

while if, on the other hand, with Schleiermacher, we consider the essence of Christianity to be the formulation of the instinct of dependence so unprecedentedly strong both by nature and education in her, we shall possibly wonder less that so many of her friends have found edification in her numerous conversations and letters concerning her religious experience and belief.

The above is very far from exhausting even in epitome the interesting points suggested by the study of this remarkable case. Laura has very little idea of the interest she has excited in the world; is intensely delighted to see her friends, or to receive any little attention or remembrance from them; and is so good-hearted that the writer is pleased to state in closing that, in spite of the weeks of annoyance to which his experiments subjected her, she was always cheerfully ready at the appointed time, and still cherishes only the kindest sentiments towards her tormentor.

G. STANLEY HALL.

NOTE.—A question of great interest, suggested by the Editor with reference to a note in Whateley's *Logic*, is how far has Laura been able with the help of her means of expression to form concepts proper, and how far her thinking is able to proceed without the help of her manual marks and signs. Whateley's statement (foot-note to Introduction, § 5) that slight and unintelligible motion of the fingers can generally be observed when she is musing by herself, is not in accordance with the writer's observation. She often sits alone apparently absorbed in thought and reflecting her emotions in smiles, frowns, &c., and with no movement whatever of the hand, although the latter is sometimes observed. If we consider that all impressions above those of touch, which others apprehend in the form of sensuous images must be thought by her, if at all, as general conceptions, it seems probable that her thinking does range beyond the individual objects of *her* sense without finding signs necessary as instruments of thought. This conjecture is strengthened by the general intelligence which appears to have characterised her childhood before her education began.

G. S. H.

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## II.—HARMONY OF COLOURS.

IN an acute and interesting article "On Discord," published by Mr. Edmund Gurney in the last number of this Review, there are one or two very sensible remarks on the difficulty of reducing the effects of colours in combination to simple physiological and psychological laws. These difficulties, as Mr. Gurney observes, "are almost enough to make one despair of anything like an exact and complete *rationale* of colour-discords and affinities". Mr. Gurney is here only concerned with the obstacles in the way of interpreting the facts: he does not touch on a

more fundamental difficulty still, that of ascertaining the facts themselves. When this is taken into account as well, when the chaotic state of opinion as to what combinations of colour are harmonious or discordant is fully recognised, it seems as if we might safely dispense with the precaution which Mr. Gurney takes in introducing the little adverb "almost".

If, then, anything further is attempted by way of accounting for the agreeable and disagreeable effects of combined colours, it must be done in a very different spirit from that of most past theorists. It has commonly been assumed that there is a close parallel between colour and tone harmony. But while the physiology of the ear has supplied a firm basis for musical science, the physiology of the eye has so far done little to support any definite principles of colour-combination. As Helmholtz, the great authority in both branches of physiology, reminds us, "it would be absurd to attempt so sharp a definition in respect of the so-called harmony of colours as we are able to attain in dealing with musical intervals".<sup>1</sup> The object of the present paper will be mainly to emphasise this truth by examining into the facts at our disposal, and by criticising the leading theories put forward. At the same time an attempt will be made to indicate roughly how much physiology and psychology can do for our seemingly impenetrable subject.

To begin with the facts, a slight acquaintance with the arts of music and painting will show that in the latter there are no simple uniformities of combination answering to the fixed and definite relations holding between tones. In all known systems of music,<sup>2</sup> an octave or a fifth is recognised as consonant, a semi-tone or a major seventh as dissonant. But where are the chromatic intervals corresponding to these? Let the reader spend an hour in studying the illustrations of decorative colouring given by Mr. Owen Jones in his *Grammar of Ornament*, and he will be convinced of the truth of the observation. He will certainly be struck by the great diversity of taste shown by different peoples, both as to the relative value of single colours and as to the best order of arrangement. Thus, for example, the combination of blue and green, which is wholly eschewed in some styles, seems to be almost a favourite arrangement in Persian art (tile-patterns). A similar diversity of taste is discoverable among individual colourists. And if this want of agreement is conspicuous in art, it is still more prominent in common life. Witness the endless discussions which are carried

<sup>1</sup> *Physiologische Optik*, p. 270.

<sup>2</sup> Of course, I refer here only to the music of the West in which discrete tones are employed.

on among women as to what is correct in the way of colour-arrangements in dress and in furniture.

Where practice is so diversified we may expect rules to be conflicting, and this is what we find. Works of practical instruction in painting afford a curious illustration of this want of uniformity. For example, the juxtaposition of blue and green, which is often condemned by teachers of art, is called by Mr. Ruskin one of the loveliest combinations the eye ever meets with.<sup>1</sup> Again, red and green, though commonly allowed to be good, are called an inferior combination by Sir J. G. Wilkinson. Still more oddly, complementary colours, though often said to be the most pleasing combination, are excluded from all art by a German writer (Schiffermüller) as crude and boorish.

Is there, then, beneath all this diversity any real agreement, and if so, to what does this amount? In order to ascertain this, it is necessary to make a wide and careful survey of different branches of art, more especially the decorative arts (mural painting, ceramic colouring, glass-staining, &c.), which are not restricted like imitative painting by the facts of nature, nor controlled like dress by extra-æsthetic influences.

