Color In The Kindergarten

Milton Bradley Co.
Springfield, Mass.

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For a notice of THE KINDERGARTEN NEWS see last page of cover.

MILTON BRADLEY CO.,

SPRINGFIELD, MASS.

COLOR

IN THE

KINDERGARTEN.

A MANUAL OF THE THEORY OF COLOR
AND THE PRACTICAL USE OF
COLOR MATERIAL IN THE KINDERGARTEN.

BY MILTON BRADLEY.

MILTON BRADLEY CO.,

SPRINGFIELD, MASS.

INTRODUCTION.

Frœbel made no mistake when he included color as a part of the first material used in his system of elementary education. The realm of color is universal; it is the first thing that attracts the child, winning his eye before he pays any attention to form. A bright color is noticed almost as soon as a peculiar noise.

All color comes from the sunlight and is contained in it. When Sir Isaac Newton discovered that a beam of sunlight could be separated into an indefinite number of colors by refraction he opened the way for the first step in color instruction.

In the First Gift Frœbel presents the whole of color, so arranged that it may be separated into its most natural and scientific component parts.

He was wise in selecting six colors for this gift, instead of the seven which had been designated by Newton and generally adopted in the popular consideration of the spectrum.

Very little color enters into the Kindergarten Gifts, except the First. But in the Occupations color has an important place, being represented in the papers, sticks, thread, silk, worsted. beads, etc.

The most valuable color instruction is connected with parquetry and weaving. If a child could be in a kindergarten for two or three years much valuable work in paper cutting might be done. In the cardboard sewing some good color teaching can be begun, but the color surfaces are so small that the effect cannot be as striking as are the results in using the papers.

No exact work can be done in color with the sticks and beads because the natural color of the wood affects the dyes, making them dull, and the use of any material except wood must involve too great cost.

Kindergartners are pleased to remember that elementary instruction in form and color, so far as it has been pursued in any logical way, originated with Frœbel and has been continued in the kindergarten since his time without essential change. With kindergartners it is unnecessary to argue the question why we need to teach children anything about color in these days when we have to teach them so many, many things. Because kindergartners understand that color more than anything else, with the possible exception of drawing, is the connecting link between art and the sciences they readily admit that we should teach it to the children for the pleasure that a correct knowledge of color will give them through life and the profit it will afford them.

As soon as he began to manufacture kindergarten material, nearly twenty-five years ago, the writer faced the difficulties in the way of a clear understanding of color and any attempt to teach the essential facts about it. He found it impossible in buying colored papers from the paper mills or warehouses to match the lots previously purchased with any degree of satisfaction or to insure his customers that any color he had furnished them could be duplicated. There were no generally accepted standards of color and every man set up standards to suit himself, if it ever occured to him that any were necessary.

It was a realization of these facts that led the author to study the color question in its different bearings and to ultimately write and publish "Color in the Schoolroom." Since the appearance of that book the subject has been further developed, and it is with a view of putting the latest discoveries before the kindergartners in a condensed form and of providing them with a guide for the special color work involved in the Gifts and Occupations that the author ventures to offer them this little supplementary book. In this connection he wishes to gratefully acknowledge the enthusiastic help in the experimental study of color which he has received through a term of years from teachers of every grade, from the kindergarten to the university.

SPRINGFIELD, MASS., May 1, 1893.

The Theory of Color.

IN ORDER to think, talk and write about any subject we must have a language or nomenclature by which thoughts concerning that subject may be expressed. Standards of color corresponding to definite names are a pre-requisite to a nomenclature of colors. Hitherto all statements about color have been exceedingly vague, because of the lack of names with which to accurately define the different colors. The solar spectrum, discovered by Sir Isaac Newton two hundred years ago, contains absolutely unchangeable standards on which to base an intelligent nomenclature of colors; but until recently no practical use has been made of them, because while writers on art since Newton's day have referred to the solar spectrum as being nature's chart of colors, they have also proceeded to set up for themselves charts which they have claimed to be superior to that provided by nature.

In the solar spectrum there are six colors which all normally-sighted persons readily select as clearly distinguishable from the others, and they have been named by common consent red, orange, yellow, green, blue and violet. Just why Newton saw and named seven colors instead of six, introducing indigo between the blue and the violet, is not altogether clear. But it is now stated on scientific authority that one person in a thousand seems to have an abnormally delicate sense of color which leads him to select a particular violet blue as having the same or nearly the same definiteness that characterizes the six colors named above, which fact suggests that probably Newton belonged to this class, as he would not have named a color that he did not clearly see. But whatever explanation may be given for Newton's selection of a seventh color, it is now maintained by all who have given the subject careful thought that the six colors furnish a convenient and sufficient number of standards for all practical purposes.

The Theory of Sir David Brewster.

Until very recently the Brewster or red, yellow and blue theory has been the only thing approaching a system accepted by artists and colorists, all else being relegated to the realms of taste and feeling. Both Newton and Brewster believed that the colors of the solar spectrum were produced by the overlapping of three sets of colored rays, red, yellow and blue. The red rays at one end were thought to mix with the yellow rays to make the orange, and on the other side of the yellow the blue rays combined with the yellow to produce green. On the same principle in material colors the orange, green and purple were supposed to be made by the mixing of red, yellow and blue pigments.

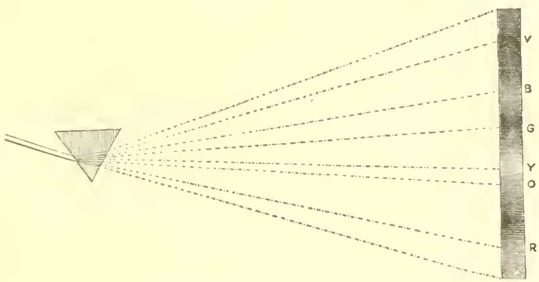
The whole of this theory is practically embraced in the statement that there are three primary colors, red, yellow and blue; that by the mixtures of these three primaries the secondary colors, orange, green and violet, may be produced, and then again the secondaries may be combined in pairs to form the tertiaries, citrine, russet and olive. The advocates of this scheme further assert that the secondaries are complementary to the primaries, the green to the red, the violet to the yellow and the orange to the blue.

But it can now be easily proved that there is nothing of truth in this Brewster theory, either as applied to the science of color or the practical use of pigments. It is at the present time well known that the orange in the solar spectrum is not produced by the overlapping or intermixing of red and yellow rays, but that each separate color or hue in the spectrum has its own wave length and is as much a primary as the red or yellow. It is also equally true that in the pigmentary colors the red, yellow and blue will not produce by mixture an orange, green or violet approximating the other three in tone or purity.

In the system of color instruction advocated in these pages the solar spectrum is accepted as furnishing the standards, but instead of selecting three primaries, red, yellow and blue, six primaries or standards, red, orange, yellow, green, blue and violet are chosen, which with white and black furnish the means for producing scientifically all other colors. Then it will be seen that the three primaries of Brewster are here accepted and definitely determined, and to them are added three others from the same source as that from which he claimed to derive his. Consequently we present the six colors to the child as original standards, instead of teaching him that there are three which must be combined to make the three others, and thus he is taught the truth and not something that will have to be unlearned later.

The Young-Helmholtz Theory.

Opposed to the Brewster theory of color is the Young-Helmholtz theory, which is quite generally accepted by the scientists of the present time. According to this theory all color in nature is contained in sunlight, which is practically white light. When a beam of sunlight, admitted into a darkened room, passes through a glass prism it is spread out like a fan into a band of



beautiful colors, beginning at one end with a dark red, gradually changing to a brighter red, which runs into an orange and then through yellow, green and blue to violet, which gradually fades away into darkness. This is the solar spectrum and the effect is represented by the accompanying diagram.

The explanation of this phenomnon is that the beam of sunlight is composed of a great number of different kinds of rays, which in passing through the prism are refracted or bent from their direct course, and some are bent more than others; the red least of all, and the violet most. It is supposed that light is propagated by waves or undulations, in an extremely rare substance termed ether, which is supposed to occupy all space and transparent bodies. These waves are thought to be similar to sound waves in the air, or the ripples on the smooth surface of a pond when a pebble is thrown into it.

Because so many of the phenomena of light can be satisfactorily explained by this theory it has been very generally adopted by the best scientists. The amount that rays of light are refracted from a straight line in passing through a prism is in proportion to the number of waves or undulations per second, and in inverse proportion to the length of the waves. The red waves are refracted the least and are the longest, while the violet rays are refracted the most and are the shortest.

The wave lengths of our six standards are approximately in the proportions of the following numbers: Red, 6600; Orange, 6100; Yellow, 5800; Green, 5200; Blue, 4700; Violet, 4200; these figures representing ten millionths of a millimeter.

While, as before stated, the adherents of the Brewster theory profess to believe that there are three primary colors, red, yellow and blue, from which all the other colors can be made, the scientists, adopting the Helmholtz theory, claim that in sunlight there are three primary colors, red, green and violet, from which all other colors in nature may be produced, or in other words that there are three color perceptions in the eye, which combine to make all other color effects.

Outside the realm of pure science it is not a matter of interest whether all color in nature is or may be produced from any three color perceptions, because it is easily demonstrated that from no three pigmentary colors can all other colors be made, and in the arts and sciences all artificial color effects are secured by the use of pigments. Therefore because with any three standards the results of pigmentary combinations are very unlike the corresponding combinations of the same standards in colored light this theory is of no practical value.

The Standards Must Be Chosen From The Solar Spectrum.

But if six colors are selected from the solar spectrum and the best possible imitations of them made in pigments, as for example, in colored papers, these colors may be combined with results substantially similar to the effects obtained by corresponding combinations of spectrum colors, except that as the pigmentary colors of the papers fall very far below the spectrum colors in purity and illumination, so their combinations must give results correspondingly below the same combinations of the spectrum colors.

Having already provided the six pigmentary colors just mentioned, with white and black, as standards from which to form and name other colors in terms of the standards, some means for measuring the quantity of each color used becomes necessary. It is impossible to obtain these quantities by measuring or weighing the pigments, because, although the pigment may be weighed or measured, the amount of the color effect cannot be determined in ounces and pints. For example, if we wish to produce and definitely distinguish a special color between green and yellow, it is necessary that we have some means for ascertaining the amount of green and yellow entering into its composition, in order to give it a name of any practical value. But, very fortunately, it has been discovered that if on a white disk of card or other substance sectors of two or more alternating colors are painted, and then the disk placed on a rapidly rotating spindle, the several colors merge into one color which is the combined effect of the several sectors painted on the disk. It is also true that the color effect is determined by the relative number of degrees which measure each of the colors.

