

ON THE APPARENT HEAVINESS OF COLOURS.
A CONTRIBUTION TO THE AESTHETICS OF COLOUR.

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[From the Psychological Laboratory of Cambridge.]

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1. *The Object.*

THE idea of the following set of experiments, begun in the spring of 1905, concerning the apparent heaviness of colours, was originally suggested to me by Prof. Lipps' contribution to the '*Festschrift*' dedicated to Helmholtz on his 70th birthday, entitled "Die ästhetischen Faktoren der Raumschauung" (*Beiträge zur Psych. and Phys. d. Sinnesorgane*, 1891), a suggestion which I gratefully acknowledge. Starting with the idea of a seemingly inherent, but really '*eingefühlte*,' energy in straight and curved lines, manifested by their direction, length,

curvature, etc. and of a similar expansive tendency, balanced and counteracted by the constraining force of the boundary lines in geometrical figures, Lipps has endeavoured to account on such a basis for a number of geometrical-optical illusions and for the aesthetic effect produced by such spatial combinations. He has since then elaborated this notion into a more complex and wonderfully subtle system, under the paradoxical name of 'Mechanical Aesthetics,' in his *Raumaesthetik* (1897), has brought it into connexion with his '*Einfühlungs-Theorie*,' in his *Grundlegung der Aesthetik* (1905), and has discussed it again, still more recently, in a paper in the first volume of the *Zeits. für Aesthetik* (1906).

The idea occurred to me whether a feature analogous to the energy in linear or spatial arrangements might not be tested experimentally in the case of colours. The difficulty was to find such an energy in colours. It is evident that in the absence of any direction or definitely circumscribed extension (absence, in so far as any boundary lines are not inherent in the colour, but simply imposed upon it *ab extra*), they cannot possess any activity or energy in the sense of that shown by lines or geometrical figures. Yet they do seem to have a characteristic feature, which in some measure might be considered as analogous to the active upward tendency of a vertical line, or the self-centred balance of a circle: namely their *apparent weight*. By the weight of a colour I briefly mean this: supposing a wall 10 ft. high were to be painted in two different shades of one colour, viz. pink and red, in such a way that both should be in equal proportions, the one occupying the space below the other; should the red be placed below, up to 5 ft. from the floor, and the remaining 5 ft. be painted pink, or should the position of the colours be reversed? It is pretty safe to say that the former course would be adopted. The effect of 5 ft. of red on the top of 5 ft. of pink would give to the majority of people an uncomfortable feeling of top-heaviness, instability and lack of balance, which would be absent from the reverse arrangement of the colours. If the red were at any price to be placed above the pink, the only manner in which this could be done satisfactorily, and without producing a special effect, such for instance as lowering the apparent height of the walls, would be, to give, say, 8 ft. of the total height to the pink, and the remaining 2 ft., as a narrow frieze, to the red. Here again the impression of oppressive top-heaviness might be avoided.

The explanation of these facts (if such be the facts) must obviously be looked for in the relation of the two colours, and of the areas occupied by them, to each other, and I submit here that the solution

lies in the apparent differences in weight between the two shades. Red seems of greater weight, density, consistency, or in whatever other way this peculiarity might be expressed, than the pink; hence 5 ft. of pink are easily supported by the same amount of red, but 5 ft. of red on top of the same length of pink would seem to lack the necessary foundation to keep it in its place; again, 8 ft. of pink might be of apparently sufficient strength to prevent the 2 ft. of red, so to speak, from sinking to the bottom. The impression would be an instance of a complex compounded of the visual (colour-) perception and ideas either of weight or of density or solidity, accordingly as heaviness as such, or consistency, massiveness, or impenetrability, etc. were attributed to the colours¹.

The fact that certain, usually darker tints, are preferred below other, generally paler ones, has practically become a decorative canon, though to my knowledge the legitimacy or universal applicability of such a postulate has never been questioned nor have its psychological foundations been investigated. The 'rule' might be formulated thus: "that dark colours should stand below light ones"; but such a wide statement requires a little more specification. In the case of two shades of the same colour (as red and pink) the matter seems pretty clear and obvious. Not only is there very little hesitation as to the arrangement, namely that the darker shade should be placed below the lighter, but the reason for it is evidently referable to the darkness or lower luminosity of the darker shade. The question becomes more complicated in a combination of two different colour-tones: given two colours as red and blue, or pale-green and pink, one finds very much less certainty about the choice of arrangement. On account of the difficulty of determining, by sight, the relative luminosities, which might unambiguously settle the selection, deviations from the rule frequently occur, due to other factors, such as a personal predilection for one or other of the colours, the 'strikingness' of its brilliancy and saturation, warmth or coldness, dulness or energy, associations with natural objects, such as landscapes, in short any of the innumerable and often apparently quite irrational grounds which determine colour-preferences.

¹ This 'idea' of weight or solidity may remain purely abstract, or may in some cases actually be realised in concrete images of a muscular or tactile nature, accordingly as individuals stop at the simple 'representative' stage or proceed to revived sensations. 'Idea' is meant in the following paragraphs to cover all stages lying between these extremes.

The problem, consequently, presents two points, capable of being experimentally tested :

(1) How far does the rule that dark shades or colours be placed below light ones, hold good? Is it applicable to shade-differences only, or also to tone-differences? and

(2) What is the principle on which this rule rests?

It might possibly, as has been suggested by several of my subjects, be due to association with natural objects or phenomena; or it may, as I ventured to submit, be interpreted as the result of a complication of the colour-sensation with ideas of weight or solidity; that is to say, it might simply be an application of the mechanical law of gravity through the attribution of weight to colour, and thus form a parallel to Lipps' mechanical-aesthetic interpretation of linear and spatial objects. Exceptions or deviations from this 'weight-principle' (if I may be permitted this short expression) would have to be accounted for by other factors.

The weight-principle itself may in the case of shade-differences be traceable to either saturation or luminosity; and as regards tone-differences, the colour-tone itself might be adduced to afford an explanation. I believe, however, that luminosity is sufficient for the interpretation of the facts, at least apart from cases, very numerous indeed, where factors, other than the weight-principle become operative.