In making this examination it is to be borne in mind that the properly chromatic relations of colours can only be certainly ascertained when these are taken in fairly equal degrees of brightness. If one colour is much darker than the other the combination may please through the contrast of light and dark, even though the colours do not combine well. Again it is to be remembered that the presence of a third colour, including black and white, materially affects the apparent degree of affinity of two colours. Thus, for example, green and blue seem to be reconciled when opposed to a large mass of warm colour.<sup>2</sup>

Proceeding in this way, one will find that the amount of agreement actually demonstrable is exceedingly small. First of all it will be observed with reference to binary combinations that all the most distinctly marked colours, namely, red, yellow, green and blue, may occasionally be seen in juxtaposition, though certain combinations undoubtedly appear much more frequently than others (as, for instance, blue and red more often than blue and green). It is to be added that the combinations of colours which seem to be most popular include both wide and narrow

<sup>1</sup> It is only fair to add that Mr. Ruskin is here speaking of colours in nature where effects of lustre, &c., are apt slightly to disguise the relations of colour. But this does not detract from the value of the observation.

<sup>2</sup> It may be added that when a colour serves as a narrow border to a large area of some other colour the relations of the two cannot be so well ascertained as when both colours have a considerable area of their own.

intervals in the spectrum-circle.<sup>1</sup> On the other hand, certain combinations of intermediate hues as, for example, spectrum-red and purple-red, yellow and sap-green, appear never or only very rarely.

If, again, we inquire into the principles which regulate larger combinations of colours, as triads, &c., the utmost that is clearly ascertainable is that certain groupings present themselves much more frequently than others. Thus, for example, it seems tolerably certain that there is a general preference for the "primaries," according to painters, namely, red, yellow and blue, above *most* other triple combinations,<sup>2</sup> though it is not at all clear that they stand alone in this respect, since the combinations red, green and yellow, orange, green and violet, appear frequently enough to deserve the name of favourite triads.

Such are some of the principal agreements, or more correctly approximate agreements, which are discoverable by means of a careful inspection of art-usage. I purposely abstain from entering into the still more difficult question what changes with respect to colour-combination appear to attend the gradual development of the colour-arts. In order to get at uniformities, we must have no prejudice in favour of primitive or of advanced art. It might perhaps be thought that the simple facts of colour-sensibility would be best reached by confining ourselves to the lowest stages of art. But we must not assume that in early art there is a truer appreciation of chromatic harmony than in later art.<sup>3</sup> In truth, if we must choose between simple and highly developed art, it would surely be more reasonable to argue that the feeling for colour-affinity being a finer sensibility than the feeling for mere colour and its varieties, would show itself most plainly in the higher stages of art-progress. But for our present purpose it will be best to treat the question of colour-harmony as far as possible apart from the development of art.

So much as to the facts, and now as to the methods of interpretation proposed. First a word may be said of the crude theory put forward by writers on colour that all combinations of colour should be based on the three so-called "primaries" (red,

<sup>1</sup> By the spectrum-circle is meant the circle that would be formed by uniting the extremities of the spectrum-scale, with the addition of the colour (purple) formed by combining the extreme rays.

<sup>2</sup> Instead of spectrum-red (vermilion), purple may be employed, as in several pictures by Paolo Veronese.

<sup>3</sup> As is done by Mr. Owen Jones and Sir J. G. Wilkinson when they place early art above later because of its preference for "primaries" (red, yellow and blue) to secondaries and tertiaries. It does not even follow that early artists did prefer the primaries *as colours*, since they may have used them because as pigments they were the most manageable.

yellow and blue) as the normal or at least most natural arrangement. This theory is a hasty attempt to find a scientific foundation for artistic rules in physical facts. It fails because it assumes that the laws of the action of light on the retina can be gathered from the laws of combining pigments. All students of optics now know that, when we are speaking of coloured light, yellow is no primary at all,<sup>1</sup> and that the production of a green pigment by mixing blue and yellow pigments is not simply due to an addition of blue and yellow rays, but involves a diminution of these rays consequent on the combination of different processes of absorption. For the rest, as has been observed, the doctrine of the superior value of the primaries does not appear to be borne out by the facts.

A more genuinely scientific attempt to found a theory of colour-harmony on physical facts is made by those who follow Newton in dividing the colours of the spectrum after the manner of a musical octave according to the numerical ratios of their underlying vibrations. One of the most recent exponents of this musical theory of colour is Unger.<sup>2</sup> This writer seeks most elaborately to prove that the best chromatic intervals answer to the best tonic intervals; e.g., red-blue or orange-violet answers to the fifth. He also attempts to construct major and minor colour-harmonies, and even a system of transient colour-discords. Unger's method is singularly ingenious, but far from convincing. The latest authorities in physical optics, as Helmholtz and Brücke, agree that the spectrum cannot without forcing the facts be resolved into an octave.<sup>3</sup> For the rest Unger's illustrations of his theory from the history of art really prove nothing except that almost every conceivable combination of colours is to be met with in the works of the masters.

Even were there not these objections to the comparison of the spectrum with the musical scale for the purpose of discovering some definite laws of colour-concord, such a comparison would in the present state of our knowledge be useless. The discoveries of Helmholtz in physiological acoustics go to establish the conclusion that musical harmony does not directly depend on the numerical ratios of the vibrations of the notes combining, but on the absence of beats between these notes and between their several partial tones. Hence it is vain to make out that colours

<sup>1</sup> Professor Maxwell has fully exposed the pretensions of yellow to be considered a primary element of colour. See a paper "On the theory of Compound Colours," in *Philosophical Transactions*, 1860, pp. 77, 78.