If a white disk is divided into four equal parts by two diameters at right angles to each other, and three of these sectors are painted with the standard yellow and one of the parts with the standard green, rotation will produce a green yellow represented by three parts yellow and one of green; or if the disk is divided into 100 parts the result will be 75 parts yellow and 25 green.

If having a prismatic spectrum thrown on a screen in a dark room we hold two small mirrors in the path of the light, one so placed as to receive, for example, the red rays and the other the violet rays, the mirrors may be so moved as to reflect the red and the violet rays on one spot on another screen. The result of this arrangement will be a mingling of the two colors to produce a color between the violet and red usually called purple. And so we may select any other two colors and thus determine what color is produced by the mingling of any two or more spectrum colors. But it is very inconvenient to make such tests, even with the best apparatus and most favorable conditions, and absolutely impracticable in elementary instruction with children.

The Use of the Color Wheel.

Fig. 1.

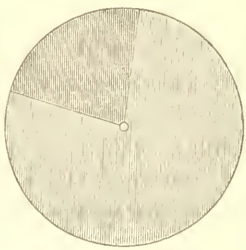


Fig. 2.

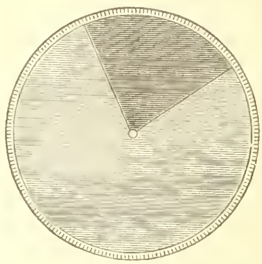


Fig. 3.

It is an interesting fact that the rotation of the disks painted in sectors as above described produces effects practically the same as the mingling of the two reflected lights. This is due to the physiological effect called retention of vision. If we set the end of a stick on fire and rapidly whirl it the appearance of a circle of light is produced because the impression made on the retina of the eye at one instant remains until the end of the burning stick comes around to the same point again, and thus a complete circle of light is seen. The mingling of the colors on the rotating disk is due to the same quality of the eye.

An English scientist, J. Clerk Maxwell, while trying experiments with painted disks less than forty years ago, happily conceived the idea of cutting a radial slit in each disk from circumference to center, so that by joining two slitted disks they could be made to show any desired proportion of each, and hence they are called Maxwell disks.

Fig. 1 shows the method of joining the two disks and Fig. 2 their appearance when properly joined to be placed on the rotating spindle of a color wheel or color mixer, as the apparatus is often called.

Fig. 3 shows two combined color disks ready to be placed on the rotating spindle and with them a large white disk the circumference of which is divided into 100 parts.

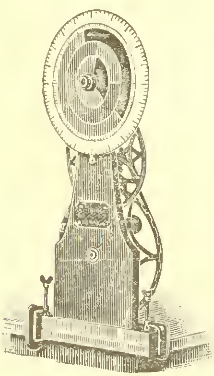


Fig. 4.

Fig. 4 shows a color wheel with a combination of disks on the spindle ready to be rotated.

These disks have heretofore been used as a curious piece of philosophical apparatus rather than as of any practical value in color investigation, but when the idea of basing a color nomenclature on the six spectrum colors was conceived the disks at once assumed a practical value never before ascribed to them, and now are an important factor in the only system of artistic color instruction based on the scientific truths of color.

Let us suppose that the two disks shown in Fig. 2 are green and yellow, but with a trifle less green than in the painted disk above mentioned. The increased amount of yellow and the smaller quantity of green will cause a color to appear by rotation which will be somewhat different from the first-described painted disk. In order to determine by definite measurement how much the difference is we place behind these two united disks a whole graduated disk the circumference of which is divided into 100 parts, as shown in Fig. 3. From this graduated scale we may determine that the green yellow color is composed of green 22 parts and yellow 78 parts. No argument is necessary to prove that where an exactness of color is required it is much better to be able to express a color in such definite terms as are here used than to say that this color is a little "less greenish" than the other.

In the use of the color wheel it should be remembered, however, that a very high rate of speed must be sustained, as many as fifty revolutions to the second being necessary, in order to produce a perfect mixture.

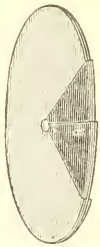


Fig. 5.

Fig. 5 shows three disks joined ready for use on the spindle, and in the same way any number within reasonable limits can be combined so that any two or more colors may be mixed and the composition definitely recorded in the terms of the colors of the disks.

The Old Theories Tested by the Wheel.

As has been stated, the advocates of the Brewster or red, yellow and blue theory claim that orange may be produced from red and yellow. In fact leading educators have said in one breath that "in the solar spectrum, which is nature's chart of colors, the principal colors are red, orange, yellow, green, blue and violet; of these red, yellow and blue are primaries, from which may be made the secondaries, orange, green and violet." Now we can test this statement by the use of the disks.

If red and yellow disks of medium size are joined on the spindle in proportion, and a smaller orange disk is placed in front, the outer ring of color should by rotation match the orange at the center. A trial of this experiment will be not only interesting but convincing. Although the result of the rotation will be a color which might under some circumstances be called an orange, it is in no sense the same color as the spectrum orange at the center.

If we attempt to produce a green by combining the yellow and blue disks the result will be surprising, but probably not convincing, because the statement that yellow and blue make green has been so persistently reiterated as a fundamental axiom that people who have given the subject but little attention will feel that to doubt it is rank heresy. In a text book treating of color is found the following passage: "Green substances reflect the green, i. e., the blue and yellow rays of the sunlight and absorb all the others." It is a fact, however, that in the mixture of blue and yellow light there is little or no trace of green.

If a greenish blue and a greenish yellow are used in the disks, as a matter of course a slightly green effect will be obtained, but with a good standard blue and standard yellow the result is very nearly a neutral gray. It is true that in pigments a dull green can be made from the standard blue and yellow, and from a greenish blue, as Prussian blue, and from a greenish yellow a very fair green can be secured, but in neither case does the result approach the standard green, which has been adopted as the best imitation of the spectrum green.

If red and blue disks are joined a much more satisfactory imitation of the violet may be made than is possible in the orange or the green, but it lacks the purity of the standard violet.

But when these experiments with the disks are presented in argument against the red, yellow and blue primaries, the advocates of that theory claim that in the pigments much better results are obtained, and that in the practical use of color we must depend on pigments, and hence the wheel is of no value in the argument. This view of the case can no longer be maintained, because the day has passed when an intelligent teacher will knowingly ignore the force of an argument backed by scientific facts. True we must use pigments in representing nature, but when nature has provided us with six good pigments for representing her brilliant colors why accept only three and from them make miserable approximations of the other three?

Again, why shall we not consider the effects in nature which are produced by the varying mixtures of colored light, and investigate the principles on which they are produced, even though as artists it becomes our task to imperfectly imitate the colors to the best of our ability with the pigments at our command? If we consider the principles governing the color effects which are presented to our eyes in the ever-changing landscape, can we not much better interpret these effects and thus be better prepared to imitate them on the canvas or the paper? Nearly all color in nature is produced by the combination of local color and reflected colors. Often at evening the sunlight takes on a red glow, caused by the reflected sunlight.

In a room where the windows open on a green lawn with many trees nearly all the light is reflected from green surfaces, and hence is green light. In such a case a correct painting of objects in that room would have a general green effect.

In order to obtain the most truthful effects of color in nature the artist should have sufficient knowledge of the principles which govern the combination of colors by reflected light so that his reason may aid his eyes.

The afternoon light in a room on the west side of a city street may nearly all be red light, reflected from an opposite red brick wall. The writer once experienced a realizing sense of this fact while examining some black goods in a tailor's shop so situated. He complained that they looked brown, but the salesman truthfully replied that the black was a good color, but that in the afternoon the brick wall opposite spoiled the looks of all the black goods.

The story is told of an artist who wished to represent a piece of blue bric-a-brac with a bit of yellow lace thrown on it, but having no lace at hand evolved an artistic production from his limited knowledge of the science of color and gave the surface a green color. Had he known that blue and yellow light combined make gray instead of green he would have avoided the error.

The fact that gray is the product of blue and yellow light is sometimes taken advantage of in forming backgrounds in lithographic printing, in which a stippling of alternate dots of yellow and blue, very close together but not overlapping, is used to produce a beautifully transparent gray much more pleasing than any one tint of gray. This result is due to the blending of the two colors in the eye with the same effect as the colors of two rotating disks are mingled. The fact that there is a difference between the color effects produced by mixing two pigments and the mixing of the light reflected from similar colored surfaces is a very strong argument for a system of color instruction based on disk combinations, rather than on pigmentary mixtures.

A little experimenting with the rotating disks and with pigments will convince any one that the disk combinations form the only possible basis at present known for logical color instruction.

Concerning the Complementary Colors.

Having shown that the three colors red, yellow and blue cannot be combined to make an orange, a green or a violet of a corresponding degree of purity, we will consider the other claim which is set up by the advocates of the Brewster theory, namely, that the secondaries are complementary to the primaries, the green to the red, the violet to the yellow and the orange to the blue.

All color is contained in white light, and if we take from white light any given color, the color remaining is considered the complementary. If a small disk of standard red paper is placed on a white wall and the eyes fixed intently on it for a few seconds, and then the eyes slightly moved back and forth, a ring of a bluish green tint will be seen surrounding the red paper. This is called the accidental color, and is supposed to be identical with the complementary, but the image is too faint to give any very exact color effect. But it is sufficient to give a clue to the complementary, and we are to infer that a color between green and blue is that which is wanted.

If now we can determine in what proportions red, blue and green must be united to produce white light, we may solve the problem. This is not possible in the use of any pigmentary colors, because of the impurity of all pigments as compared with spectrum colors. Although the mixture of colored light reflected from the disks, which are made of pigmentary colors, gives much purer color than the actual mechanical mixture of the two pigments, still, being a reflection of pigmentary colors, it is far from pure, and therefore the result must be a white of a low degree of illumination.

If we hold a white card in a bright daylight introduced through a window into a room, not necessarily direct sunlight, it appears white. If we cast a shadow or shade on a portion of the card by interposing some opaque object, the color is changed, but knowing that it is a white card we do not think of this as another color, but call it a shade. It, however, is in fact a gray, and a peculiar gray called a neutral gray. We can perfectly imitate this gray by combining a white and black disk on the wheel. It is a simple and interesting experiment to see what beautiful grays may be produced in this way.

