4, 3x4=12, we get these two products 63 and 12. These are applied inversely, as in the former case, and we use 63 parts of Purple-Blue 3/4 with 12 parts of Yellow 7/9. The conclusion



is that the *stronger Chroma and higher Value should occupy the lesser area and the weaker Chroma and lower Value should occupy the greater area.*

All of the areas on the color sheets throughout this book have been measured and apportioned upon this principle with as great a degree of accuracy as possible, to better exemplify the rule; but it is not assumed that in printing a complicated color design the areas could all be measured and made to conform strictly to this law; or that the effect would necessarily be inharmonious if they did not. This is merely a guiding principle or ideal point at which we may aim in the actual printing of a color design. If we had such a design to print in two colors, for example, and one of the blocks from which we were to print it occupied what we would estimate by eye to be about twice as much surface or area as the other block, it would be a simple matter to choose colors to conform. We might take Purple 4/6 for the larger area and Green-Yellow 6/8 for the smaller, or Blue 2/3 for the larger and Yellow-Red 3/4 for the smaller, or any other colors which would give us a proportion approximating that of the difference between the areas of our design. Circumstances will not always permit a strict adherence to the proportions indicated by this formula; but it will rarely, if ever, be impossible to follow the general principle of printing the larger area in the lower Value and weaker Chroma and the smaller area in the higher Value and stronger Chroma.

For purposes of illustration we have considered only designs in two colors; but it is scarcely necessary to say that the same rule would apply to three or any other number of colors. Reference to the prints of the design by Miss Helen Dryden, which appears at the end of this article with an analysis of their color Balance, will make this fact clear.

COLOR COMBINATIONS

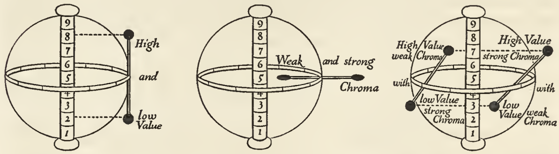
If in the foregoing we have touched upon the combining of colors in use, it has been only by way of explanation of some point in the laws of Measurement and Balance; and it is hoped that no impression has been created that the color combinations possible within the range of the Munsell System are limited to the examples which have thus far been mentioned. This is so far from being the case that any attempt to cover the subject of color combinations possible to this System would be quite futile within the limited scope of this article. A logical and orderly system will, in fact, offer a greater range of possibilities for the combination of color than could be discovered at random.

We must, therefore, be content to mention here only a few of the directions or paths which offer harmonious color combinations, trusting that the reader may be sufficiently interested by these to seek other possibilities of his own accord.

In considering the use of two colors together, we have repeatedly alluded to those having opposite Hues, because this appeared to be the clearest example with which to explain the idea of Balance. This combination of opposites is one of the simplest and surest of color harmonies. We have seen how, if properly proportioned as to amount or area, these opposite colors will balance in perfect neutrality; but another interesting fact with regard to them is that when placed together these contrasting colors tend to stimulate and enhance each other. This effect of contrast may be noted on the three gray sheets—the first of the color sheets, where the ten Hues are shown at three levels of Value, each printed with its opposite.

Though none of these colors is more than Middle Chroma, the effect is of their being much stronger. Other examples of opposite colors will be found on sheets 8, 9, 12, 16, 17 and 18.

Another very simple and practically infallible series of color harmonies may be made within a single Hue. Thus we may combine a low Value of any Hue with a high Value of the same; or, a weak Chroma of any Hue with a stronger Chroma of the same. A more interesting combination within a single Hue is that of a low Value and weak Chroma with a high Value and stronger Chroma or vice versa.

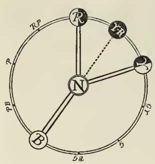


Experiments with the possibilities of single Hues will yield very interesting results in the great variety of colors thus obtainable. The areas printed on sheet 10, for example, are all derived from various steps of the single Hue, Yellow; and some of them will be a source of surprise to those who are accustomed to think of yellow within the limited field assigned to it by popular belief. Examples of other single Hue combinations will be found on sheets 6, 7 and 11.