2. *Material and Method.*

For the purpose of testing these two problems a number of plates were made, to exhibit the colours to be investigated. Each plate contained two geometrical figures of identical shape, and each figure was composed of two colours, placed one above the other, the difference being the inverse arrangement of the colours, in such a manner that the colour which occupied the lower half in the one figure occupied the upper one in the other. The figure chosen was a triangle with two equal sides, the base measuring 12 cm., and each of the other two sides 20 cm. Each triangle was divided horizontally by the line where the two colours met, on the average at a distance of 8.02 cm. from the base. The reason which led me to select triangles for this purpose was this: The impression of the apparent weight of colours is mainly relative; *i.e.* it is primarily an impression of weight-differences; and in order to obtain the impression in any marked degree, the colours have to be

apperceived as belonging to each other, by being part of *one* object (as a wall, for instance). The spatial connexion between them is therefore of paramount importance, and the point was to present them in such a manner, that they could not possibly be dissociated from each other, nor be apperceived separately as belonging to different objects. Again, the idea of height or verticality is essential, in order that the weight of a colour, either supporting or pressing down upon the other colour, should be clearly felt. Now, a triangle seemed to me to combine both these desiderata. While on the one hand presenting verticality in the most emphatic manner, it brought at the same time the colours into the most forcible proximity to each other, by making each section only part of the whole figure; it certainly did so more than a vertical rectangle, divided horizontally, could have done, and thereby prevented the dissociation of the colours from each other, or the apperception of a single part of the figure rather than the whole. I believe the subjects were materially assisted in this object by the triangular shape of the figure. Its general appearance is shown in Fig. 3 below, and the very fact of the lower half by itself appearing incomplete, the idea of a triangle being once present, would naturally lead the observer to complete it, by at once including the whole figure in one apperceptive act. A vertical rectangle, divided horizontally would, on the other hand, easily and naturally have lent itself to a resolution into two squares, each containing one colour, and each being finished and complete in itself; and thereby the intimate connexion between the colours would have been broken. As it was, this difficulty has not in all cases been successfully overcome, even by the use of triangles. Especially in the case of tone-differences, one individual colour was occasionally so absorbingly interesting, particularly to a certain type of subject, that the spatial relationship of the two colours was ignored, and the question resolved itself simply into one of colour-preferences, instead of weight-differences. And here a defect in the use of triangles appeared which I had not anticipated, but which ought to be pointed out, as neutralising in some cases its advantages. The triangles being divided as they were, it was inevitable that the lower colour should occupy a larger area than the upper one, and persons following simply their colour-preferences, usually selected that triangle in which the preferred colour occupied the larger space, where "there was more of it," after the expression of several subjects; and thus a new criterion for choice was introduced, sometimes systematically for all figures, sometimes only in cases where weight-differences

were hardly perceptible and did not offer a sufficiently clear principle for selection. At the same time, this defect, inherent in the use of triangles, revealed an interesting fact to which attention will be drawn later on.

The plates were simply made in the following manner: two pieces of coloured paper were cut into four strips of sufficient width, and were pasted crosswise, side by side on a piece of cardboard (cf. Fig. 1). Another piece of cardboard of the same size, on which two triangles were cut out side by side (Fig. 2), was pasted on to the first piece, so that the four strips of paper were seen in the triangular figures,



FIG. 1.

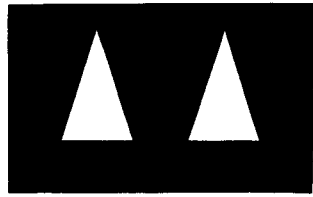


FIG. 2.

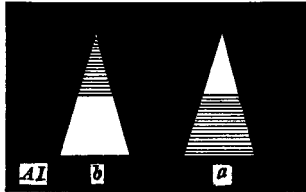


FIG. 3.

presenting the appearance of Fig. 3. Since the first point was to test the application of the rule, that dark colours should stand below lighter ones, to *shade-* and *tone-*differences, I arranged two series of six plates each, the first containing only shades of the same colours, while the second showed actual colour-differences. The first was called A and the second E, and each triangle on each plate was lettered *a* and *b*, *a* marking the triangle in which to all appearances the darker colour or shade was below, *b* where it was above. The manner of marking the plates and triangles is shown in Fig. 3.

Consequently, *a* was the triangle which ought to have been selected, if the weight-principle was applied, though it might, of course, also happen to be preferred for other reasons. The second piece of cardboard (on which the triangles were cut out) was covered with ordinary

French-grey writing paper, so that the colours appeared on a grey, slightly bluish background. In order to vary the conditions a little more, when desirable, I had another piece of cardboard made, with triangles cut out after the pattern of the second, but covered with black paper, so that, by superimposing it on the plates, the colours could be shown on black, thus giving two more series marked respectively B and F; B being the A series (shade-differences) on black, F being the same for E (tone-differences). The advantages of using also a black background only struck me after I had begun the experiments, and consequently a number of subjects were not tested with this variation; in the subjoined table of the results I shall omit these two series, B and F, to save space, but shall give them in the analysis, whenever the results, obtained with them, present special features of interest.

If the weight-principle were to apply to colour-arrangements in which the one colour stood vertically above the other and, so to speak, weighed upon the one below it by the simple action of gravity, it would be interesting to observe the effect of combinations in which the verticality of the colour-sequence is less obtrusive, the question of stability or balance therefore less emphasised and the spatial relationship of the two colours less forcibly impressed upon the subject than is the case in the triangles. I therefore supplemented the main series A and E by

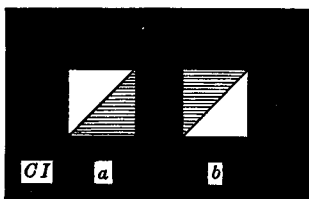


FIG. 4.

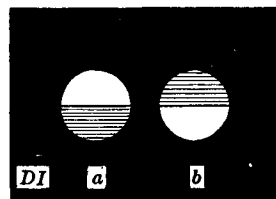


FIG. 5.

four other shorter series, marked respectively C, D, G and H. Each comprised four plates, on each of which two figures containing two shades or colours were shown side by side. C and G presented *squares*, divided *diagonally* by the meeting line of the two colours, C containing only shade-differences and G the tone-differences. D and H contain *circles*, divided *horizontally*, D with differences in shade and H with differences in tone. The manner of marking them was the same as in the case of the triangles, and Figs. 4 and 5 give an idea of their general appearance. It is evident that the relative absence of pronounced

vertical extension and the comparative lack of points of orientation (such as are naturally given in the triangles by their base-line) in these four series, might modify or at least weaken the weight-effect of the colours, as compared with the triangles. It would be no longer simply a question of one colour supporting or not being able to support another colour as in the triangles; at best, a square like *C I b* might give one the idea of the darker top-part sliding off the lighter bottom-part, or the circle *b* in *D I* capsizing and turning itself round into position *a*, to find its balance. The answers, given by some subjects, partly confirm this expectation; often the weight-effect of the colours was even so far weakened that no preference was given to either arrangement; otherwise the heaviness of one colour manifested itself in impressions like those just described.

The usual optical illusions concerning the shape of the figures was, of course, commonly present: thus the *squares* appeared slightly elongated vertically, *i.e.* as vertical rectangles, though I believe, owing to the diagonal line, the illusion was not as pronounced as it would have been, had the square been of a single colour. In any case this illusion can hardly have influenced the results. The *circles* seemed very markedly flattened, *i.e.* appeared as horizontal ellipses, on account of the diameter being visible, and possibly this may in many cases have counteracted the expectation of their capsizing; but as I never heard a remark to this effect from any of the subjects, though plenty regarding their elongated appearance, I am unable to say to what extent this may have been effective, and only mention it as a possible factor of confusion. A somewhat more serious defect, however, I happened to discover in the case of the squares, although not of the nature of an optical illusion. In Figure 4 the two squares are seen side by side, and it will be noticed that the colours on the inside of the square are the same, as indeed was unavoidable; this seems to have suggested to some subjects the idea that the colours ran through underneath the grey intervening space; in other words, that the colour was continuous and that there was "more of it" than of the outside colours. This supposed continuity of the inside colours may have constituted a vitiating factor; if the two figures were not properly separated from each other in the apperception, the impression would have been that of three bands of colour running diagonally across the whole plate and only hidden accidentally in parts by the grey paper (Fig. 6). It is evident that, if regarded in this light, the figures would have lost their individuality and each colour-arrangement would no longer have appeared to be

conditioned by its own balance. The defect might have been remedied either by separating the squares from each other by a greater distance or by drawing a black vertical line between them to prevent their being taken as belonging to each other. As such cases however were rare, I thought it best not to introduce a new variation, which would have rendered the latter part of the experiments with this series incomparable with the former part, carried out under the old conditions.