All such colors are known as neutral grays and they perform a very important part in color analysis, and may be produced by the combination of white and black disks.

Therefore, if red, blue and green disks of medium size are joined on the wheel and in front of them small white and black disks are combined, we have a means for solving this problem. If these various disks can be so adjusted that when rotated the effect of the three colored disks is a neutral gray or white under a low degree of illumination, exactly matching a gray that may be obtained by adjusting the small black and white disks, then one step in the solution is taken, as shown in Fig. 6.

With such an arrangement a very close match is produced, when the combined disks show the proportions to be red, 41½; blue, 22½; green, 36 for the larger disks, and for the small disks white, 15 and black, 85. Now if blue and green are combined in the same proportions, as indicated above and in quantities sufficient when added together to fill the entire circle, of 100 parts, blue will contain 38.3 parts and green, 61.7 parts, as shown in Fig. 7; and the disks when rotated will give the color which is the complementary of red: namely, a blue green.

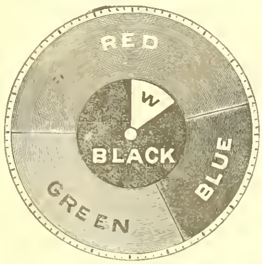


FIG. 6.

FIG. 7.

In the same way the complementary of each of the other standard colors, and, in fact, of any color may be obtained.

The complementary of orange is another color between the green and blue, but more largely blue. The complementary of green is a violet red, and of violet a color between yellow and green, while yellow and blue are very nearly complementary to each other.

Taken together, these experiments prove that the complementaries of the old primaries are not found in the secondaries.

How to Secure a Color Nomenclature.

As has been seen in the use of the green and yellow disks, a variety of hues between two adjacent standards may be produced and thus all the spectrum colors imitated.

The possibility of imitating these colors having been discovered, the way to establish a definite nomenclature of colors becomes plain. Each standard has only to be designated by some fixed symbol and measured by the use of the graduated disk to determine the amount of each color which enters into any given combination. To this end for convenience the following symbols are adopted:—

R for red, O for orange, Y for yellow, G for green, B for blue and V for violet. W serves us for white and B would be adopted for black had it not already been used for blue, and therefore we employ N for the Latin word niger, indicating black. With these symbols and the graduated disk divided into 100 parts we have a perfect and simple decimal nomenclature for all colors which can be made from our standards.

Now let us notice the practical advantage that would result from a general adoption of this nomenclature. Suppose a customer to visit a wholesale dealer in San Francisco in quest of a large quantity of paper of a special color. He has a sample somewhat near the color and presents it to the dealer. This may be a color between orange and yellow, and he says, "I want something a little more yellowish than this." The dealer is an agent for some Eastern manufacturer and is ready to order it, if the customer can furnish a sample, but it is impossible to express in words just how much "more yellowish" the color must be. Also the customer is in great haste and a week's delay for the mail is an important item. But the dealer is provided with a color wheel, a duplicate of which is in use at his mill in the East. Therefore he slips the orange and the yellow disk on the spindle and in a very few minutes the exact color is produced and accepted by the customer. This may be Y. 35, O. 65, and a telegram is sent immediately for 100 reams regular size and weight, color O. 65, Y. 35, and 'tis done, and the next day in a New England mill the paper is being coated with a color exactly the same as that shown on the wheel in the San Francisco store. This is no romance, because we have for years been telephoning colors from our office to the mill, several miles away.

Tints and Shades.

Every color in nature is modified by light. A high degree of illumination, as bright sunlight, reduces the color, forming a tint of the color. If a shadow is thrown on a color it is obscured, until as the shadow deepens the color is lost in darkness. These effects are called shades of color. In pigments tints and shades may be produced by the use of white and black pigments; with the wheel by white and black disks. Neither in pigments nor with the disks are the results absolutely like the real effect of sunlight and deep shadows. In pigments black does not produce as perfect shades as various other dark pigments, while white pigments give fairly good tints.

With the disks the reverse is true, and the black disks give beautiful transparent shades, while the impossibility of securing a perfectly white disk, together with some effect of rotation not perfectly understood, introduces in the lighter tints of some colors a violet gray effect that is not as pure a tint of the color as is secured by the mixture of white pigments. This is most noticeable in the red and the blue. It is not seen in the violet, and appears very slightly in the orange and green and but little in the yellow. On the whole the disk combinations of colors are much purer than the mixture of the same colors in pigments, and the quantity of each can be measured and recorded.

The shades of yellow as shown on the wheel will not be readily accepted, but careful comparison with the yellow paper in shadow proves that heretofore an orange yellow shade has been used for a yellow shade.

As much dissatisfaction had been expressed with the papers provided for the kindergarten, this scheme of color was first applied to the production of a systematic line of such papers. First the six standards and black and white were made and then two spectrum colors between each two standards, so as to provide eighteen spectrum colors, which are considered sufficient for types of all the pure colors in nature. Lastly two tints and two shades of each were made.

Scales of Color.

When we arrange one of the spectrum colors with its tints on one side of it and its shades on the other, in regular order, from lightest tint to darkest shade, a color scale is formed, as shown in each of the horizontal lines in the following chart. Each color is called a tone of the scale and each scale consists of five tones. The standard or hue is called the key tone; hence we speak of the red scale or the blue green scale.

Now when we place a series of scales with the key tones in the same order as found in the spectrum we have an arrangement like that illustrated in this "Chart of Spectrum Scales."

R. V. T. 2.	R. V. T. 1.	R. V.	R. V. S. 1.	R. V. S. 2.
V. T. 2.	V. T. 1.	V.	V. S. 1.	V. S. 2.
B. V. T. 2.	B. V. T. 1.	B. V.	B. V. S. 1.	B. V. S. 2.
V. B. T. 2.	V. B. T. 1.	V. B.	V. B. S. 1.	V. B. S. 2.
B. T. 2.	B. T. 1.	B.	B. S. 1.	B. S. 2.
X. G. B. T. 2.	X. G. B. T. 1.	X. G. B.	X. G. B. S. 1.	X G. B. S. 2.
G. B. T. 2.	G. B. T. 1.	G. B.	G. B S. 1.	G. B. S. 2.
B G. T. 2.	B. G. T. 1.	B. G.	B. G. S. 1.	B. G. S. 2.
G. T. 2.	G. T. 1.	G.	G. S. 1.	G. S. 2.
Y. G T. 2.	Y. G. T. 1.	Y. G.	Y. G. S 1.	Y. G. S. 2.
G. Y. T. 2.	G. Y. T. 1.	G. Y.	G. Y. S. 1.	G. Y. S. 2.
Y. T. 2.	Y. T. 1.	Y.	Y. S. 1.	Y. S 2.
O. Y. T. 2.	O. Y. T. 1.	O. Y.	O. Y. S. 1.	O. Y. S. 2.
Y. O. T. 2.	Y. O. T. 1.	Y. O.	Y. O. S. 1.	Y O. S. 2.
O. T. 2	O. T. 1.	O.	O. S. 1.	O. S. 2.
R. O. T. 2.	R. O. T. 1.	R. O.	R. O. S. 1.	R. O. S. 2.
O. R. T. 2.	O. R. T. 1.	O. R.	O. R. S 1.	O. R. S. 2.
R. T. 2.	R. T. 1.	R.	R. S. 1.	R. S. 2.
V. R. T. 2.	V. R T. 1.	V. R	V. R. S. 1.	V. R. S. 2.

CHART OF SPECTRUM SCALES.

It will be noticed in this diagram that three scales intermediate between blue and green are shown instead of two, as between each other two standards. The color nearest the blue marked X. G. B. is introduced to bring the spectrum nearer perfection, but is not necessary in elementary work.

One of the chief aims of color instruction is the harmonious combination of colors, and this chart serves as the basis of the theory of harmonies.

Classification of Harmonies.

While it is not to be supposed that the theory of harmonies can be taught to kindergarten pupils, the laws of harmonies are here briefly outlined for the teacher, so that all the use of colors may be such as shall not violate these elementary laws, even though the limitations of the material employed render impossible the most subtle and perfect harmonies.

The value of a given harmony depends on the hues, tones and quantities of the several colors used. This is a subject about which it has thus far been impossible to profitably talk or write because of the lack of definite standards of colors and color terms on which to base statements of facts or proposed theories, but with these supplied by the color wheel we may hope for rapid advance in the near future.

For the present the division of harmonies into classes is very much a matter of personal opinion, because our knowledge of the principles governing harmonies is as yet so limited, but Mr. Henry T. Bailey, State Supervisor of Drawing in Massachusetts, has suggested a classification which seems to be better than anything else proposed, in which he classes all harmonies under these five heads: Contrasted, Dominant, Complementary, Analogous and Perfected.

Contrasted.—The contrasted harmonies are those in which color is contrasted with non-color, or more accurately in which an active color, that is, a tone from the spectrum circuit, is contrasted with a passive color, white, black, gray or silver and gold; for example, a blue green tint with white, or green blue with warm gray No. 1.

Dominant.—By dominant harmonies we mean those in which are combined different tones in one color scale. For example, red tint No. 1, red shade No. 1, or green blue tint, green blue, green blue shade. A dominant harmony composed of grays, or white, gray and black, is sometimes called a neutral harmony.

Complementary.—This term refers to those harmonies in which are combined opposite or complementary colors in the spectrum circuit. The best of them are those which exhibit not only opposition in color but also opposition in tone. That is, tints of one color with shades of its complementary produce a more pleasing effect than do complementaries of equal value. The best complementary harmonies contain one or more passive colors.

Analogous.—This name is applied to those harmonies in which are combined tones from analogous scales. The best analogous harmonies are produced when we take tints from one side of the key tone and combine them with shades from the scale on the opposite side of that containing the key tone.

Perfected.—By perfected harmonies we mean those in which analogous colors are combined with the complementary of the key color, as yellow green tint, green, blue green shade, with violet red. Also those in which the effect of one analogous harmony is complementary to the effect of another. All coloring in nature and in the examples of the best historic art will be found to conform to one of these five harmonies.

From the fact that this division of harmonies is based on the science of color we must not suppose that it furnishes any definite rules for forming the best harmonies. With our present knowledge rules can only at the best prevent certain absolutely bad combinations and give indications of the best effects. The best harmonies can at present only be determined by a consensus of the opinions of trained artists in color. But the immediate value of a scheme of color with a nomenclature of color based on standards will be found in the possibilities it offers for discussion by means of verbal and printed reports of the experiments and opinions of artists and of their productions.