<sup>2</sup> See the full statement of his theory in his work *Die bildende Kunst*.

<sup>3</sup> See Helmholtz's able critique of Newton's theory in *Physiologische Optik*, pp. 236-7; also Brücke, *Die Physiologie der Farben*, Introduction, pp. 5 and 6.

which harmonise well stand in a simple ratio to one another in respect of their vibrations, unless it can be proved further that these ratios involve the absence of disturbing elements corresponding to the beats of discordant notes; and physical optics does not, I believe, suggest the presence of any such elements.

But if the physics of light and of sound fails to help us in drawing an analogy between the effects of colour and tone combinations, may we not call in the aid of the physiology of the two organs concerned? With respect to the eye, recent research has taught us a good deal concerning the nervous conditions of colour-impression. We may provisionally adopt the hypothesis of Young and Helmholtz that all our impressions of colour are built up out of three elementary sensations (red, green and blue or violet) which correspond to the excitations of three specifically different classes of nerve-fibres. We may further suppose that these three classes of fibres are equally distributed over the retina.<sup>1</sup> Once more we may assume that the effects of colour-combination are capable of being produced by the stimulation of different areas of the retina. That is to say, the eye must be supposed to appreciate two colours in juxtaposition to some extent at least without moving from one to the other, and by simply fixating the common boundary of the two colours. This assumption, which seems to be required by the facts, does not, however, preclude the supposition that the pleasing or disagreeable relation of two colours is much more vividly felt when the eye fixates each colour in succession, or in other words when each colour successively stimulates the region of the yellow spot.<sup>2</sup>

Let us now see whether these considerations enable us to trace an analogy between the effects of colour and tone concord. It may be said that Helmholtz's doctrine of musical harmony refers this phenomenon to a positive as well as a negative condition, namely, the presence of certain common elements (the upper or partial tones) in the combining tones. Similarly, if we adopt Young and Helmholtz's hypothesis, it follows that in the case of colours lying near one another in the spectrum-circle,

<sup>1</sup> This is not exactly true as the observations of Purkinje and others shew.

<sup>2</sup> Since the comparison of two colours with a view to appreciating their affinity by the eye at rest is only exact in the case of contiguous colours, and becomes very imperfect when there is any considerable space between the colours, we might perhaps hypothetically assume that there is a sympathetic relation between the nervous elements of contiguous regions of the retina, owing to which the excitation of one central region affects in a much lesser degree the closely adjacent regions and in the same manner.

there is a distinct common element, namely, the sensation answering to the fibres excited in each of these cases. If then we say that all colour-concord holds between adjacent colours, and conversely, that all adjacent colours harmonise, we seem to have a theory of colour-concord analogous to that of tone-concord.

Such a theory, however, would first of all be clearly opposed to the facts, since as we have seen, many harmonious intervals are wide ones, while on the other hand some adjacent colours are distinctly unpopular combinations. But even if the theory tallied with the facts it would not bear close inspection. Helmholtz's theory of three classes of optic fibres teaches that each of these is stimulated to some extent by all ordinary impressions of colour, so that, according to the supposition we are now considering, the specific feeling of harmony ought to be an accompaniment of every possible combination of colours. This is surely a sufficient *reductio ad absurdum* of the hypothesis.

But besides all this, it is plain that the nervous and mental processes involved in perceiving a combination of tones and of colours are too unlike to allow of our drawing any close analogy between their accompanying feelings. Two complete musical tones or clangs never fuse into one indivisible tone, and the feeling of harmony arises just because these constituents, though appearing in some strange way to join in one mass of sensation, do not (as in the case of the partial tones of a single note) wholly sink their individual existence. But two impressions of colour, if they fall simultaneously on the same part of the retina, blend inseparably in one apparently simple sensation.<sup>1</sup> Thus yellow is supposed to be the sensation produced by stimulating the two sets of fibres corresponding to green and to red on the same retinal area. On the other hand, the so-called effect of colour-harmony is produced when the two impressions fall on different retinal areas and, unlike two tones of a musical chord, remain sharply separated from one another.

There is, indeed, one class of these effects of combined colours which may be said to bear a close resemblance to musical harmonies. I refer to the case in which colours are presented in such small masses that they partially lose their individual character and blend in a compound colour. An illustration of this effect may be found by looking over the column of warm light cast by a setting sun on the gently undulating surface of a summer sea. The alternate strips which reflect the rosy light

<sup>1</sup> This coalescence has been asserted by Dove and others to take place even between the impressions of "corresponding" areas of the two retinas. See Helmholtz, *Physiologische Optik* pp. 776, *et seq.*



and which are shaded by the soft undulations of the surface appear to blend, especially if the eye is partially closed, and the effect, on the present writer's feeling at least, is closely akin to that of a musical accord. Another familiar example of this phenomenon may be met with in certain wall-papers, where the colour of the small patches of the pattern runs, so to speak, over the colour of the ground.<sup>1</sup> Persian shawls owe some of their agreeable character to this circumstance of partial blending. This effect is plainly due to a compounding of the impressions produced by the two contiguous colours, whether these impressions are supposed to fall on contiguous areas of the retina, or on the same area (the yellow spot) as the eye involuntarily passes from one to the other.<sup>2</sup> It is plain that the two colours which are in this way to blend in part must not be complementary colours, since in this case the composition of the two impressions would result in white and not in a third "colour" in the narrow sense of the word.<sup>3</sup>

There is little doubt in my mind that this effect of partial coalescence of colour-impressions enters into the effects of art much more than is generally supposed. The peculiar charm of graduated tint may in part be due to this tendency to fuse small contiguous masses of colour, for it is hardly possible in looking at the colours of the spectrum to help imagining that the related tints do actually commingle.<sup>4</sup> Painters are very fond of judging of the effects of colour in combination by half closing the eye and so obliterating the sharp demarcations of the contiguous tints. It seems likely then that some of the most delicious effects of colour in combination, as for example those of the finely modulated pictures of Mr. Burne Jones, involve this partial blending of individual tints.