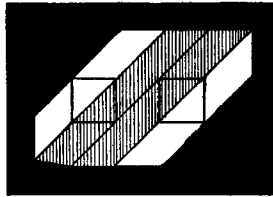


FIG. 6.

Some other optical illusions referable to the colour rather than to the linear elements in the squares and circles will be mentioned later.

All the colours used were shown by coloured papers, pasted on cardboard in the manner described. Some were papers specially pigmented with saturated spectral colours, such as are manufactured for optical experiments, others, particularly dark, pale, broken and mixed tints, I managed to procure in sufficient selection from the bookbinding and wall-paper-trades. In all 30 shades were used as shown in Table I.

A complete list of all the material used and the distribution of the colours is given in Table II.

Altogether 50 subjects were tested with these plates. They varied in age from 8 to about 50; for the greater part they were graduates and undergraduates of the University, between 20 and 40. The youngest subject (eight years old) is number two in the table of results, number seven being the next one in age, a boy of about 12 or 13. The minority included some ladies, and also some men of inferior education; but as will be apparent from the results, the educational status does not affect the point at issue in any remarkable way; whatever divergencies between various individuals do occur, are in my opinion rather to be referred to differences in emotional or generally psychical constitution than to purely intellectual powers or training.

The method of testing was briefly the following: the subject was seated in a chair in an attitude most convenient to himself and the plates were shown to him in sequence at a suitable height, so that his visual plane was at right angles to the plate, to avoid distortions

TABLE I, *giving the colour material and luminosities.*

Colour	Description	Luminosity ¹	No.
I Blue	1 saturated spectral blue ...	88·66	6
	2 less saturated, very brilliant	79·0	
	3 paler (dark sky-blue) ...	78·0	
	4 brilliant pale blue ...	70·0	
	5 green-blue (turquoise) ...	65·0	
	6 very pale blue ...	31·83	
II Red	1 saturated crimson ...	79·5	5
	2 less saturated (rose) ...	76·5	
	3 dark pink ...	53·5	
	4 paler pink (salmon) ...	48·83	
	5 very pale pink ...	31·66	
III Green	1 very dark green ...	86·16	7
	2 dark green ...	83·5	
	3 grey-green (pale olive) ...	69·33	
	4 pale green (yellowish) ...	60·83	
	5 pale green (bluish) ...	54·5	
	6 bright blue-green ...	48·16	
	7 bright yellow-green...	32·5	
IV Brown	1 dark brown (chocolate) ...	87·0	4
	2 dark red-brown (terra-cotta)	73·16	
	3 light red-brown ,,	54·33	
	4 pinkish brown ...	52·0	
V Yellow	1 saturated yellow ...	29·83	3
	2 pale yellow ...	22·16	
	3 pale green-yellow ...	16·5	
VI Purple	1 blue-purple ...	87·16	2
	2 red-purple (magenta) ...	81·5	
VII {Green Grey	1 dark ...	70·0	2
	2 pale ...	46·83	
VIII Orange	1 saturated ...	59·83	1
	Total of Colours used	30

¹ The figures are the percentage of black in the grey compared with each colour. As it was only a question of the relative not absolute luminosity, these values are not corrected by the deduction of the luminosity of the black paper. The figures are the average of six observations on each colour. The luminosities were found by means of Maxwell's rotating discs, after the method described by Rood, 'Colour,' London, 1904. 4th ed. p. 34 (International Scientific Series).

TABLE II, showing total material and distribution of colours.

A, triangles, shade-differences	E, triangles, tone-differences	No. of plates
I green-grey 1 + green-grey 2 II blue 6 + blue 3 III green 1 + green 6 IV yellow 1 + yellow 2 V red 5 + red 2 VI brown 2 + brown 3	I blue 1 + orange II purple 1 + green 1 III purple 2 + blue 5 IV green 5 + red 2 V red 4 + green 3 VI blue 1 + yellow 3	12
B, same as A, on black	F, same as E, on black	12
C, squares, shade-differences	D, circles, shade-differences	
I brown 2 + brown 4 II green 2 + green 7 III yellow 1 + yellow 2 IV red 1 + red 4	I brown 2 + brown 4 II green 4 + green 5 III blue 5 + blue 6 IV orange + yellow 1 ¹	8
G, squares, tone-differences	H, circles, tone-differences	
I blue 2 + red 1 II green 6 + brown 2 III yellow 1 + red 2 IV blue 4 + yellow 3	I brown 1 + red 3 II green 7 + yellow 2 III brown 4 + green 5 IV red 1 + green 2	8
Total of plates used in the tests		40

of the figure by perspective. They were held at a distance to suit his eyesight, but at the same time far enough away to hide small irregularities in the outlines of the figures or minor blemishes in the colours. As one of the two strips of paper, composing a figure, was slightly overlapping the other to ensure a clean boundary line, care was taken to present the plate at a sufficient distance to prevent the subject from becoming aware which strip was overlapping the other. He was then asked which of the two figures he preferred *as a whole*, time being given to inspect them at leisure, until he was able to make a choice. Cases of hesitation or doubt were noted, and, if desired, a second choice could be made, in which event both were registered. After nearly each exposure and selection I asked the

¹ This combination ought to be classed under H.

subject to give me the reason of his choice of the figure preferred, or at least the ground for his rejecting the other. Not infrequently subjects pronounced the combinations too hideous to be able to make a choice at all; I then asked to select, if possible, the figure which displeased the less of the two; in fact, all through, I took care to impress upon the subjects the fact that it was less the preferences than the *reasons* for the preferences that I wished to know, and that, in the absence of these, the reasons for rejection, though only negative, might to some extent supply the lack of the former. Often no reason was forthcoming at all in the beginning of the experiments, but with a little practice, some reason or supposed reason was generally discovered. The method was consequently purely introspective, and I was pleasantly surprised to find a definiteness and frankness in most answers which afforded some guarantee of the genuineness of the reasons prompting the choice. I was equally astonished at the amount of introspection in the majority of subjects; there were indeed some with whom it was exceedingly small, but it was always possible to obtain information of some sort, with the exception of no. 27 and no. 32, who were at an absolute loss to account for anything and seemed to live in a most amazing state of ignorance of their own mental life. That the introspective method labours under certain defects and may be vitiated to some extent by self-deception must, of course, be admitted; and it seems to me that more especially in aesthetic experiments on colour-effects, there are particular difficulties attaching to it. The old adage that "there is no accounting for tastes" is perhaps more extensively appealed to concerning colour-impressions than in any other form of aesthetic experiences, and the poorness of effect to which the majority of people seem susceptible, only increases the neglect with which such effects are treated. People hardly ever talk to each other on this point: that one person may like a colour which another detests, is accepted as an ultimate fact, as a preordained arrangement which it would be useless to inquire into. People do not, as a rule, try to explain even to themselves their reasons for their preference or dislike, and a good many subjects were greatly surprised at the idea of being asked to account for them. The majority affirmed that they had never thought about it and confessed that they found some difficulty in giving reasons. Nevertheless, there is no other method for aesthetic experiments; the statistical method of proceeding, as I shall try to show, serving no purpose whatever. It is a case of making a virtue of necessity.