The ultimate value of this system may be seen in the possibility of formulating rules for a very large number of the best harmonies based on the average opinions of many artists and expressed in the terms of our nomenclature.

Broken Colors.

In addition to the spectrum standards and intermediate hues and their tints and shades which are included in the chart of spectrum scales, there is another class of colors which in general terms may be called broken colors, or gray colors.

A broken color, as a broken red for example, is a standard red mixed with neutral gray, that is with black and white. In still other words, a broken color is a tint of that color in shadow; or again we may say it is a shade of a tint or a tint of a shade.

In nature nearly all colors are broken. First, there is always more or less vapor together with other impurities in the air, so that even in a clear day objects a few hundred feet from us are seen through a gray veil, as it were, and in a misty or hazy day this is very evident. In the case of somewhat distant foliage the general color effect is produced by the light reflected from the aggregation of leaves, some of which may be in bright sunlight and others in shadow, with a mixture of broken twigs. All these tints and shades of green and brown are mingled in one general effect in the eye. Also, owing to the rounded forms and irregular illumination of objects, we see very little full or local color in nature.

Therefore the study of broken colors becomes the most fascinating branch of this whole subject. It also has an interest because nearly all the colors found in tapestries, hangings, carpets, ladies' dress goods, etc., come under this head. In fact it would be hazardous for an artisan or an artist to use any full spectrum color in his work, except in threads, lines or dots. A considerable quantity of pure, standard green, for instance, would mar the effect of any landscape.

It is a very interesting diversion to analyze samples of the dress goods sold each season under the most wonderful names. For example, "Ecru" is a broken orange yellow, with a nomenclature of O.12, Y.15, W.17, N.56. "Lin," is quite different in color, but the difference is largely in the quantity and proportions of white and black, thus: O.7, Y.6, W.6, N.81. "Styx," is a broken red, thus: R.10, W.21, N.69; "Ashes of Roses" is a broken violet red, thus: R.8¼, V.2¼, W.15½, N.74; "Hanneton," is a broken orange: O.7¾, W.9¼, N.83; "Old Rose," broken red: R.65½, W.24½, N.10; "Oasis," broken yellow green: Y.7, G.10½, W.8½, N.74; "Empire:" G.18½, B.11, W.16½, N.53.

So we might analyze "Elephants' Breath," "Baby Blue," "Nile Green" "Crushed Strawberry" and hundreds of other names used by the manufacturers and dealers, but while the same names occur with considerable regularity each season the colors change with the demands of the goddess of fashion.

The names of a number of natural pigments have heretofore been the best-recognized standards for color names, and among these are "Vermillion," "Burnt Sienna," "Raw Sienna" and "Indian Red."

The following are the analyses of three samples of vermillion of the best tube oil colors in the market: R.80, O.14, W.6; R.87, O.8, W.5; R.50, O.24, N.26.

These three samples of "Burnt Sienna" analyze as follows: American, R.1½, O.6, W.3, N.89½; German, R.22½, O.11½, W.2, N.64; French, R.25, O.12½, W.5½, N.57.

Similar samples of "Raw Sienna" analyze as follows: O.18½, Y.6½, N.75; O.17, Y.14, W.1, N.68; O.8½, Y.3½, W.2, N.86.

Two samples of "Indian Red" analyze as follows: R.11½, O.7, W.4, N.77½; R.13½, O.13½, W.2½, N.70½.

From these figures it is readily seen that no use of pigmentary names can be relied on for a nomenclature.

The So-called Tertiary Colors.

In the Brewster theory of color the tertiaries hold an important place, they are spoken of as a specific class of colors, and are divided into three different lines, namely: "Citrines," "Russets" and "Olives."

It is claimed that the union of orange and green makes citrine; of orange and of purple, russet; of green and purple, olive. It must be evident to every one giving the subject any careful thought that as in this system orange is, for example, a mixture of red and yellow in indefinite proportions, and green is the mixture of blue and yellow in various quantities, the name citrine can have no definite meaning, as the orange may be any color from red to yellow, while the green may be a mixture of blue and yellow pigments in any proportion, so that if these indefinite secondaries are mixed in indefinite proportions the result must be very dissimilar.

Moreover, although the names citrine, russet and olive are familiar and convenient terms for three general classes of colors, it is probable that no two persons would agree very nearly as to any single color best representing either class.

There are various colors which are recognized as coming within the line of citrines. The following are analyses of two which may be considered fair samples: First, O.2½, Y.8, W.6½, N.83; second, O.4, Y.19½, W.3, N.73½. Both are broken orange yellow, but the last is much less broken and much lighter.

An analysis of two examples of olives gives G.13, B.6, W.12, N.69, and G.19, B.11½, W.10½, N.59. The last is lighter and much less broken than the first, having 30½ parts of color, while the other has but 19. Both are broken blue greens.

From two samples of russet we get R.36, O.4, W.9, N.51 and R.47, O.7, W.8, N.38. The latter has more color, i. e., is less broken, and is also lighter. Both are broken blue greens.

So in all these cases we have for the term citrine a gray orange yellow; for olive, gray blue green, and for russet, gray orange red, each of which is a spectrum hue mixed with white and black.

Probably many people will think that these combinations of color do not express what they mean when they say citrine, olive or russet, which shows that some more definite terms are required than those which we are accustomed to use.

How the Grays are Classified.

As we have seen that a broken color is a gray color, if, for example, we add more black and white to a russet which is a gray orange red, reducing the proportion of color at the same time, we shall pass the line where it should be called a gray orange red or a russet, and shall have a russet gray, or a gray with a little red and orange in it, i. e., a warm gray.

If the olives are treated in the same way we have cool grays. If we take only white and black we have neutral grays. If a little green is mixed with neutral grays we have a line of green grays. Thus all grays may for convenience be classed as neutral, warm, cool and green grays.

The term warm color is applied to any color at the red end of the spectrum, including red, orange and yellow. The green blues, blues and violet blues, with possibly the violet, may be called cool colors, while the green is a doubtful color in this sense.

Simultaneous Contrasts.

The subject of Simultaneous Contrasts is very interesting and relates to the mutual effect that two colors have on each other when placed in juxtaposition. Much has been published on this subject, entire books having been written regarding it, but they have been of comparatively little value, because of the lack of any definite standards of color, and hence the lack of any clear statement about the colors to which they refer. Therefore it has been impossible for a reader or a student to exactly repeat the experiments described.

A very good illustration of the effect of Simultaneous Contrasts may be seen by first mounting on a piece of cardboard one square each of the six standard colors and pasting on the center of each a smaller disk of some gray, a dark neutral gray, for example. When this is done it will be difficult for the person making the experiment to convince another that all the gray disks came from the same sheet of paper.

A Review of the Bradley Color Scheme.

To sum up briefly the Color Scheme which the writer has tried to present in the foregoing pages, it may be stated as follows :—

First, six standard colors are selected from the solar spectrum and their locations absolutely fixed by their wave lengths, so that they can at any future time be referred to for comparison with pigmentary colors.

Second, the best possible pigmentary imitation of these six colors are made, which, with the purest white and blackest black form eight standards of color. From these pigmentary standards Maxwell disks are made, by which intermediate spectrum hues are determined and named, and by which a complete and simple nomenclature of colors in terms of the standards is possible and practicable. In accordance with this nomenclature a line of colored papers has been prepared for elementary instruction in color.

This system of color instruction is based on the belief that the study of color as seen in nature should be the first thing to occupy our attention and that the art of mixing pigments to produce corresponding effects will be a very simple matter to one who has the color sense properly trained.

Some Color Definitions.

All color terms used by artists, naturalists, manufacturers, tradesmen, milliners and the members of our households are as indefinite as one might naturally expect from the utter lack of a logical basis for the whole subject of color.

Without definitions or means for intelligently naming any color, it is not strange that the terms used in speaking of colors and color effects are so contradictory as to lose much of their force, if perchance they retain anything of their original meaning. For example, probably most people apply the term SHADE to any modification of a color, either a hue, tint or shade.

It is true that a concise and reasonably full dictionary of color terms must be the outcome of long experience in the study of the science of color and its use in our every-day lives, and at the best only suggestions can be made at present. But as there must be a beginning and some terms seem to be fairly well established, the following incomplete list of definitions is offered, always subject to amendment by the majority vote, for whenever such changes indicate advance they should be welcome.

Standard Colors.—As used in this system of color nomenclature, the best pigmentary imitation of each of the six spectrum colors red, orange, yellow, green, blue and violet, and black and white.

Pigmentary Colors.—All colors used and produced in the arts and sciences. This is in distinction from colors seen in nature, as in flowers and the solar spectrum. The term refers not only to pigments in the strictest sense but to all surfaces coated, painted or dyed artificially.

Pure Colors.—A pure or full color, also called a saturated color, is the most intense form of that color without the admixture of white or black or gray. All spectrum colors are pure, while no pigmentary color is absolutely pure, but the pigmentary color which approaches most nearly to the corresponding color in the spectrum must be selected as the pigmentary type of purity for that color. For example, the standard for green must be the best possible pigmentary imitation of the spot in the spectrum which by general consent is called green, and so not only for the six standards but for all their combinations which produce the other colors in nature.

In pigmentary colors the term pure is entirely one of relative degree. As processes of manufacture are improved and new chemical discoveries made, there is good reason to believe that we shall have much more intense colors and hence much better imitations of spectrum colors than are at present possible. Therefore as our pigments become purer those now accepted as full colors will in time become tints or broken colors and new standards will be adopted.

Hue.—The hue of a color is that color mixed with a smaller quantity of another color. An orange hue of red is the standard red mixed with a smaller quantity of orange. With the disks pure hues are secured only by mixing two standards adjacent in the spectrum circuit.

Local Color.—The term applied to the natural color of an object when seen in ordinarily good daylight and at a convenient distance, as a sheet of paper at arms length, a tree at twice its height, etc.

Tint.—Any pure or full color mixed with white, or reduced by strong light. In the disk combinations a spectrum disk combined with a white disk.

Shade.—A full color in shadow, i. e., with a low degree of illumination. In disk combinations a disk of a spectrum color combined with a black disk produces by rotat'on a shade of that color. In pigments the admixture of black does not usually produce as satisfactory a shade of a color as may be secured with some other pigments, and each artist has his own preferences in making shades of the various colors on his palette.