Yet while attaching much weight to this greatly overlooked effect, I cannot claim for it the rank of the central and essential

<sup>1</sup> I lately bought a bed-room paper having a small scarlet pattern on a light buff ground. When looked at closely in a small piece in the decorator's shop the colours remained distinct, but when the paper was put up they seemed to blend as an orange tint which was much too fiery-looking for a room with a south aspect.

<sup>2</sup> If the latter it must be that the first impression remains as a positive after-image or ocular spectrum during the excitation of the second sensation.

<sup>3</sup> I find that for some reason reds suffuse themselves in this way over other colours, as blues, greys, &c., with special readiness. This may be due to the greater energy of the impression in the case of the red rays, and the consequent greater persistence of the after-image.

<sup>4</sup> According to this supposition any given tint may be viewed as the impression resulting from the harmonious combination of the adjacent tints on both sides.



fact in colour-combination. After all, in most cases, colours are to be seen as perfectly detached from one another. And since combinations of colours, when so detached, are sometimes called harmonious, it follows that such blending does not adequately account for the effects of colour-concord.

So much for the theory that chromatic harmony rests on a similar basis to that of musical harmony. Let us now glance at the second order of attempts to place the theory of chromatic combination on a physiological basis, namely those which set out from the phenomena of complementary colours. The disposition of the retina, after any impression of colour, to see its complementary hue as observed in the phenomena of complementary images, and in the mutual influences of contrasted colours in juxtaposition near their common boundary, was made use of by Goethe in his celebrated doctrine of colour (*Farbenlehre*) in accounting for the æsthetic value of combinations of colour. He expressed the fact by saying that "every single colour excites by a specific sensation the tendency to universality," whence the peculiar value of complementary colours, and of the whole scale of colours as seen in the spectrum. Much the same idea is worked out by Schopenhauer in his curious essay on Colours (*Ueber die Farben*). This writer looks on colours as the result of a qualitative partition of the activity of the retina, and regards the addition of the complementary hue to a given colour as the perfection of this activity. The fact that colours in juxtaposition tend under certain circumstances to influence one another so as to assume the appearance of complementary hues, was taken by Chevreul as the key to the true laws of chromatic harmony. Chevreul appears to have exaggerated the importance of the facts relating to the mutual modification of colours in juxtaposition. Such influences are very limited, and it is quite conjectural to suppose that contiguous colours *always* produce an appreciable modification of hue, through a calling-up of a negative image or contrast. Indeed this idea seems to be clearly contradicted by the simple fact that blue and red have their peculiar force of colour augmented by juxtaposition, whereas, if negative images were formed, the blue would lose its blueness and look greenish, and similarly the red would suffer and approach yellow. His harmony is, in fact, as he himself explicitly states, the combination of contrasts. Once more, Zimmermann in his *Allgemeine Ästhetik* regards the complementary image as a necessary concomitant of a colour and even as an essential element of the impression, and by help of this assumption seeks to institute an analogy between the effect of two complementary colours, of which each is thus in a sense contained in the other, and that of two musical tones, say those of an octave of which

the higher is already present in the lower.<sup>1</sup> This same idea of a complementary activity of the retina is made the basis of a theory of colour-harmony by E. Hering. It is also regarded as the fundamental fact by Mr. Grant Allen in his *Physiological Aesthetics*.

That complementary colours have a special æsthetic value seems indisputable in spite of the attempts of some to disparage these combinations.<sup>2</sup> Since on Young's hypothesis a complementary colour is one which brings into action that order or those orders of nervous fibre which the original colour leaves comparatively quiescent, it is certain, as will be seen by-and-by, that the juxtaposition of the two, whether they fall on the same retinal area in succession, or simultaneously on contiguous regions sympathetically related, must have a certain fresh and stimulating as well as a full and satisfying character for the eye. This latter effect, it is obvious, should be obtained just as well by a further subdivision of the colours, for example, of blue and orange into blue, green and red, (the red being made much more powerful than the green).

There is, however, great indefiniteness in this notion of complete retinal activity. At first sight it would appear, when translated into terms of Young's hypothesis, to involve an equal excitation of all classes of fibres diffused over the retina. But this is obviously impossible except by means of a very large white surface. It would be absurd to contend that two considerable areas of colour in juxtaposition are each perceived in succession by the whole of the retinal surface. Further, it cannot, as we have before remarked, be argued that two contiguous hues are always perceived by the same part of the retinal surface, and hence the fact that two considerable patches of colour in juxtaposition are pleasing even when the eye is most at rest, seems to show that a heterogeneous and partial qualitative activity of *different* regions of the retina has this satisfying character just as much as the complete activity of any given area.