Whenever there was a great dearth of introspection, I tried to elicit some information by questions, proposing a variety of reasons which experience had shown to be operative in other cases. The risk of such 'leading questions' must again be readily conceded, but I think it ought not to be over-estimated. The promptness with which certain suggestions were repudiated, the care and hesitation with which others were weighed before being tentatively accepted and the sudden spontaneity of explanations entirely different, assured me on the whole of the harmlessness of such questions. Above all it testified to the good will, earnestness and sincerity of all concerned in the experiments and I should like to take this opportunity of thanking them again for their readiness to submit to the rather tedious tests, and for the assistance they thereby rendered me. I should also like to express my best thanks to Dr Rivers for the facilities he has given me and for his advice in carrying out the experiments.

I now proceed to the results of the experiments, given in the following Table. Series B and F are omitted, as I mentioned before, and similarly the comments made on the selections by the subjects. These will be mentioned and utilised in the analysis. Blank spaces indicate a few omissions which occurred by oversight; "no preference" is marked by a dash, doubts or difficulties in selection are denoted by a query after the figure chosen.

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<i>Group II. 1</i> (pp. 134—136).																																			
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<i>Group III. 3</i> (pp. 146—148).																																			
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<i>Group III. 2</i> (pp. 145—6).																																			
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<i>Group III. 1</i> (pp. 143—145).																																			
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A	Ia	IIa	IIIa	IVa?	Va	VIa	C	Ia	IIa	IIIa	IVa	G	Ia	IIa	III	IVa																			

Note: Records referred to on pp. 134—148 and not given under their respective groups, will be found under Group I. or other preceding Groups.

Two cases not referred to in the text.

3. *The Analysis.*

I. What is the meaning of the results as given in Table III and how are they to be interpreted?

In Table IV below, compiled from Tables I and II, will be found the luminosities of the colours, forming the combinations, and the letters of the figures, which ought to be preferred on the weight-principle, assuming the weight-principle to be based on the luminosities; and the most obvious course would seem to tabulate statistically the results of Table III and deduce by calculation the preponderance of preferences of the *a*'s, to prove both the existence and the basis of the weight-principle. But a moment's reflection will show the deceptiveness of such a statistical method in this case; and since this is a matter which affects experimental work in Aesthetics generally, I feel bound to substantiate my previous remark, that here statistics serve very little, if any, purpose. Its use in aesthetic experiments I believe even to be to a large extent responsible for the discredit into which the latter have fallen, both in the eyes of laymen and men of science.

The application of statistics to aesthetic experiments dates from Fechner, who, in his investigation into Zeising's principle of the 'golden section,' for instance, has inaugurated their use. He tested a number of subjects with a series of rectangles, one of which was constructed on the golden section-ratio, registered the preferences and deduced statistically his results. His object was to ascertain which form of rectangle was the most universally pleasing, hoping that by a certain consensus of opinion the one, embodying the golden section, would receive the greatest number of votes, and that thereby the applicability of the principle would be proved. He certainly did obtain results which on the whole confirmed his expectations, the majority of choices falling on or near that particular figure. But did he prove thereby the existence of such a principle as the golden section? Would it have been proved, even if all the preferences had been given to the one figure which represented the golden section-ratio? I think, he could claim to have shown nothing but a strong presumption in favour of it, but by no means to have given a proof of its existence. His tacit assumption that, if the rectangle constructed on the golden section-ratio were usually selected, it must be selected for this reason, is after all simply an assumption, incapable of proof by the statistical analysis of his results. What his tests show, and what alone they could show, was that a certain rectangle, the sides of which bore approximately the

ratio of 3:5, was more generally acceptable than those which differed widely from it. The main result was the statement of a fact which in itself contained no data for its explanation, and the fallacy was the assumption that there must necessarily be only *one* explanation, and that the golden section must needs be the principle accounting for all the preferences, given to the one rectangle constructed on its ratio. Invaluable as the statistic method undoubtedly is, its use is restricted to certain conditions; the mere numerical accumulation of facts can render no proof of the existence of any underlying principle, unless it can be demonstrated or at least reasonably be assumed that all the facts are due to the working of one and the same principle. Yet, in the present state of our knowledge, there is nothing to indicate that in aesthetic preferences one single reason is everywhere active; on the contrary, everything goes to show that a variety of reasons prompts aesthetic selections. The uniform reduction of all aesthetic phenomena to one single principle would mean, at least at present, an indefensible narrowing and impoverishment of Aesthetics as a science, and would make it impossible for it to do justice both to the various forms of aesthetic objects and the individual differences in the experiences. Thus even granting, in the case of Fechner, that the golden section had been operative in some of his subjects, there is nothing to show that other reasons might not have prompted others to the same choice, and by simply disregarding the subjective motives of each individual, he necessarily vitiated his results, by swelling the number of preferences given to the golden section-division by others which were not by any means due to the same cause. The systematic neglect of the individual factor, due to the distrust of introspective evidence as unscientific because it is subjective, and the unjustified assumption that one principle must account for everything, seems to me mainly responsible for the disrepute into which experimental work in Aesthetics has—and it must be admitted, fairly deservedly—fallen. There may be other objections and difficulties such as have been pointed out by Volkelt¹ and Lange² for instance; but this, it seems to me, is the real reason for the half incredulous, half contemptuous smile with which the very idea of 'aesthetic' experiments is generally received.

Experimental work in Aesthetics has no justification, if its aim does not go beyond the discovery of generally pleasing objects. Yet strange

¹ (L.) = F. Volkelt, *System der Aesthetik*, München, 1905, Bd. 1. S. 36.

² K. Lange, "Über die Methode der Kunstphilosophie," *Zeits. für Psychol. u. Physiol. d. Sinnesorgane*, Bd. xxxvi. 1904, S. 395 ff.

as it may seem, this has been and is still to a large extent the main object of tests and experiments with simple geometrical figures, rhythms, colours and colour combinations. Aesthetic experiments are not an end but only a means, a means to the comprehension of more complex and intricate aesthetic experiences, by providing relatively simple conditions which may facilitate the understanding, explanation and tracing of the mental states involved in the appreciation of aesthetic objects. The only necessary assumption is the similarity between aesthetic states of a more complicated and those of a simpler type. That there may be besides differences of a qualitative nature, due to the artificial and forced conditions of the experiment, must naturally be admitted and cannot simply be set aside. Still the value of experimental tests will be conceded, if they be regarded as such a means; but in order to attain its object, experimental aesthetics (to quote from an article by Segal¹) "must be, not statistical, but psychological."