Scale.—A scale of color is a series of colors consisting of a pure or full color at the center and graduated by a succession of steps to a light tint on one side and a deep shade on the other.

Tone.—Each step in a color scale is a tone of that color, and the full color may be called the normal tone or the key tone. In art this word has had such a variety of meaning as to render it very convenient for Amateur Art Critics, together with such terms as breadth, atmosphere, quality, values, etc., but in the consideration of color it should have this one, definite meaning.

Warm Colors.—Red, orange and yellow, and combinations in which they predominate.

Cool Colors.—Usually considered to be green, blue and violet, and the combinations in which they predominate. But it is, perhaps, questionable whether green and violet may properly be termed either warm or cool. The term cool as applied to colors is quite indefinite, except in a general way, but red, orange and yellow are universally considered as warm, and blue and green blue as cool.

Neutral Gray.—Pure black and white mixed by disk rotation, or white in shadow. Black and white pigments mixed do not usually produce a neutral gray, but rather a blue gray.

Warm Gray.—A neutral gray with the admixture of a small quantity of red, orange or yellow.

Cool Gray.—A neutral gray with a small quantity of a cool color.

Neutral Colors.—A term usually applied to gray, white, black, silver and gold; but the term PASSIVE COLORS has been suggested as better, with ACTIVE COLORS for the pronounced colors, such as the spectrum colors and their combinations. This suggestion is made because the word neutral should be confined to black and white and their combinations, while the term passive can be used more broadly.

The term neutral has also sometimes been improperly applied to all grays and very broken colors.

Broken Colors.—Often improperly called broken tints. For simplicity a tint is described as a pure color mixed with white, and a shade as the color mixed with black; the corresponding broken color is the same color mixed with both black and white or neutral gray. A tint of a color thrown into a shadow or a shade of a color in bright sunlight gives a broken color. For various reasons a very large proportion of the colors in nature are broken. Broken colors are much easier to combine harmoniously than full colors, or even tints and shades.

In disk combinations when a pure color is combined with both a white and black disk the result will be a broken color. When a color is mixed with both black and white, i. e., with gray, and becomes thereby a broken color, it then belongs to a broken scale and has no place in any pure scale, i. e., a scale in which the key tone is a pure color. Neither has a broken scale of a color any place in a chart of pure scales or spectrum scales.

Luminosity.—The luminosity of a color is determined by comparing it with a neutral gray. When a color seems to be of the same brightness as a given neutral gray, i. e., not lighter nor darker, then that gray is its measure of luminosity.

Potentiality.—The ability or strength of a color to effect other colors by combinations with them. For example, white has a greater potentiality than black, yellow greater than red, and violet the least of all the spectrum colors.

Ray of Light.—The finest supposable element of light-impression in the eye.

Beam of Light.—A number of rays.

Quality.—This term seems to be used rather indefinitely when applied to color, but perhaps it is not far removed from the term hue or kind of color.

Value.—This word as applied to art is much abused and one which gives trouble to many. It may be difficult to define this term, although it has a very definite meaning to the artist. It is the one subject which must be carefully considered by the engraver or artist who attempts to interpret nature in black and white. It is the thing that the photographic plate usually fails to give in color subjects.

Complementary Colors.—As white light is the sum of all color if we take from white light a given color the remaining color is the complement of the given color. When the eye has been fatigued by looking intently for a few seconds at a red spot on a white wall and is then slightly turned to the wall, a faint tint of a bluish green is seen, and this is called the accidental color of the red, which is supposed to be identical with its complementary color. If with the disks we determine a color which with a given color will produce by rotation a neutral gray, we have the complementary color more accurately than by any other means at present known in the use of pigmentary colors.

Harmony.—Two cólors are said to be in harmony or to combine harmoniously if the effect is pleasing when they are in juxtaposition or are used in a composition.

Spectrum Circuit.—If a pigmentary imitation of the solar spectrum with the addition of violet red at the red end and red violet at the violet end be made, and the two ends joined, we shall have a spectrum circuit. This may be in the form of a circle, an ellipse or an oval.

Primary Colors.—In the Brewster theory, red, yellow and blue. In the Young-Helmholtz theory red, green and violet are termed primary colors because it is supposed that from these three sensations all color preceptions are experienced. But this theory is questioned by many scientists to-day. Practically every spectrum color is a primary, because each has its own wave length.

Secondary Colors.—In the Brewster theory orange, green and purple are called secondary because it is claimed that they are produced by the combination of primary colors in pairs.

Tertiary Colors.—A term used in the Brewster theory to denote three classes of colors called russet, citrine and olive, made by mixing the secondaries in pairs. These are all broken spectrum colors. The orange and purple produce russet; the orange and green form citrine; the green and purple, olive. There seems to be no good reason for perpetuating the indefinite terms secondaries and tertiaries as applied to color.

Color Material in the Kindergarten.

THE object of this section of our manual is to suggest some methods for the presentation of color to the kindergarten children through the material used. Color is so universal that almost everything around us furnishes some lesson, when the teacher and the children have once learned to heed it.

No real kindergartner will for a moment conclude that because certain suggestions are printed in a manual of instruction such methods are to be followed to the exclusion of all others. But if enough examples are here shown and the reasons given why they are used, the teacher may readily judge whether certain other methods which may suggest themselves to her mind may be substituted without violating any fundamental principle.

The teaching of color when properly conducted is certain to be interesting to both teacher and pupil. It is not an isolated study, but is closely connected with other educational topics and with our daily lives.

As the study of language which taught the child to express himself correctly only in the lesson of the day would be almost worthless, and the reading lesson would be of little value which simply taught the pupil to read one text book, so that color instruction is valueless which does not bring something more than the mere pleasure to be derived from it for the moment. It should lead the pupil to closer observation, to see color where he has never thought of looking for it, to discover harmonies where he never knew before they could be found, and should ultimately lead him to the practical application of what he has learned in the arts and manufactures.

The method of development and the length of the lesson must be left largely to the teacher's judgment. Each lesson should be carefully prepared, and in developing the lessons there are three important topics to be remembered and held definitely in mind by the teacher, namely: Recognition, arrangement and use. The child should be taught to recognize the particular colors, to know them wherever he sees them, just as he would know a familiar face; he should be able to arrange spectrum colors in their proper order and to use them in making harmonious combinations.

Short lessons are recommended, as experience proves that ten or fifteen-minute lessons accomplish better results than longer ones.

As the sun is the source of all color in nature and the solar spectrum the chart of color standards, the child should first be made familiar with the spectrum.

The Prismatic Spectrum.

A cheap glass prism which can be bought for a few cents will serve the purpose of the kindergarten in the absence of the expensive one sold with an ordinary outfit of physical apparatus. As no kindergarten ought to be held in a room devoid of sunlight it is well to allow one or more prisms to so hang that the children may see a spectrum somewhere in the room much of the time.

To show a clear spectrum bright sunlight is essential and a clear day desirable, as light clouds dim the brightness of the colors. Hold the prism with as steady a hand as possible and a little experimenting when no children are present will determine the best location for operating. If there should be inside or outside blinds the effect will be greatly improved by closing them, so as to darken the room as much as possible. But even without a darkened room a color spot can easily be shown.

The spectrum may be thrown wherever the colors can be seen clearest, whether it be on the wall or on the floor. Some colors develop brightest in one place and some in another. So when a particular color is to be studied the spectrum must be presented where that color can be seen most favorably.

Look at the spectrum as a whole and what can be seen? First call the particular attention of the pupils to the outside colors of the spectrum, the red and violet; next take the two colors which follow these, namely, the orange and blue, and lastly study the green and the yellow, the central colors of the spectrum band. This order seems to be the best to follow. The orange very likely may be found to be the most difficult one to handle, and therefore will require greater care.

The Colored Papers.

Distribute samples of colored papers in the six colors, red, orange, yellow, green, blue and violet. Ask the pupil to match the outside colors of the spectrum in the paper. Ask for the names of these colors; match colors next to these in the same way, and lastly match the central ones. Tell them that all these colors and many more are in the sunlight, and see if the spectrum reminds them of anything they have seen before, as the rainbow or the sun shining through a glass of water.

Call attention to the fact that these six colors are the ones most clearly seen in the spectrum, and tell the pupil they are called the spectrum standards. These colors must be observed until they become fixed standards, the child's own property just as much as the mental image of the ball, cube or cylinder.

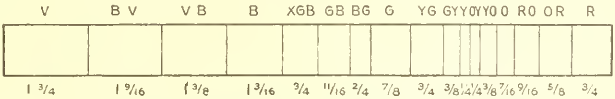
Each standard must be made the subject of particular study, and fixed in the mind by comparison with the spectrum. If the child thinks when he sees red, "This is like my spectrum red," and forms a correct conclusion, he is ready for orange, and so with each of the colors.

If it were possible at each lesson to show the children a spectrum in a perfectly dark room they could get a definite idea of the exact red, orange, yellow, etc., but as this is impracticable, and on very many days no natural spectrum can be obtained, a paper spectrum is a valuable substitute for general instruction. From the colored papers a very pleasing and valuable imitation of a real solar spectrum can be made. This will have the six standard colors and two intermediate colors or spectrum hues between each two standards, with the violet red at the red end and the red violet at the violet end. While these colors are not found in the spectrum, they are frequently met in nature and form a complete spectrum circuit.

The Rainy-day Spectrum.

This paper spectrum has been aptly termed a "Rainy-day Spectrum."

The following diagram gives the dimension of the space to be occupied by each color in a well-adjusted prismatic solar spectrum, with a length of thirteen inches outside the red and



violet. The artificial spectrum becomes a necessity for use instead of the "real spectrum" when the consideration of the intermediate hue is taken up, because, except with a long spectrum in a dark room, nothing more than a general impression of the color of the six standards can be obtained from a sun spectrum.

During their early lessons the teacher should ask the children to bring from home samples of the color which they are studying. Bits of worsted and silk or of cloth or paper, together with plants, leaves and flowers will answer the purpose.

Allow the children to group the colors that are similar and develop the idea of resemblance and difference of colors and bring out the fact that while there are many similar colors there is only one standard of a color, and to the standard colors we give the names red, orange, yellow, green, blue and violet, and by these standards all colors are tested and classified, and hence the importance of training the eye to recognize the spectrum standards readily.

Ask for any sample of red that may have been brought. If those are produced which do not match the standard tell the children that they are not pure colors but are mixed with black, white or both or some other color. They may also be told that pure colors are not necessarily the most beautiful in combination. Talk about the colors in nature and tell them there is but little pure color seen there, for the reason that the spectrum colors are subdued by the gray of the atmosphere.