There is another objection to the erection of the complementary relation into a precise scientific principle of chromatic combination. Two complementary coloured lights are such as being combined produce the sensation of whiteness. But in

<sup>1</sup> It is not of course accurate to speak of the complementary image being "contained in" an impression of colour. Strictly speaking it is the result of a second stimulation, objective or subjective, acting on relatively vigorous and consequently highly susceptible elements.

<sup>2</sup> Brücke describes a method by which he secured a series of impressions of perfectly complementary hues, and tells us that in every case the combination was pleasing (*Die Physiologie der Farben*, pp. 35, ff.; cf. pp. 204, 205).

order that they may produce this effect their *quantities* must have a certain proportion. If the one is much more powerful than the other, the result of combining them is not white but a whitish variety of the colour in excess. Now complementary colours in art are supposed by the advocates of this principle to be harmonious in an endless variety of proportion, whether the quantity of each light be measured by the area reflecting it or by its brightness. This shows that the eye is not, as some interpreters of complementary hues appear to teach, always seeking to realise a sort of unconscious perception of whiteness. The idea that complementary colours are synonymous with harmonious colours, evidently implies that colours lying near one another in the spectrum-circle are always discordant. This is not correct, since, as we have seen, closely related tints frequently combine with great effect. On the other hand, it is undoubtedly true that the most plainly and incontestably discordant effects of colour take place when the combining colours are thus related. So far as I can make out, the only instance of what is generally felt to be real chromatic dissonance is where one colour is visibly injured or impoverished by another, and this only happens when the colours lie near one another in the spectrum-circle. In dealing with this class of cases we shall, I think, exhaust all the truth that resides in the complementary theory, and at the same time dispose of all the points of resemblance between colour and tone harmony.

It is important to state that the effects now considered arise when the colours are produced by reflecting surfaces and not by the direct rays of the sun. There is good reason to suppose that the spectrum-rays, however combined, would not give rise to this unpleasant effect. It occurs frequently in juxtapositions of coloured fabrics, as for example, a scarlet shawl worn on a purple dress, or a blue shawl on a violet dress. It may be easily produced by combining tinted papers such as are used by book-binders. Thus a strip of chocolate brown paper if placed beside a bright pink strip seems to lose all its colour. In this way certain scarlets are apt to look brickly if placed by rose-red, and some yellows lose their force by the side of warmer tints.<sup>1</sup>

It is possible that these effects are to be accounted for on the same principle as the mutually reinforcing influence of complementary colours, namely the exhausting effect of light-stimulation. The colour which is injured or "killed" commonly contains some element conspicuous in the other though in a much feebler

<sup>1</sup> So far as I can ascertain, one of the two colours always suffers more than the other, though in some cases there seems to be a mutually destructive effect.

degree. The eye feels this element to be taken out of the second colour and is consequently dissatisfied. What remains is either a faint and unsatisfying element of another colour (as when a gamboge yellow looks pale and greenish against a warmer colour), or an approximation to a dingy colourless grey (as when chocolate brown is killed by pink).

Again the fact that this effect of impoverishment seems to be confined to the colours of surfaces suggests the reflection that it is frequently due to the impurity of the colour which suffers, that is to say, to an admixture of other elements (faint white light in the form of grey, &c.). It is certain at least that the poorer and the less pure a colour when viewed apart, the more easily will it be killed when placed beside a rich and purer colour.

Now after we have frequently experienced this injurious effect we regard any new juxtaposition of colours in order to see whether they detract from one another's peculiar excellence; and when they do not, we are disposed to call them harmonious. This idea is certainly one, and perhaps the commonest, meaning of the phrase "harmony of colours".

Yet this fact of not injuring one another's characteristic quality does not exhaust the meaning of the term colour-harmony. In truth it looks as if writers on colour had been led astray by the associations of the word harmony. They have assumed that colour-harmony like tone-harmony must repose on some specific sensation. But the word harmony in many other connexions evidently means much the same as affinity, resemblance, or unity.<sup>1</sup> When for example we speak of an action harmonising with our idea of a person's character, we mean simply that it resembles in its nature and motives previously observed moral qualities. Now in the same way it may be said that much of what is meant by harmony in colour is some aspect of likeness consciously felt. In other words, the beauty of colours in combination may rest to a large extent on a conscious process of comparison, and involve a distinct perception of relation. In this sense harmony is the opposite of contrast, and can only be studied in connexion with this. I purpose devoting the rest of this paper to a brief consideration of the several ways in which the complementary æsthetic principles of harmony and contrast manifest themselves in the pleasing effects of colour in combination.

<sup>1</sup> Strictly speaking, the word harmony points rather to a subjective emotion, to the peaceful feeling of satisfaction which results from the perception of a certain objective correspondence, unity, or resemblance. I conceive that the words harmony and unity or uniformity in diversity, when employed in art, express but two aspects of the same fact, namely, an emotional and an intellectual aspect.

First of all, then, it will be well to enumerate the several distinguishable qualities or aspects of colour which serve as the terms of the relations of contrast and similarity. Some of these are fixed characteristics for each of the individual colours, others vary in the case of each colour.