It is easy to illustrate from the Table of results the insufficiency or rather fallacy of a statistical tabulation of the objective preferences. Referring to Table IV below, it is evident that if the weight-principle is operative, *a* in A I should be chosen, and taking five cases, it will be seen that nos. 17, 21, 31, and 47 actually do prefer *a* to *b*, while for instance no. 35 records his inability to make a choice. Objectively the four former cases are equivalent to each other and would, if they were the only observed cases, give 100% of preferences for the weight-principle; as a matter of fact, there is only one instance (or 25%) of choice based on it, namely no. 17; no. 21 prefers *a* on account of a landscape-association (cf. below), and no. 47 because he prefers the darker shade of the greenish-grey which in *a* covers a larger area than in *b*. No. 31 belongs to a small, but interesting class, which for want of a better name, I should call 'the negative weight-class'; subjects belonging to this type select as a rule the *b*'s, on account of their greater lightness and more marked triangularity (cf. below) and no. 31 was led to select *a* in this case, because the luminosities of the two shades used in A I, differ only slightly, and *a* consequently does not show the massiveness or squattiness which he otherwise objects to in the *a*'s. No. 35 again, who on the whole is a fairly consistent adherent of the weight-principle, was, for the same reason as no. 31, unable to make up his mind which of the two figures to prefer and therefore

¹ F. Segal, "Über die Wohlgefälligkeit einfacher räumlicher Formen," *Archiv f. gesamte Psychol.* Bd. VII, S. 86.

abstained from choice. In these four or five cases some of the leading criteria which actuated the selections throughout the tests are represented, and the importance of taking note of the subjective reasons for choice, and the impossibility of obtaining trustworthy results by a statistical classification could, I think, be hardly more strikingly demonstrated.

The first question to be considered was the following: "does the rule that dark tints should be placed below lighter ones, apply only to shade-differences, or both to shade and colour-differences?"

To obtain an answer from the results in Table III it is necessary first of all to eliminate those cases which professedly accept selective criteria other than those inherent in the colour-arrangements themselves for the solution of the problem which colour or shade should stand below the other in the figures. This is not, as it might at first sight seem, arguing in a circle; if, it might be objected, those cases which do not conform to the rule are eliminated, it would not be surprising to find that the remainder do conform to it. But we are not eliminating cases which do not conform to the rule, *because* they do not conform to it, but because the rule, whether followed or not, does not exist for them. We are not concerned with the objective preferences in themselves, but with the reasons on which they are based; and from this point of view, it is evident that cases which are influenced not by the purely spatial relationship of the two colours and their mutual inter-dependence, but by other motives, can have no claim to sway the balance either for or against the above rule, which applies precisely to that spatial relationship. Such cases are, for instance, those of preferences for individual colours; they break the connexion between the two colours contained in one figure, by emphasizing one to the detriment of the other. Theoretically there ought then to be no preference for one figure rather than for the other, since the same colour is found in both; and if, as we shall find, there are nevertheless very strong predilections among individuals of this type, the selection is due to the spatial form of the figure and not exclusively to the colour-arrangement as such. Again, landscape-associations, which are fairly numerous, determine preferences which must here be excluded, as being the result of a purely accidentally operative factor; they too are traceable directly to the linear element of the figures, cooperating with the colour-combination, but independent of the position of the colours relatively to each other, apart from their being placed within such and such a geometrical space. If the colours had been presented on a wall instead of enclosed in a

triangle or circle, the landscape-association would probably never have arisen. These are only two classes which can obviously have no voice in the determination of this first point; but there are other factors of a similar nature, and the sometimes very chaotic appearance of the records in Table III is due partly to the constant use of one, and partly to the miscellaneous application of several such principles.

After the elimination of such cases, the remainder are those which make selections on the basis of a mutual influence of the colours on each other and of their spatial relationships to each other. That they indeed adopt the weight-principle in some form or other, is at this juncture simply a coincidence with which we are not at present concerned. It is only interesting as offering a guarantee that the effect of the spatial connexion between the two colours was considered in the selections.

Even a cursory survey of the records of this class in series A and E shows, I think, two points with sufficient clearness:

(1) That the rule, almost without exception in the shade-differences, applies equally to the tone-differences; but that (2) the tone-differences introduce into the selections an element of uncertainty and hesitation, as shown by the occasionally very erratic preferences in series E.

The most convincing cases are those of nos. 11, 14, 17, 26, 41, 42, 43, 44, and 50, for instance. Considered as a class, their characteristic is the remarkable similarity shown in their uniform preferences for the *a*'s in A and also in E, with occasional differences of opinion concerning E II, and E III. Since none of the subjects betrayed any signs of employing various criteria, but consciously adopted one single principle of selection in their preferences, there can be little doubt that the same principle that was active in series A was also applied to series E, both to the shade- and colour-differences. And there can be equally little doubt about the objective features in the figures which led them in their selections. I subjoin here for reference Table IV, which shows the combinations of luminosities in the figures and the selections which ought to be made, if the luminosities are taken as the determining factor. That the preferences of this class are really based upon the lightness and darkness of the colours, *i.e.* upon their relative luminosities, is, I think, sufficiently evident from the concord of these cases with Table IV, and would hardly require any special proof, even if such proof were not furnished by their introspective evidence. Though the conformity with the postulated selections of Table IV is sometimes perfect in both series, a certain amount of indecision and discrepancy of opinion is nevertheless

evident in series E, in spite of the complete regularity in series A. Cases representative of this point are for instance, nos. 10, 29, and 36; and I believe, by way of explanation, that the difficulty of comparing the luminosities of two different tones, in comparison with the facility of doing so in the case of shade-differences, is beyond dispute responsible for a good deal of the uncertainty, shown either by inability to choose as in no. 29, or by divergencies of opinion between these subjects in their actual selections.

TABLE IV, *showing combinations of luminosities and selections postulated thereby.*

A			E		
I	70·0 + 46·83	a	I	88·66 + 59·83	a
II	78·0 + 31·83	a	II	87·16 + 86·16	?
III	86·16 + 48·16	a	III	81·5 + 65·0	a
IV	29·83 + 22·16	a?	IV	76·5 + 54·5	a
V	76·5 + 31·66	a	V	69·33 + 48·83	a
VI	73·16 + 54·33	a	VI	88·66 + 16·5	a
C			D		
I	73·10 + 52·0	a	I	73·16 + 52·0	a
II	83·5 + 54·5	a	II	60·83 + 54·5	a
III	29·83 + 22·16	a?	III	65·0 + 31·83	a
IV	79·5 + 48·83	a	IV	59·83 + 29·83	a
G			H		
I	79·5 + 79·0	?	I	87·0 + 53·5	a
II	48·16 + 73·16	b	II	32·5 + 22·16	a?
III	76·5 + 29·83	a	III	54·5 + 52·0	?
IV	70·0 + 16·5	a	IV	79·5 + 83·5	a?