With this brief general introduction of the subject, a definite line of work is suggested with the apparatus and material which is recommended for the entire kindergarten course. As this relates exclusively to the color work, no connection with other work is indicated and each teacher must use her own judgment as to place and seasons for making the connections.

Value of the Color Wheel.

Some educators who recognize the value of the color wheel in determining facts regarding color and in establishing a nomenclature on which the practical analysis of colors may be based are somewhat in doubt as to its value in the kindergarten and lower grades of school, and need a little information on this point in order to be convinced that it has its place here, while there are others who favor its use in these very grades, but are not sure how best to apply it and are also asking for light in the same direction.

Many teachers who have made the trial are convinced that this apparatus is fully as useful in the lowest grades, as in the higher, and it is with that belief that the following suggestions are offered.

The color wheel is of great value in the lowest grades, because with it a large class can be taught as rapidly and as thoroughly as a single pupil, and a great number of color combinations can be produced with a facility and in a purity of color not possible with any other apparatus or material.

In the use of pigments in elementary grades the teacher is confined to water colors or colored crayons, both of which are very imperfectly adapted to gain satisfactory results. With water colors in cakes or tubes it is impossible for an expert to evenly cover any considerable surface with a color approaching a pure tone, and as commonly used the result is a mere tint of the required color. The same thing is equally true with colored pencils, while pastels are evidently unfit for little children to handle in the kindergarten or the schoolroom.

As soon as the children have become familiar with the standard colors by the use of colored papers they can be taught to recognize the tints and shades of those standards, although some teachers maintain that the spectrum hues between the standards should be next considered, leaving the tints and shades till later.

The majority of kindergartners, however, have thus far preferred to teach the various tones of each standard color before introducing the subject of hues, although many have not thought it wise to at once use the terms tints and shades, rather preferring to call them light and dark colors. The children may be asked to bring red objects, and thus make a collection of all sorts of reds. The simplest and first classification will naturally be into light and dark reds. With the wheel many of these colors can be imitated by using red with white or black.

It will no doubt be found that the reds will also differ in hue, having either orange or violet mixed with them, together with white or black, and probably both. But at first a little care must be used in the selection of such as can be nearly imitated on the wheel with red and white or red and black disks, without the use of white and black in one color. The children will then see that the standard modified by the white produces the light red and that the shades are formed by using the black disks. This fact having been taught in a general way from the samples brought in, may then be shown more systematically by the use of a red disk combined with a somewhat smaller black or white disk. First show the full red disk in rotation and then add a small amount of black and rotate again. This will give a ring of pure red at the outside and a slightly darker red at the center. By repeatedly adding a little more black a series of shades of red may be seen.

In the same way the light reds may be indicated by using the white disk instead of the black. For reasons already explained on Page 19 it is not well to show very light tints in red and blue on the wheel, but when the fact is made clear that white mixed with the color results in a light red and black produces dark red, the papers in tints and shades may be introduced as good examples of these tones.

In the next lesson when orange is considered there will be no difficulty regarding the truthfulness of the tints made on the wheel, even when they are very light, but at first the little child will not be able to connect in his mind a very light tint or a very dark shade with the standard. Each standard will perhaps afford sufficient interest for one exercise, as ten minutes is long enough for little children to be occupied with one lesson. No child should be less than ten feet distant from the wheel in order to secure the best effect.

Spectrum Hues.

Having become familiar with the standards the child knows red and also orange, for example, and may now be shown that there are a very large number of colors between the red and the orange. With the red and orange disks combined, all the hues between red and orange may be made familiar to the class. As there are four sizes of disks, we will designate them 1, 2, 3, 4, No. 1 being the smallest.

A sample lesson may be as follows: Show a red disk No. 3 and ask what color it is; also an orange disk No. 2 with the same question. Combine the two disks on the spindle with the edge of the orange disk merely caught on to the red, but not projecting far enough to be noticed by the children, and rotate, showing them that it is red. Then stop and add a little orange, calling attention to the addition. Rotate and ask if they see any difference between the outer and inner part of the disk. By short steps add more orange so as to show a succession of colors between red and orange, calling these orange reds, until the amount of orange nearly equals the red.

Before reaching equal parts of orange and red, remove the disks and substitute orange disk, No. 3 and red disk, No. 2. Begin at full orange and work back through several steps nearly to one-half red, teaching that these are RED ORANGE HUES. As there is no definitely-established line of division between the class of colors called "orange red" and "red orange" which can be explained to the children the changing of the disks and reversing of the relative sizes serves to separate in their minds the colors as indicated by the change of name from "orange red" to "red orange."

The hues between two standards is sufficient for one lesson, and with each lesson the corresponding samples of papers should be shown.

Tints and Shades of Hues.

The tints and shades of hues can be shown by using a white or black disk with the two combined color disks. In this case, however, all the disks should be of one size. The No. 2 disks are very convenient for a small class, as they give sufficient surface and whirl with less effort than a larger size.

In showing tints and shades of an orange red, for example, it is desirable to keep the relative proportions of orange to red approximately constant, while the amount of white or black is increased at each step. For example, if at the beginning the red was twice as much as the orange the same proportion of two to one should be continued as white or black is added. In presenting these experiments to the children it is unnecessary to accurately measure the quantities of the color each time, but by starting with approximately equal parts or a proportion of one to two or one to three, for example, it is not difficult to retain nearly the same proportions throughout a series of tones.

Experiments will demonstrate that the color sense of even young children can be developed to a wonderful degree by these simple experiments, and they will very soon learn to speak of colors in terms as definite as those now used by the kindergarten children concerning form.

A few years ago it would have been a circumstance worthy of notice if a child should have used the terms sphere, cube, cylinder, hexagon or pentagon, but in families where there are kindergarten children these terms are now household words. Largely owing to the kindergarten the days of "baby talk" have passed away and there is no reason why definite terms in color nomenclature may not be as common in the next decade as are mathematical terms to-day. In nature study this reform is making rapid progress, and it has been demonstrated that the child can as easily learn a scientific name of a part of a plant or an animal as some other word relating to it that really means nothing.

A little child who had become somewhat familiar with the color wheel one day said to the teacher, "What color do you think that dress is?" referring to a suit of the so-called "mahogany color." Wishing to test the judgment of the child the reply was, "What do you think it is?" The child replied, "Well, I rather think it is a shade of red orange," which was a very close description of the color. And why is it not better to say a dark red orange than "mahogany color," if any definite color expression is required?

The children may be allowed to bring samples of cloths, or flowers for analysis and after they have had some practice may be asked, before the experiment is made, what colors they think should be combined to produce the same effect on the wheel. The colors of fabrics will very generally be broken colors, requiring the use of both black and white disks, and very frequently will be broken intermediate *hues* rather than standards. All this need not be told the children, but they may be shown the disks which by rotation form an imitation of the color and their attention called to the colors and the relative proportions in which they appear. They thus see an actual chart of the color expressed in standards.

In analyzing the colors of flowers they will generally prove to come near to the spectrum colors or their tints and can be quite readily imitated, especially those of the wild flowers.

In pansies and a few other flowers the colors may be too intense to be imitated with the disks, because the natural color is purer than any corresponding pigments yet discovered, from which to make the paper disks. If such a case occurs the same *kind* of color can be made and thus a name given, even though an exact match in purity cannot be produced.

It is reasonable to expect that in due time such an advance in practical chemistry may be gained that much purer and stronger color effects can be obtained in pigments and thus the scope of color analyses enlarged.

The following exercise in color may be introduced as a recreation, after a class has made considerable progress. Make a combination of two or more disks, holding them meanwhile so that the pupils cannot see them, and have an assistant hold a sheet of cardboard or other screen in front of the wheel while the disks are being adjusted on the spindle and until a good speed has been secured in the rotation. Then ask the class what colors are mixed to produce the effect. Having secured some guesses from the pupils, let the rotation cease and the children will see exactly the disks which have been combined to make the color and also will learn objectively the relative proportions of the several colors used, as measured by the surfaces exposed in the several disks.

In the the theory of color presented in this manual the complementary and perfected harmonies are based on the complementary colors as determined by the use of the color wheel, but it is doubtful if those experiments should be shown kindergarten children, and possibly the contrasted and dominant harmonies are as many definite divisions of the subject as can be profitably named to them. But combinations of the papers in analogous and complementary harmonies may be used with the little children.

The analogous combinations may be derived from the chart of spectrum scales. In the training class the wheel should be used to show how the exact complementary colors are determined, but with the children those combinations may be approximated with the papers. For red the blue green is a good complementary and for orange the green blue. Theoretically the complementary of yellow is a very slight violet blue, and of blue an orange yellow, but in the papers, as the intermediate hues are limited to two between each two standards, the yellow and blue are more nearly complementary to each other than any other pairs. The complementary of green is violet red and of violet the yellow greens or green yellows of the papers.

If complementary harmonies are attempted with the papers they must be produced with great care, and the tints and shades are far safer to use than full standards. If full standards are introduced the amount of that color in any design must be very small in proportion to the whole surface of the design.

Any teacher having the use of a color wheel will find profitable recreation in matching various natural colors and obtaining their analyses, because in this way such training of the color sense is secured as will insure accurate judgment in the selection of colors for experiments and facility in their analyses before a class.

Nothing will so rapidly train the color perception as this personal practice, and the experience gained will enable a teacher to do excellent expert work in matching colors presented by the children and thus avoid some unpleasant delays when the wheel is being operated before their critical eyes.

Ability to use the color wheel is only acquired by practice, both in the mechanical manipulation of the machine and in the combinations of the disks to imitate natural or pigmentary colors. No audience is more critical or more appreciative than a company of children and very much of the good effect is lost if they detect a failure to successfully produce a color, even though a reason may be given which would be entirely satisfactory to an adult audience.

For this work a small mirror may be arranged in front of the wheel at perhaps a distance of five or six feet, so as to show the disks at the same time the wheel is being rotated. Possibly the closest matches may not be secured in this way, but the convenience is so great as to recommend this device to whoever wishes to make experiments.

The First Gift.