Of the fixed aspects the most obvious is the chromatic quality itself. In order to estimate the affinities of colours viewed as impressions consciously compared, it seems necessary to set out with four fundamentally distinct colours, namely, red, yellow, green, and blue.<sup>1</sup> No one of these is felt as related to the others by resemblance, while all intermediate colours, as orange or blue-green, are immediately perceived to be transitions from some of these seemingly elementary impressions to others. The affinity between one of these intermediate tints and either of the adjacent elements, may be called the first degree. On the other hand, the relation holding between any two elementary colours lying next one another in the spectrum-circle may be styled the second degree of affinity. This second degree does not involve similarity like the first, but simply expresses the fact that we may pass from one to the other by insensible intervals without introducing a third element.

Not only have the several colours their specific colour-quality, they manifest other similarities which appear to fall into a regular scale. It is noticeable that there is no scale of height in colour as fixed by the rapidity of vibrations of the several hues, and corresponding to the scale of mere pitch in music. The "lowest" note in the colour-scale, red, is more analogous in its effect to the higher musical notes. There seems to be a fairly even decline in respect of energy of sensation. Red is violent; yellow though brighter is less exciting; green is still less stimulating, while blue is the colour which best suggests repose. Of course these characters are greatly modified by variations in brightness or intensity. They apply to the average tones of these colours, and also to their spectrum-intensities.

Closely corresponding to this gradation in stimulative energy, is the division of colours into warm and cold hues. There is clearly a maximum of warmth in spectrum-red and a gradual falling-off through orange and yellow to green. But green and blue are generally treated as pretty equal in their coldness, if indeed green is not the colder of the two, as many artists suppose. The shading-off of blue into violet, again, is a clear return to the warm extremity of the scale.

Other peculiarities of the several colours may be found, some

<sup>1</sup> I cannot assign any reason why this subjective scale differs from Young's objective scale by the addition of the fourth element, yellow.

of which fall, like the above, into something of a general scale, as advancing and retiring colours, while others are confined to single colours, as the particular attractiveness which Goethe attributes to blue, the colour that woos us on by seeming to fly from us. But most attempts to define exhaustively the characteristic effects of the individual colours seem to involve arbitrary distinctions.<sup>1</sup>

Let us now pass to those aspects of colours which vary in the case of a given individual tint. First of all there is the intensity or brightness of a colour which answers to strength of sensation and degree of stimulation. Opposed to this is darkness of hue, which is connected with feebleness of stimulation, and which in its lowest degrees is known as blackness. Each of these extremes has its characteristic emotional effect, brightness of colour being exciting and gladdening, while darkness of tint has a certain quieting and solemnising influence.<sup>2</sup>

Next to the aspect of brightness or darkness of a colour comes what is known as its degree of saturation or colour-force. It is known that even spectrum-colours are not perfectly pure from an admixture of white light, which tends to weaken their colour-force.<sup>3</sup> In the case of coloured surfaces the admixture of white light tends to make the colour pale. The more saturated a colour the fuller its force as colour, the less saturated it is the nearer does it approach in its character to white. The two extremes of vivid colour and white are marked by a characteristic emotional effect. Colour is more sensuous, more voluptuous, produces a more voluminous mass of pleasurable feeling: white is less exciting and more serene.

In the case of coloured surfaces a colour may be made less saturated by being "broken" or mixed with neutral grey, which answers to a feeble quantity of white light. In this way the voluptuous colour-effect may be toned down. The extreme supplied by grey is a much quieter impression than white, and has something like a touch of sadness in it. Hence grey serves by contrast to bring out the rich voluptuous effect of colour still more powerfully than white, and in the case of all bright colours emphasises their brilliance as well. Of course the shade of grey

<sup>1</sup> See, for example, Wundt's recent attempt to define the characteristic emotional tone of the several colours (*Physiologische Psychologie*, pp. 440-444).

<sup>2</sup> A change in the degree of light-stimulus is sometimes attended with a change in the quality of the colour. Thus red or yellow light when very feeble gives the colour known as brown.

<sup>3</sup> Helmholtz describes a very interesting experiment by which he was able to obtain a colour-impression fuller or more saturated than that of the spectrum (*Physiologische Optik*, p. 370).

may vary from something indistinguishable from white to perfect black. Every colour, however pure, tends, when it reaches a certain degree of feebleness, to pass into grey and finally into black, as may be seen in the gradual change of nature's tints which accompanies night-fall. Black being the name we give to a surface which reflects the minimum degree of light is equally opposed to white and to colour. It serves to accentuate the brilliance or luminous quality of each.

Thus every colour presents itself as a triple series of gradations between the extremes of (*a*) bright tone and dark shade, (*b*) saturated colour and white, and (*c*) bright and saturated colour and grey or black. It is plain that these scales supply to any particular colour an indefinite number of distinct aspects, which aspects moreover, being common to all colours, afford points of affinity and contrast among different tints.

Let us now glance briefly at the way in which the principle of contrast enters into the combinations of colour. Contrast is the greatest degree of change or variety of impression, which is known to be a universal condition of art. It is only by change, by passing from one impression to another, that vividness of effect can be maintained, and the greater the degree of unlikeness between two impressions the more vivid the effect. Hence strong contrast is the most potent effect in art. There is no doubt that the æsthetic value of change and contrast rests on simple laws of the nervous system. On the one hand, a uniform unchanging impression tends to lose its effect through a gradual loss of functional vigour in the nervous elements involved. On the other hand, transition from one impression to another unlike this implies the excitation in the second case of elements not engaged in the first, that is to say, of elements with a plentiful store of vigour. Yet these considerations do not exhaust the phenomenon. The value of contrast depends on a consciousness of the relation between the contrasting impressions, and so involves a retention of a fairly vivid idea of the first impression. Thus the effect of contrast may be realised when there is no time for the exhausting effect just spoken of, *e.g.*, in passing from a high to a low tone very rapidly. In the case of colours which persist side by side, the effect of contrast may be instantaneous.