(I should mention here, that possibly in the tone-differences the colour-tone itself was not quite without influence on the choice, quite apart from the luminosities; but only occasionally and under certain circumstances. I noticed sometimes that, when there was a great difficulty in deciding between the luminosities of two colours, and the selection was not quite unambiguously settled by reference to it, the subject in his uncertainty clutched, so to speak, at any other criterion that might happen to present itself rather than leave the question

undecided. This occurred notably in E II, which in fact was specially devised as test-plate for this emergency. It is not improbable, though I was unable to obtain definite information on this point, that a certain 'strikingness' or other peculiarity of one of the two colours might have helped to solve the doubt; and I confess that I cannot otherwise account for the discrepancies of selections in E II; one would have expected no selection at all, as indeed often happened, if the luminosities alone were considered (cf. Table IV), while, as a matter of fact, the majority of subjects chose either *a* or *b*, even subjects who otherwise were uniformly and exclusively guided by the relative luminosities. But instances of this colour-influence are exceptional and the admission of its occasional effect does not, therefore, invalidate the general assertion that it is the luminosity which forms the principal factor in the preferences, in as much as the colour-tone only acted as a supplementary criterion, if the usual one failed.)

The cases I have quoted so far, as showing the application of the rule to shade- and colour-differences are only the purest and most representative; but the same fact is amply attested by others which are less unadulterated and show the sporadic influence of the working of various principles. The number of such 'adulterated' cases is, as might be expected, very large, but they contribute, notwithstanding their irregular appearance, to the cumulative evidence for this point. Cases in question are: nos. 3, 4?, 9, 18, 19, 20, 23?, 24, 25, 27, 28, 29, 30, 33, 35, 37, 39, 40, 45, 46, 48, and 49?.

As illustration may serve the record of no. 45: Series A I—III and V conform to the rule and similarly E IV and VI. In A IV, *b* is preferred because "it looked less heavy and massive than *a*" (there was often some difficulty with this plate), and in A VI, *a* and *b* are both unpleasant and therefore indifferent. In E I there is a strong objection to the glaring blue and *b* is chosen as containing less of it (in the apex) and as regards E V the result is the same as in A VI, only for the opposite reason; both *a* and *b* are pleasant and the outcome is that no selection is made. Instances therefore, which do not conform to the rule are explicable on special grounds which have nothing to do with the mutual influence of the colours on each other, and consequently can not militate against the rule.

Such irregularity is, as a matter of fact, the usual result, absolutely uniform cases as nos. 17 and 50 being decidedly exceptions; but after a careful analysis of cases seemingly quite chaotic, the fact still remains that the rule applies and even predominates, in spite of frequent

divergences from it, in series E, the tone-differences, as well as in A, provided always that the luminosity-differences are sufficiently marked to afford a criterion; otherwise hesitation, uncertainty or even indifference is the result.

II. The recognition of the important part which luminosity plays as the leading factor in determining the selections, brings us face to face with a second question: What is the reason of the 'rule'? The answer, that the *luminosities* form this basis, only begs the question, since that much is already implied in the rule itself. The problem is to link the facts up with some principle of wider application, such for instance as the law of gravity, and the above question really amounts to this: "Is the rule really grounded, as I have suggested, on some weight-principle, *i.e.* on the attribution of heaviness to colours of *less*, and of comparative lightness to colours of *greater*, luminosity? Or is it due to some normative idea, based upon associations with, or revived memories, of, natural objects or phenomena?"

In confirmation of the former view I have to offer evidence of three kinds: the first two as introspective testimony of the subjects, the third as a presumption in favour of it, derived from the objective records of Table III.

1. The testimony of many subjects pointed directly to some kind of weight or heaviness ascribed to the darker colours. It generally took the *negative* form that the *b*'s in A and E, especially in A, looked "top-heavy," and were therefore rejected. Subjects who volunteered this statement, when asked for the reasons of their selections, were very numerous: nos. 5, 10, 13, 17, 23, 35, 36, 37, 41, 42, 43, 44, 45, and 50, all expressed the same impression in practically the same words, namely that *b* was top-heavy. A few went so far as to account *positively* for their preferences, as for instances, that in *a* the darker colour looked more "substantial" (no. 13), that it gave better "support" (nos. 26 and 35), that it appeared more "solid" (no. 43) or imparted to the whole figure a better "balance" (no. 48).

There were some subjects who were unable to offer an explanation spontaneously, though they quite obviously belonged to the same class, both by reason of the regularity of their selections and the absence of other acknowledged principles. When the question, however, was put to them afterwards whether the *b*'s of certain plates did not perhaps look top-heavy or unbalanced, they promptly admitted this impression. It would, of course, be rash to place much stress on evidence of this kind, but as no other reason was given and the results accorded

perfectly with this criterion, it might be considered fairly safe to assume that the suggestion accorded with the subjective impression. Instances of this kind are furnished by nos. 20, 27, and 29. I believe that generally the acceptance of the suggestion was quite *bond fide*. No. 49 flatly refused to adopt it, by saying that he did not have the impression of top-heaviness, but simply preferred the darker colour below. It was useless to press for a reason nor could any other acceptable motive be discovered. Other persons who were unable to give any account of themselves, were rare on the whole; nos. 3 and 33 confined themselves, as no. 49, to baldly stating that they liked to see the darker colour below, but nothing more, while others, as nos. 24 and 25, though neither giving nor accepting any explanation, were evidently following the usual rule.

Very few individuals seemed to approach the whole question in any prejudiced spirit or with any preconceived notions as to the position which the darker colour *ought* to occupy, the majority confessing that they had never even given a thought to the matter. Nos. 9, 14, and 39 admitted that they were to some extent guided by the normative idea that the darker colour *should* stand below the lighter; but that the impression was in itself sufficiently pronounced to yield regular preferences, is shown by no. 10, who was perfectly aware of the rule and of the whole purport of the tests, yet nevertheless expressed his astonishment that his judgments were as definite and his impression of the weight-differences as marked as they actually were.

Of specially noteworthy features in this connexion only three are to be mentioned: (1) No. 38 stated that he was conscious of top-heaviness only in the case of the squares and circles, while his selections in A and E, though objectively conforming to the rule, were accounted for on other grounds. This is a distinctly unusual result. (2) No. 40 gave an explanation which is equally exceptional: namely that the darker colour "stood out" more than the lighter one and that therefore the latter seemed "more natural" above; it would therefore seem as if some perspective illusion were at work in some of his preferences, though not quite of the kind which we shall meet later. His record is, by the way, very intricate and rather irregular. (3) An interesting point is represented by nos. 11 and 30. No. 11 is objectively quite regular, and afterwards admitted the idea of heaviness; but his first explanation (which in his case may have been the true one, though perhaps only a periphrase of the weight-idea) was "that some colours were more striking than others and that the less striking rested

naturally upon them." This "strikingness" was still more marked in no. 30, who indignantly repudiated the idea of weight in colour, and would have it that the apparent heaviness (which he admitted) was due to the more forcible manner in which some colours struck him.