The balls of the First Gift should be covered with wools corresponding as nearly as possible to the six spectrum standards, as this is the first expression of color that occurs in the kindergarten material and first impressions are very important to the child. For many years, possibly ever since their inception by

Frœbel, the colors of the First Gift have been much nearer the standards now adopted than the colors found in the Occupations. But the mistake has been made of using a dark purple instead of the beautiful violet of the spectrum which is one of the most attractive colors to the child, although the least aggressive. The First Gift balls should be compared with the sun spectrum, and in this comparison the green and violet of the balls should be as truly representations of the spectrum colors as the other four.

Sewing.

While the colored thread, worsted or silk used in the card sewing or embroidery affords a connecting link between recognition of color and color combination, the sewed line shows but a small surface of color. Nevertheless it is well to work whatever school of sewing is used in accordance with the theory of color. The application must be made to the school of sewing in its entirety. Any kindergartner, however, will be at liberty to modify our suggestions to suit the needs of her pupils as dictated by her own judgment.

It seems desirable to use the six standards in the spectrum order, incidentally thereby making the work serve to teach this order. After each of the six standards have been taught and used, let each child make a choice of color and then give a general review.

In connection with this review allow the use of the tint and shade of each standard, paying no attention to them as tints and shades, but allowing the children to use their own natural expressions for these terms, as light red, dark red, etc. The unconscious expression of the standard with its tint and shade seems to help fix the standard color in mind, while it also gives a pleasing variety to the work. One card, a circle for instance, having been sewed in a standard color, the next card may consist of three smaller circles and the sewing be done in the tint and shade of the standard, this being followed by two circles on one card sewed with the tint and shade only.

Close up this review by allowing the little folks to choose a color, requiring them to tell as they make the choice whether they have a standard orange, or a light or dark orange, as the case may be.

The circular school of sewing here used is intended merely as a medium for illustrating the order and sequence in which the colors may be employed in any school of sewing. The one idea intended to be expressed is that in this Occupation the spectrum colors should be used in their order and given their proper names, rather than a miscellaneous lot of colors having no value as standards and no definite names.

The accompanying designs will be readily understood without extended explanation.

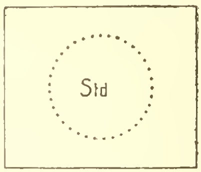


Fig. 1.

Fig. 1 represents a card pricked for a single circle. Six of these may be sewed, one in each of the standards.

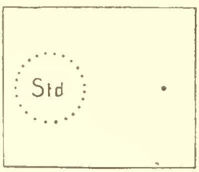


Fig. 2.

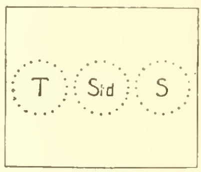


Fig. 3

Fig .2 represents a First Gift ball, and should, of course, be in one of the standards. A thread from the circle to the dot at the right indicates the string to the ball.

Fig 3 introduces the tint, standard and shade in three equal circles.

Fig. 4 a tint and shade.

Fig. 5 another arrangement of standard, tint and shade on one card.

Fig. 6 shows the tint, standard and shade in three concentric circles.

Fig. 7 another arrangement of circles for tint and shade.

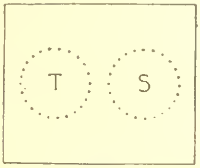


Fig. 4

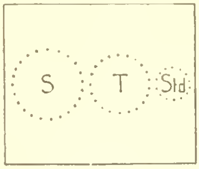


Fig. 5.

Fig. 8 a very effective arrangement of three equal circles in standard, tint and shade.

Fig. 9 consists of six concentric circles in the standards, with red at the outside and violet at the center.

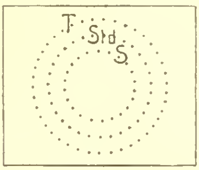


Fig. 6.

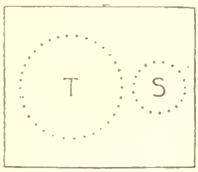


Fig. 7.

This design can be modified in many ways. The order may be reversed by placing violet at the outside and red at the center. Also the same design and arrangement may be used in tints and shades.

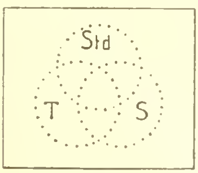


Fig. 8.

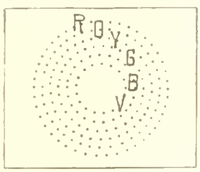


Fig. 9.

The use of sewing in color instruction is rendered practicable only by the recent introduction in kindergarten material of cotton and silk threads in the standard colors and a tint and shade of each.

Weaving.

The Occupation of weaving affords a greater opportunity for the practical application of color than almost any of the others, partly because the combinations of colors are oftentimes so important a part in developing the design, a good design being not unfrequently spoiled by the wrong selection of color.

Determine before commencing to weave just how much of this school of work will be given and then study to adapt the true theory of color and harmony to the work as a whole. When beginning the weaving, select the simplest combinations of colors but choose such as will help to fix in the mind the particular color being taught at the time. For instance, if standard red is being studied, use red in combination in the weaving.

Contrasted harmony is the one best suited to carry out this thought, and the following suggestions are given as an aid:—

It is always safe to combine a standard with a gray, remembering, however, that the effect of a given gray is better with some colors than with others.

Neutral grays are composed only of black and white and should theoretically combine agreeably with all active colors but with some colors the effect is more pleasing than with others.

Warm grays contain some red, orange and yellow in addition to the black and white, and the warm colors, red, orange and yellow or their complementaries are considered most satisfactory with warm grays, while the cool colors, green, blue, violet and their complementaries combine better with the cool grays. The cool grays are made by adding some blue to the black and white.

In the Bradley colored papers the warm and cool grays marked No. 1 contain but a small proportion of color and usually combine well with any of the spectrum standards or hues. But sometimes the dark grays are more desirable. If limited to the use of one passive color, either white or a light neutral gray is the best one to use.

It is also recommended that the mat be of the standard color and the fringe of the passive color. One reason for this arrangement, is that the mat furnishes a larger surface of color and this is desirable when a definite color is being taught. Moreover, many teachers consider this manner of combination more pleasing, and if, for example, a red mat and grey strips have been used the finished design may be mounted on a white ground and thus a new effect produced in three colors.

Use the six standards in the order they are found in the spectrum and when they are well fixed in mind, review each and in place of the gray combine it with its own tint or shade, calling the latter light and dark colors until the terms tint and shade are taught in connection with the use of the color wheel.

This combination of the tint and shade with its standard produces dominant harmony. When considering dominant harmony the following suggestions may be found helpful.

Two tints of the same scale combine well, or two shades together produce a pleasing effect and probably in some instances a tint and a shade will give the better combination; or a standard may be used with either its tints or shades if desired, though usually the full colors do not produce as good effects as the modified colors. The addition of a passive color is admissable and often improves the effect.

It is left to the individual taste as to whether the mat shall be of the tint or the shade. When the completed work is to be mounted in a book as with training classes, a pleasing effect is produced by so arranging the work that opposite pages when considered in combination will produce a harmony. If intermediate hues are selected for some of the mats and fringes two adjacent pages may form in combination, either analogous or complementary harmony.

For example, one page may be in yellow green and the opposite in blue green thus producing an analogous harmony or a red page with the opposite in blue green will furnish a complementary effect. Thus while each page taken by itself may be an example of a dominant harmony, the pages by combinations in pairs facing each other may produce analogous or complementary harmonies.

Intertwining.

The relation of color to intertwining is similar to that of color to paper cutting or paper folding. Much color effect may be developed in the mounting.

Parquetry.

Next in importance to weaving as regards color is parquetry. This Occupation is valuable alike to the teacher of color and to the drawing teacher in teaching design.

It embodies the forms of the Seventh Gift and increases the interest in that Gift by bringing in the element of color and by making permanent the forms of life and beauty.

Begin by arranging simple borders and rosettes. This must be done in accordance with the first principles of design in order that no wrong habits may be acquired which will have to be corrected when design is studied in connection with drawing.

In the following borders the use of colors is suggested.

Figs. 1 to 6 show the repetition of the same form and color. In Figs. 7 to 13 alternation of both form and color are shown. The two colors are indicated by single and double ruling in the engraved designs.

The same principles regarding colors may be modified to apply to rosettes and other designs.

FIG. 1.

FIG. 2.

First repeat the form in a straight line with the same space between each two forms as in Figs 1 and 2

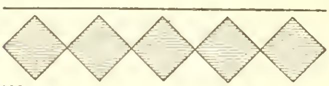


FIG. 3.

FIG. 4.

Next repeat one form in one color, letting the forms just touch as in Figs 3 and 4.

The same form and color are used in each Fig. 5 and Fig. 6, but the forms overlap. This is more difficult to do. The forms may overlap from center to center, or only a quarter, but the overlapping should be uniformly the same.

FIG. 5.

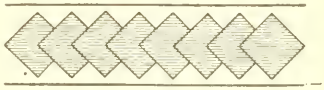


FIG. 6.

When beginning with young children let them paste the forms on a background of any neutral paper or even common manilla may be used. The parallel line may be shown by a pencil line and dots may be placed to indicate the spaces. If gummed parquetry is used do not allow the child to wet the papers in his mouth. A moist camel's hair brush is a very neat way of doing it. When the ungummed parquetry is used supply each child with a drop of mucilage, a wooden tooth-pick, with which to apply the mucilage and a piece of old cotton cloth. There will be a tendency to use too much mucilage, but very little is needed to fasten the form. Use the cloth to press the form in place, pressing directly down upon it so as not to let it slip from its correct position. Great care must be taken to teach the child to do this work neatly. While these ways have been suggested there is no objection to any other ways which may be devised.

When simple repetition is well understood begin to teach alternation. This may be done in each of the Figures from 1 to 6 inclusive by using the same form and alternating two colors. The same form may be placed in groups of two or three either touching or overlapping and alternating two colors as in Fig. 7.

FIG. 7.

Alternation may be still further illustrated by alternating two forms in either one or two colors and with a space between the forms, as in Figs. 8 and 9.

Fig. 10 makes use of the same form and alternates the position, these may be spaced or may touch, and the colors can be alternated or not just as the teacher prefers.

Fig. 11 alternates the position and color and the forms overlap. The darker squares touch at their corners before the lighter squares are pasted over them.

Fig. 8.

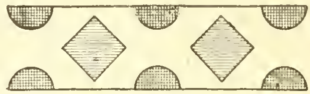


Fig. 9.

Figs. 12 and 13 are suggestions for producing an alternation in both form and color and overlapping the forms.

Fig. 10.

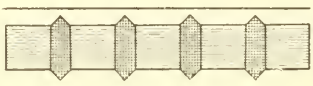


Fig. 11.