According to the double aspect of change just spoken of as relief after an exhausting impression, and a transition to a more vivid impression, various colours in juxtaposition may be said to relieve and accentuate one another. As the eye passes from one to another and reverses this movement, each element supplies at once a condition of repose and of new and vigorous effect. Yet we may roughly distinguish three cases here. First of all,



the contrasting colours may be both stimulating, being approximately equal in intensity or brightness and in extent. In this case which we may call that of equilibrium, and which is best illustrated by a juxtaposition of complementary colours, or colours nearly allied to these, there is the mutual effect of relief and intensification just described. Secondly, the two colours may be very unequal in stimulating force. If the weaker colour occupies the larger space and provides the ground of the brighter colour, as in arrangements of bright warm colours on grey or dark grounds, we have the effect of accentuation. If on the other hand the weaker colour appears as an incidental element in a large mass of bright colour, as in the Chinese and Japanese arrangements where small masses of black are scattered among bright colours, we have rather the effect of momentary relief or repose.

For the rest the pleasure of colour-combination increases according to the amount of discoverable contrast in which each term enhances the value of the other. More especially the characteristic effects of brightness and darkness, the essential element in *chiaroscuro*, and of energetic and restful colour, which again includes the opposition of warm and cold, enter as conspicuous features in the larger number of colour-schemes.

Variety and contrast are of the very soul of the colour-arts. The eye desires change, and the characteristic excellence of any particular colour is only seen when it is placed in surroundings fitted to bring out its specific quality. Just as nature delights the eye by its many variegated tints so the arts of colour seek to gratify it by the greatest possible variety of hue.

Yet change and the unlikeness of contrasting elements are only one desideratum in a combination of colours. There must be unity as well as variety, similarity as well as dissimilarity, supplying the peaceful feeling of harmony. The one principle opposes itself to and limits the other. If there were no unity variety would grow chaotic and confusing, while without variety uniformity would become monotonous. The degree of variety, moreover, is not always the same. Sometimes, where an exhilarating, highly stimulating effect is desired, variety and contrast abound, and the connecting thread of unity becomes faintly discernible. On the other hand, where a more peaceful impression is sought, variety may be reduced to a minimum. Let us see for a moment, in the light of the practice of the best colourists, how the principle of variety and contrast is limited in the case of colours.

In the first place, then, the least conspicuous action of the principle of unity in colours is seen in the preservation of a certain due *proportion* among the elements. One element must

not as a rule extrude another or domineer over it so as to destroy its force. This principle clearly embodies the idea of "perfect retinal activity" mentioned above. It furnishes the most abstract rule in colouring, and one which is exceedingly likely to be over-ruled by other principles. In applying it there is commonly a reference to the complete spectrum-scale of colour. This serves as a standard of complete organic unity, and any given scheme of colour is estimated with more or less distinct consciousness in relation to this scale. When all parts of this scale are clearly and adequately represented, the mind of the spectator has a sense of completeness, which feeling may be called an emotion of harmony, since it depends on a perception of a correspondence with a pre-existing mental standard. It is given as a rule of decorative painting by Mr. Owen Jones, that when seen at a certain distance the colours should seem to blend in a kind of neutral bloom.<sup>1</sup> In practice it is of course sufficient that the principal well-marked classes be represented. The favourite triads—red, yellow and blue, orange, green and violet, &c., owe a part of their æsthetic value to this principle of organic completeness. Similarly the value of complementary pairs, of the contrasts of warm and cold tint, and of light and dark, rests in part on this sense of completeness and proportion.

In the second place, colours may be united much more distinctly by help of the principle of *continuity* or *gradation*. It has already been suggested that the charm of gradation rests in part on the effect of blending impressions. In addition to this a gradation of colours pleases by giving us the sense of change in the gentlest possible form. It implies constant change together with the closest possible amount of resemblance short of uniformity. When colours are linked together by intermediate gradations, they are seen to have an affinity, they are recognised as links of one continuous chain. Light and dark (*chiaroscuro*) supply a second mode of gradation, which may with great advantage be combined with that of colour.

A third and yet higher mode of attaining unity among colours is by *subordination*. Ample variety of tint and of emotional tone being secured, the various details are grouped in relation to some central dominant element, sensuous or emotional. This principle is clearly opposed to that of completeness and proportion already spoken of. There are several recognised methods of securing the supremacy of a particular colour or quality of colour. For instance, the ruling feature may occupy by far the larger part of the area of the painting or design, either in a

<sup>1</sup> Mr. Field has worked out in his "Chromatic Equivalents" the ratio both of light-intensity and of surface requisite to this effect.

single mass or in a broken chain of smaller areas. Thus a landscape painter who seeks to realise a dominant key of bright gladsome colour may, instead of dividing his picture into two approximately equal masses of light and shade, expand and diffuse the light spaces, keeping the dark masses in strict subordination as an element of contrast and relief only. It may be remarked that the breaking-up of the dominant tint or quality of colour into several divided masses gives to the wandering eye the pleasure of recurrence of the like, a pleasure which is of the very soul of melody. Another mode of giving this supremacy is to assign to the dominant element a particular position, more especially a central one in the coloured space. By this means it will project its image on the most sensitive part of the retina when the eye is at rest, and also tend to arrest and hold the eye as the point of repose after each wandering through the peripheral parts of the surface.