2. If this may be called the 'direct' introspective proof of the attribution of weight to colour, 'indirect' introspective evidence is given by a small group of cases which seem to follow what I ventured to describe as the 'negative' weight-principle. We find the representative instance of the working of this criterion in no. 6. Being one of the first cases of this type that came to my notice, I was not a little disconcerted, until I discovered its leading characteristic. It will be seen by reference to Table III that no. 6 systematically prefers the opposite to that which the positive weight-class as a rule selects: in series A the *b*'s are chosen throughout, and similarly in E, with the exception of E II *a*, where others usually prefer *b*. He informed me that his reason for his preferences was, that the *b*'s in his opinion better expressed the "triangularity" of the figures; in other words, by placing the darker colour in the upper half of the triangle, the apex stood out with greater force and distinctness from the grey background, forming a little triangle by itself and thereby emphasizing the vertical tendency, the rising energy, in fact the "triangularity" of the whole figure; the *a*'s, on the other hand, were heavy, massive, clumsy and lacked the peculiar spring and liveliness that a triangle ought to possess. Representatives of this class are very rare, at least of such consistency as no. 6. An instance, however, approaching to his case and showing a feature of special interest, is no. 23. In Table III, where only series A and E are given, he seems (as indeed he does) to belong to the positive weight-class; but when tested with A and E on black, *i.e.* with series B and F, he fairly regularly adopts the negative principle. His record, to be compared with Table III, is: B I—, II—, III *b*, IV *b*, V *b*, VI *b*; F I *b*, II *a*, III *b*, IV *a*, V *a*, VI *b*; and in his comments he says "that in A and E, when he preferred *a*, *b* looked 'top-heavy'; but that in B and F, *a* looked frequently too 'solid' and *b* was consequently preferred." I am inclined to think that this has happened sporadically also in other cases which on the whole conform to the positive principle, but has no doubt often been overlooked in introspection. Instances of which I have become aware as actually due to it are no. 30 (B VI *b*), no. 31 (E VI *b*), no. 33 (A VI *b*), and no. 45 (A IV *b*), all of which agree in stating that *b* looks less heavy than *a*. No. 48, whose results look rather erratic, is in reality following both principles, weighing them

against each other and selecting after much deliberation. He explained to me that the *b*'s often looked "better finished," by which, I think, he meant much the same thing as no. 6 by his "triangularity"; and on E I *b* he remarked, besides commenting on the "better finish" of that figure, that the dark blue top seemed to "weigh down upon the orange and keep it in its place." The impression of weight that he experienced with regard to the dark blue could hardly be more directly expressed, and this selection gives an instance of the attempt to reconcile in one figure the joint action of the positive and negative principles.

At the same time there can be little doubt that in cases of this negative weight-principle, a new factor has come into operation which complicates the simple action of the weight-principle. It is in itself suspicious, that with no. 23 the positive principle, active in series A and E, should have been abandoned for the negative principle in B and F; and especially no. 48 strongly suggested the idea that his "better finish" was partly due to the contrast between the colour in the apex of the triangles and the background. I did not have the impression that the selections of this whole class were by any means due entirely to contrast, but really to a feeling of greater lightness in some, and of an excessive massiveness of other, triangles; and the ground for this belief is principally the introspective testimony of the subjects. Thus I think, for instance, that no. 6 was relatively more free from contrast-effects than no. 48. Still the action of contrast was undeniably present and often consciously noticed by some subjects; and it was for the special purpose of testing the fluctuations, produced by the varying conditions of the background, that series B and F were devised. The black, instead of the grey background, conditioning a light-contrast, might reasonably be expected to alter the luminosities of the colours sufficiently to modify also the preferences. The principal result of substituting black for grey was that the luminosity of the light colours was apparently raised, and that the dark colours lost in perspicuousness. This latter effect was sometimes commented on, by saying that "the dark colours seemed to fuse with the background." These modifications of the luminosities might in their turn be expected to bring about an alteration in the whole balance of the figures by, as it were, changing, however slightly, the counteracting tensions of the two colours, and no. 23 proves that this actually occurred, by following in A and E the positive, and in B and F the negative principle. No. 6 shows similar changes in his preferences, selecting as follows: B I *a*, II *b*, III *b*, IV *a*, V *a*, VI *a*; F I *b*, II *a*, III —, IV *a*, VI *b*. Other instances

of fluctuations of this kind are given by nos. 21, 29, 37, 40, and 48. The results were :

21	29	37	40	48
B	B	B	B	B
I a	I —	I a	I a	I b
II a	II a	II a	II a	II a
III a	III —	III a	III b?	III a
IV a	IV —	IV a	IV a	IV —
V a	V —	V a	V a	V b
VI b	VI —	VI a	VI a	VI a
F	F	F	F	F
I a	I a	I b	I a	I a
II —	II —	II a	II a	II b
III —	III b	III b	III —	III a
IV —	IV —	IV b	IV a	IV b
V a	V —	V b	V b	V b
VI a	VI —	VI b	VI —	VI a

Already these five cases, when compared with the records for A and E, show that the modification, due to the black background, did not affect the preferences of all equally strongly or even in the same direction ; and it is, therefore, not surprising to find that a great many subjects, as far as they belong to the positive weight-class, remained even totally unaffected by the changed conditions. Such are for instance : nos. 9, 11, 12, 13, 17, 38, 42, and 43, while nos. 14, 20, 26, 34, 38, 41, 44, 45, and 50 reversed their selections in only one or two out of the 12 plates of series B and F. It is interesting to observe that nearly all those who adhered to their original preferences, were strict and thorough-going followers of the weight-principle, and the more uncompromising their selections on the weight-principle were in A and E, the less changes did they show in B and F. The idea, therefore, naturally suggests itself to consider the records of B and F as index to the strength of the weight-idea, in such a manner that the absence of changes in B and F would indicate a decided consciousness of the weight-differences, undisturbed by the contrast-effects ; the occurrence of changes, on the other hand, an unstable and weak weight-impression with the tendency to accept other criteria, such as might be offered by the changed conditions. A general statement of this kind would be quite admissible, if merely the *intensity* of the weight-impression is considered ; but a correction must be added, if it is to take into account also its *qualitative*, and not simply its intensive differences. For greater sensitiveness to the balance of a figure would produce the same results as the relative absence of the

weight-idea ; *i.e.* it would show itself in similar fluctuations of preferences under the varied conditions of B and F, so that the objective results would in themselves offer no evidence of being due to either mere weakness of the weight-impression or to the greater sensitiveness to it. Apparent instability of the weight-impression as revealed in a certain irregularity in the results might, therefore, be referred to either of these two factors, and conformity to the rule and regularity in the objective preferences, though showing the intensity of the weight-impression, are not a proof of its delicacy or refinement.

3. This exhausts the evidence furnished by introspection. What remains is the testimony of the objective preferences, which, though not giving direct proof, at least point to a strong presumption in favour of some idea of weight, underlying the selections.