Successful combinations can also be made between what are known as neighboring Hues, that is of any Hue with the Hue which immediately precedes or follows it on the scale—Green with Green-Yellow, Red with Yellow-Red, Yellow with Yellow-Red, etc. These may in turn be varied by taking them at different steps of Value and different strengths of Chroma. In the same way, Hues may be combined with neighboring intermediary Hues. In all of these cases the harmony depends upon proximity rather than contrast, as in the case of opposites. Examples of neighboring Hue combinations are to be found on sheets 4, 5, 6, 7, 13, 14 and 15.

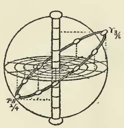
The use of three or more colors will present a problem at once more complex and more interesting and which, if approached in any regular order may assuredly be solved harmoniously. One method is to choose a certain restricted field of Hues such as Yellow to Red, for example, and then to select within this field regular steps of Hue, Value and Chroma which bear an orderly relation to each other. Examples of combinations thus planned will be found on sheets 4, 5, 6, 7, 13 and 15.

The principle governing the Balance of opposite colors will also apply to combinations of three colors. Let us assume that Blue is required as one of the colors in a three-color combination. We find that its opposite Hue is Yellow-Red, and as this is merely an admixture of Yellow and Red, it follows logically that the use of these two Hues, with due regard to proportion of areas or strength of Chroma, will yield a perfect color Balance. In order to determine the correct proportion of areas, or strength of Chroma of Red and Yellow which will bal-

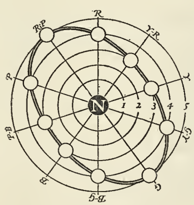


ance harmoniously with our Blue, we may proceed exactly as in the case of a two-color combination of Blue and Yellow-Red; but in this case we would divide the amount or strength of a correct Yellow-Red between our Yellow and our Red. For example, let us take Blue 4/5 and assume that we wish to combine it with a Yellow and a Red of higher Value and stronger Chroma, say 6/7. Following the rule already stated, we multiply the Value of our Blue by its Chroma, that is 4 x 5, which gives the product, 20. Now taking its opposite Yellow-Red at 6/7 and doing the same we get 6 x 7=42. If we were combining Blue 4/5 with Yellow-Red 6/7 we would use their products inversely, that is we would use 42 parts of Blue 4/5 with 20 parts of Yellow-Red 6/7. This gives us the amount of area for Yellow and for Red, because if we would use 20 parts of Yellow-Red, 6/7, it naturally follows that we would use 10 parts of Red 6/7 and 10 parts of Yellow 6/7 to effect the same Balance.

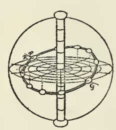
We may note one more interesting point which will be of value in connection with the use of several colors, two of which are of opposite Hues. In studying the dimension Chroma we have seen that all of the Hues cross and meet in the neutral pole, which represents the point of their union. It follows naturally that the nearer our colors approach to this common center (the weaker they are in Chroma) the more nearly they are related; and the easier it becomes to harmonize them. Now two of our Hues being direct opposites will balance each other very well; but in the choice of other Hues between these we shall be in danger of discord as we leave their immediate proximity and arrive at points half-way between them, where we find neither the balance of proximity nor of contrast. We may avoid this danger in the selection of our colors between these opposites by choosing steps of Chroma for them which shall be nearer to the neutral pole and approach to within, let us say, three steps of it. The line thus traced between our opposite Hues will form an ellipse and colors taken anywhere on this line will safely accord. This may be more readily comprehended by a glance at this diagram.



Elliptical path between opposite Hues of high and low Value



The elliptical path



Elliptical path between opposite Hues of same Value and other Hues of high & low Value

This suggests variations in the application of the rule, such as are indicated in the smaller perspectives above, where the elliptical path is shown tilted to different levels of Value.

A further study of Color thus arranged in measurable order will assuredly be rewarded by the discovery of many interesting possibilities which we have failed to note here. The subject is endless and unless this article is to be likewise endless, the few suggestions which it offers must suffice. The deeper we penetrate this always fascinating subject, the more clearly we shall see that "color harmony" is only another term for color *order;* that order will yield order; and that any path in the Color Sphere, and some paths outside it, which are themselves orderly in form and interval, will lead through a series of colors which accord, and when used together will render the agreeable sensation which we seek in all color relations.