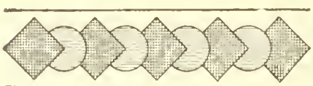


Fig. 12.

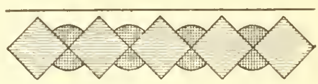


Fig. 13.

When sufficiently skilled it will add to the interest of the children if they are allowed to add a narrow margin of the same color as the units.

The skill which is acquired in handling the parquetry papers will prepare the children for the paper cutting in which they will learn to cut the units to be repeated, and ultimately of course they will design the unit.

As it is the object of this manual to treat of color the subject of form and arrangement cannot be enlarged upon, and the hints given regarding color arrangement in these few examples of borders are equally applicable to other elementary combinations of forms.

Paper Cutting.

While the paper cutting provides a means for making pleasing designs and using beautiful colors, the average kindergartner has usually confined herself to the use of few colors. This is surely a better course to pursue than to introduce such a conglomeration of color as is sometimes done.

Elementary work in color includes recognition of the six spectrum standards and with young children does not advance beyond contrasted and dominant harmony during the first year. And while the following suggestions are given for carrying out this thought, much must be left to the individual taste and judgment of the teacher in deciding the needs of her own pupils. Study how to apply color to the Occupations as a whole as far as is possible. With the children the color used should be such as would aid in the teaching of recognition of color, and with training classes the effect when mounted must be considered. During the first year many will doubtless prefer to use but one or two colors for the entire school of work, and again some will prefer to employ one color for one sequence or series of cutting, another color for the next and so on. Either way is allowable. The color of the mounting sheets will aid in making the harmony.

It also makes a pleasing arrangement to use a tint and a shade of the same color in the one series. Training class pupils may mount a design in the tint on the left-hand page of the mounting book, and a design in the shade on the right-hand page, or the tint and shade may be combined in the same design, using either of the colors for a background.

The entire work may be carried out after this plan. It will be found that children may also do very good work if allowed to mount their work on a background, and it adds to their interest. Any of the suggestions for sewing, weaving or parquetry apply to this Occupation as well.

More advanced work may be profitably done in a training class than in a kindergarten because every teacher should know much more of her subject than she expects to teach and this is specially true of work in color. This grade of work can also be introduced in the lower primary schools especially if the children have had the advantage of a kindergarten education. As the number of colors studied is increased there is of course a larger range of colors from which to choose, and while dominant harmony will be the safest to employ by careful direction on the part of the teacher something may be done with analogous harmony. With training classes this may be done in the mounting, by placing analogous colors on opposite pages of the mounting book or by placing the design on a background of any analogous color before mounting it. The latter may be employed with the children. Complementary harmony may also be developed in the same manner by mounting colors which are complementary on opposite pages, while many times a narrow border line of the complementary color is sufficient to give a pleasing result.

The colors must be selected to suit the design and the right proportion of each color must be used. Many times when a unit of one color and a background of another does not produce a pleasing effect, the combination reversed will be an improvement. Experiments and the study of historic art will be very valuable aids to teachers in this work.

In making complementary color effects in a composition great care must be taken to use very little pure color, and it is rarely that anything approaching a full color can be introduced. The broken colors are far safer and often as beautiful as the pure colors and their tints and shades.

In this manual no attempt is made to treat of any other subject than color as applied to the several Gifts and Occupations, otherwise much might be said in criticism of the school of cutting as very generally adopted in the kindergarten work as in this Occupation more than in any other there seems to be a demand for advance in the direction of art education. In a school of cutting where an attempt is made to use all the waste pieces of paper in forming a design, the results are in many cases most disastrous to artistic advancement and growth.

Paper Folding.

An interesting feature of this instructive Occupation is the color thought which may be developed. Here as in paper cutting a few well chosen colors are better than many. In order to be sure that the result will be desirable the teacher must first consider the work as a whole and then study the details. The mounting, with training classes, is an important item when selecting the colors.

The several folded forms which are to be on one page may all be of one color if desired, and the coated papers are found to be very effec ive in this Occupation, as the white side when it is folded over produces with the color a contrasted harmony which is pleasing in itself. This is of course the simplest arrangement possible.

Contrasted harmony may also be carried out with the engine colored papers by choosing an active and a passive co'or which harmonize well and folding a part of the forms in each, considering how to bring out the color to the best advantage in the arrangement which must be followed in every sequence or series of folding.

A good result in dominant harmony may be secured by using two or three tones from one color scale, selecting the tone for each folded form with reference to its position on the page when mounted, using the same color scale for the entire school or if desired the effect is good if the teacher wishes to select a different color scale for each series or for each page.

Heretofore when little attention has been given to the harmonies of color it has been popular because safe to execute an entire school of folding in one color. But in this practice much of beauty in the result and of education in the process has been lost. With a well graded line of colors in the engine colored papers very beautiful and effective results can be secured in the grouping of forms in the mounting, and some of the most valuable instruction in color combinations imparted. While it is imposible to produce in the engine colored, or pulp colored papers, the pure standard colors which are necessary for the earliest color instruction, still the Bradley line of these papers is so classified and graded that they are as educational in their way and often more beautiful in combination than the purer colors of the better graded coated papers.

Concerning Water Colors.

In a full discussion of the subject of color teaching, the use of water colors naturally calls for consideration, because in the past this material has been the only source from which it has been possible to derive any systematic expression of color in the elementary grades of study. The introduction of properly-graded colored papers has removed this restriction in the lowest grade of work, and the color wheel supplements the papers in the higher grades.

Water colors when skillfully used produce beautifully soft and delicate artistic results, but even in the hands of an artist this material is not best adapted to strong effects and full color. When a child is old enough to neatly draw any outline and to apply water colors approximately within the confines of these lines the use of the pencil and brush may afford an innocent and valuable occupation under the proper dir ction of a teacher. But for a logical system of elementary color instruction it is almost valueless, because only light tints can be evenly and smoothly spread in this medium and the observation and classification of these faint expressions of color effects require the most expert judgment and best color education. Elementary color instruction must be based on standards, affording the fullest and purest expressions of color which can be obtained, and these cannot be produced by children, nor even by experts, with the water colors put on the market in cakes and tubes.

In this statement no disparagement is intended of the beautiful color effects produced by our artists in the delicate aquarelles which adorn our drawing-rooms and are intelligently admired by those who are best educated in color effects. But these have the same place in primary color instruction that the purest examples of poetry and prose have in elementary literary education—merely as examples of best expressions.

In pastel crayons pure and full color expressions may be produced, and various colors can be beautifully mingled together, but the material is not suited to the use of young children and at the best is neither neat nor convenient for schoolroom practice.

Color Blindness.

The fact that states and cities employ experts to examine the school children to determine whether they are afflicted with color blindness is proof that the ordinary teacher is not considered competent to do the work At the same time if that definite instruction were given in color which is considered essential in other subjects of no more importance, every teacher would be able to determine definitely if a child under her care has normal color perception and if not, whether the defect is due to genuine color blindness or to a lack of knowledge how to recognize or analyze colors and to give them correct names.

The importance of such training can hardly be over estimated when one stops to consider the fact that the business interests of many individuals is at stake and that their life work may be a failure for want of proper instruction in this very subject.

It is of momentous importance to the locomotive engineer and to the marine pilot, not only as individuals, but also because travelers throughout the world intrust their lives to them for safety. And this class of applicants for positions is but one of a considerable number who may find a good or a bad color sense the turning point in determining what occupation to choose.

There are varieties and degrees of the defect or disease generally known as color blindness, but recorded experiments extending over a period of several years have determined that only about six per cent of the population can really be called color blind. Genuine color blindness has thus far been considered incurable and not in all cases can experts tell whether the difficulty is with the eye or with the brain. This uncertainty is not a matter of practical importance to the teacher. It is only important for her to determine whether defects exist which are equivalent to either partial or total color blindness.

The only way to ascertain the condition of any one with reference to his color perception is by having him compare colors, and not by naming them. Formerly color charts were used for testing color blindness in children, the teacher showing the colors to the pupils and asking the names But a child soon learned, from hearing the others recite, which spot was red, which green, etc., so that the amount of information which the teacher was able to obtain proved quite restricted and the natural desire of the child to show that he possessed as much knowledge as his mates stimulated him to unintentionally deceive the teacher. The better way of detecting color blindness is through selections made by each pupil.

Moreover, it is not a matter of indifference what colors should be selected for the pupil to match. Theory and experience combine to show that certain colors afford a more satisfactory criterion of color blindness than any others. Let the teacher give to the suspected pupil a sample of a rather light tint of bluish green, and direct him to select other samples approaching this color. If his color vision is normal he will, of course, select only the various hues of green, ranging between the extremes of greenish yellow and greenish blue. If, however, he is either red or green color blind, he will select, in addition to a number of green samples, some of the neutral tints—such as gray, buff and drab. The fact of color blindness being indicated by the selection of more or less of these neutral tints as matches for the green sample, the teacher may then proceed to test whether the case is one of red or green color blindness. For this purpose the best criterion is afforded by asking the pupil to match a sample of a rather light tint of reddish purple. If he is red color blind, dark blues, and violets will be among the colors which he will select to match the light reddish purple. If, on the other hand, he is green color blind, light grays and other neutral tints will be among his selections. If the selection of dark blues as matches for the light reddish purple indicates red color blindness, an interesting confirmatory test may be made by asking the pupil to match a sample of the most brilliant red. If he is red color blind, there will appear among the reds which he selects to match the sample more or less of the dark shades of greens and browns. While a teacher only versed in the theory of color blindness and inexperienced in the use of tests might reasonably hesitate to take the responsibility of pronouncing the pupil color blind, these tests would at least warrant her in recommending the parents of the pupil to submit the child to the examination of an expert.

It is supposed that many more men than women are color blind, but there may be a doubt whether this opinion is not due to the fact that girls are brought so much more closely into relation with colored material than boys. This problem may be more satisfactorily solved when both boys and girls shall receive a systematic color instruction.

It must be evident to any kindergartner who carefully reads the foregoing pages that the brief suggestions regarding color instruction in the use of the kindergarten material might have been indefinitely increased by a multiplication of examples and illustrations. But it has been the purpose of the author to merely offer to competent kindergartners some general suggestions regarding the application of the true theory of color to their work, so that it shall not be necessary for kindergarten children to unlearn in the high school or university anything of color which they may have been taught in the kindergarten.

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