The fourth and last mode of attaining chromatic unity is that of *assimilation*. When the highest degree of the emotional effect of harmony is desired, the colour-design must exhibit a considerable amount of similarity. In some cases a single uniform tint is esteemed agreeable, as for example, in ladies' dress and in domestic decoration.<sup>1</sup> Here the element of variety is supplied wholly by light and shade as distinguished from colour.<sup>2</sup>

More frequently the design is made up of a few closely related colours with their several tones and shades, as blues and greens, reds and browns, purple-reds and violets, &c. All such combinations of adjacent hues, provided they do not produce the discordant effect noticed above, supply a large amount of the feeling of harmony, since they are related not only in chromatic quality, but in those characters of warmth, strength, &c., or their opposites, already spoken of. A combination of colours may be assimilated in some cases by a process of suffusion, one colour being apparently laid over a number of colours. The only difficulty here is that of preserving something of the individual colours. This is only possible when the dominant and subordinate lights result in a certain colour that has something of the chromatic quality of each, that is to say, when the colours are not separated by a wider interval than that of the second degree of affinity (as red and yellow). The effect of the medium of the air on distant

<sup>1</sup> This fact appears to be overlooked by Mr. Grant Allen (*Physiological Æsthetics*) who seeks to resolve all the disagreeableness of colour-combinations into a fatiguing excitation of one class of nervous elements only.

<sup>2</sup> This is not exactly true, as change in degree of light is, as I have observed, sometimes accompanied by change in the chromatic quality.

colours illustrates this effect of suffusion, and the same effect is sometimes aimed at in art.

The higher degrees of similarity just spoken of are only aimed at when the fullest effect of harmony is desired. More commonly the artist is content to secure a lower degree of harmony by means of some unobtrusive emotional affinity. Thus, for example, a refreshing and serene character belongs to the colour-scheme of certain marine studies with morning light, in which bright tones of green and blue together with white predominate, while all warm and exciting tints are either excluded or reduced to a very inconsiderable element.

There are two methods of bringing colours together by means of some common character which appear to be so well recognised in art as to call for special attention. The first of these is known as breaking or lowering the tone of colours by bringing them nearer a shade of neutral grey (or black). In this way the individual differences of the colours are softened though not altogether lost. Imagination here supplements sense and restores to some extent the half-veiled hues. The most delightful examples of such subdued colours in peaceful harmony may be observed among the tints of sea and sky on a calm cloudy day. The present taste in decorative art and in dress illustrates the quiet harmonious effect of such subdued colours. When the colours are reduced to a very low shade, and made to approach black, we have a peculiar rich emotional effect which appears to involve an energetic action of the imagination.

The second mode of approximating colours to one another is by means of their other common pole, namely, white. To mix white light with coloured, or to make the colours pale and faint, is to bring them together by another link of affinity. Although this kind of harmony is less frequently sought in art than the other, illustrations of it are not wanting. Slight water-colour sketches on white ground appear to owe something of their peculiar charm to this principle, and in certain styles of colouring, *e.g.*, that of the Chinese and Japanese, there seems to be a preference for combinations of pale tints.

Such then are, so far as I can observe, some of the chief modes of supplying the peculiar element of unity, affinity or harmony in combined colours by means of some colour-element. It must not, however, be supposed that this kind of unity is invariably aimed at. As I have already remarked, the artist who seeks to produce a highly stimulating effect will make use of the greatest amount of variety and contrast in colour. In these cases he may be content with giving to his scheme simply the unity which comes of local connexion and symmetrical form. How much of the peculiar effect of colour-harmony will be

sought depends on the particular aim of the painter and on his individual feeling.

In closing this slight study of the principles of chromatic combination a word may be said as to the influence of experience and association on the æsthetic effects of colours in juxtaposition. I have refrained from enlarging on this side of the subject here, not because I think it unimportant, but because it seems to me better to study all the elements directly presented to us in art before asking how much is indirectly given us by revivals of past experience, individual or racial. In addition to this I will confess that, with respect to the effects of colour in combination, this line of speculation appears to me to promise but little help. It is easy to trace some of the effects of single colours to this source. Thus bright colour is gladsome in part, because it is associated with all the pleasurable feelings that arise from sunshine and bright surroundings. Again warm energetic colours, no doubt, owe some of their peculiar force on the mind to the fact of their comparative scarcity in the variegated mantle of nature, as well as to association with sensations of bodily warmth, &c. On the other hand, it is not easy to see why, if we refer simply to the arrangements of nature and their action on the visual organism, grass-green and blue should not be reckoned one of the most agreeable of combinations. One or two conjectural explanations might be derived from this source, as, for example, that combinations of closely-related colours are pleasing since they constantly present themselves on the surfaces of natural objects, or that gradation owes something of its æsthetic value to its place in the colour-plan of nature. But such tentative suggestions are very unsatisfactory, while on the other hand, the laws of colour-harmony, so far as any such laws can be said to exist, seem to be pretty fully accounted for by data immediately given us, that is to say, the structural peculiarities of the visual organ and the general laws of nervous stimulation, together with well-known principles of mental action.

JAMES SULLY.

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