The first point is the evidence given by the results of series C, D, G and H. It will be remembered that these series (of squares and circles) were specially introduced to furnish conditions which might serve to disturb the direct and unimpeded action of the weight-impression, if such were really present in the triangle-series. Neither squares nor circles carry with them the same emphatic suggestion of verticality as the triangles, though not both to the same degree. The squares would naturally do so more than the circles, particularly owing to the usual over-estimation of the vertical over the horizontal extension. But the division of the squares in the diagonal, instead of in the horizontal line might, I thought, prove a sufficient counterpoise to balance this inherent advantage of the squares over the circles. In fact, since the line dividing the colours runs diagonally across the figure, it was now the circles in which the vertical extension predominated ; for, mechanically speaking, the colours of the circles were in a position to act by their weight *vertically* upon each other, while in the squares the pressure could only be exercised laterally and in a slanting direction, and consequently not with its full force. I anticipated that, by reason of these modified conditions the weight-impression would be sufficiently weakened to allow no selections to be made on its account, but the results of Table III show that this assumption was false, at least partially. The weight-effect proved to be more delicate and impressionable than I had expected, and the majority of subjects arrived at some choice, usually with considerable precision and definiteness. The preferences, however—and this was the partial realisation of the forecast—are mostly very irregular, and the records present such a chaotic medley as practically defies analysis or classification. This in itself is, I repeat, a

not unimportant fact, for the differences of opinion, even among adherents of the weight-principle, indicate the weakness of a single directive criterion, such as the weight-principle would have afforded, and betrays the action of several underlying influences introduced by the modified conditions and largely by the purely spatial element of the figures. From this point of view, therefore, the evidence of these series confirms the expected weakening of the weight-impression, and hence by implication its presence and activity in the triangle-series.

In some of the purest cases of the weight-class as in no. 17 or 50, the preferences in series C, D, G and H are throughout in perfect conformity with it, as can be seen by reference to Table IV. The idea of instability or top-heaviness made itself felt, as mentioned before, in the expectation of seeing the darker top part of the squares slide off the lower section, and the circles in *b* turn round into position *a* to find their balance. This in various modifications was the usual impression; no. 48 even said in regard to the squares that it seemed to him as if the dark top would fall down like a shutter, turning round the lower left-hand angle of the square as on a hinge. However, individual differences in the intensity of the weight-effect revealed themselves here, if anywhere; and the results accordingly vary between the two extremes of complete selections on the weight-principle (as in no. 17 and 50) and the (almost) complete absence of preferences, as illustrated by no. 22. The number of those who gave some preferences interspersed with a greater or smaller number of doubtful choices, and those who give full, though irregular records is nearly equal (17 to 23).

Conclusions similar to those drawn from the comparison of the results in A and E with those of C, D, G and H, as wholes, are arrived at by comparing the preferences in the square- with those of the circle-series. That the squares presented some particular difficulty is shown by the fact that, while there are but two cases where only one or two selections were made from the circles (nos. 22 and 41 respectively), there are eight subjects unable to select from the squares: nos. 4, 9, 10, 21, 25 (only in C), 30 (only in G) and 39 (only two preferences). In the light of the foregoing remarks there can be little doubt that this particular difficulty consisted precisely in the application of the weight-principle to the square-series.

In trying to account for all the preferences in these series in all their confusion and irregularity, the interest of doing so would hardly compensate for the tedium of wading through endless repetitions and

uninteresting details. Some of the motives other than the weight-principle, which were especially predominant here, will be passed in review afterwards, but are out of place here, as being independent of the weight-principle. Only one point should be mentioned as partly explaining the confusion in these series, and that an objective feature which it would have been better to avoid, had I been aware of it from the beginning. It is one of the drawbacks of the otherwise advantageous method of approaching experimentally a problem without any previously formulated theory that the experimenter is apt unconsciously to introduce unnecessary complications. This is one such disturbing factor which made selection difficult and necessarily uncertain. There are several plates, as is shown by Table IV, where the luminosity-differences between the two colours is so slight as to cause some difficulty in estimating them by sight: in C III 29·83 as against 22·16, in G I 79·5 and 79·0, in D II 60·83 and 54·5, in H II 32·5 and 22·16, in III 54·5 and 52·0, and in IV 79·5 and 83·5. Generally small differences are fully appreciated, when found between shades of the same colours, but with tones even differences such as those in H II caused considerable embarrassment, not to speak of G I, where the two colours are to all intents and purposes of identical luminosity. Hence the constant irregularities in the preferences of G I, 10 subjects choosing *b*, while a great number got over the difficulty by not choosing at all. In C III there ought not to have been much uncertainty, nevertheless 15 subjects reserved their judgment; but in this case a good deal of the hesitation must be put down to the fact that C III belongs to the square-series, since the preferences of A IV, which contained the identical colours, shows little doubt or differences of opinion in the selection of *a*.

The other point, connected with the objective preferences and illustrating the action of the weight-idea in an unexpected way, is the record obtained with plates E II and III. That there must have been something peculiar about them is clear from the irregular manner in which selections from them were made, and I have already had occasion to mention that both these colour-combinations presented some difficulty as regards choice. A glance at Table IV reveals immediately the cause as far as E II is concerned. The colours were dark blue-purple and dark green with luminosities 87·16 and 86·16 respectively; for tones this difference was evidently too small to be estimated with certainty and the hesitation as to the position of the colours was therefore only natural, eight subjects again avoiding the difficulty by not choosing at all. (In F, on black, the difficulty seems to have been

increased to judge by the slightly larger number of cases of indecision.) This result I had expected, having purposely selected as a test two colours which seemed to me to balance each other, and the subsequent determination of the luminosities showed the correctness of this anticipation. E II therefore offers no new features and might be grouped with the plates mentioned in the previous paragraph as presenting simply an objective difficulty to selection. Now E III had been devised for the same purpose as E II. Since at the time of selecting and arranging the colours I was not as yet definitely aware of the weight-principle being actually based on the luminosity-differences, I simply combined and adjusted the colours by sight and satisfied myself by my own impression that in E III the two colours (red-purple and green-blue) approximately balanced and might serve as a test-plate in the same way as E II. The results confirmed this belief. Nearly all subjects expressed their doubts about selecting either *a* or *b*, eight leaving the question of preference open. Of the remainder, eliminating those who acted on motives other than the weight-feeling, 24 voted for *a* and 13 for *b*. But my astonishment was great when, on determining the luminosities, I found that of the red-purple to be 81.5, as against 65.0 of the green-blue. Even making allowances for the fact that it was a question of tones and not of shades, the difference was still considerable, and there ought not to have been the slightest doubt, either for myself, when making the plates, or for any of the subjects, that *a* ought to have been selected. The number of preferences for *b* and the doubtful cases (together 21) appeared quite unaccountable, if the determining factor was really constituted by the luminosities. It was only when measuring the triangles that I hit upon what I believe to be the solution of the riddle. While namely in E II, where the luminosities of the colours are nearly equal, the horizontal division-line between them was 7.6 cm. from the base, the distance in E III was only 7.0 cm.; so that in *a* of E III the blue top was rather higher than the purple base. That is to say, the areas covered by the colours differed very considerably in the two figures respectively; in E II 98.04 sq. cm. of blue-purple at the base, was matched against 43.12 sq. cm. of dark green at the apex; as against a red-purple base of only 90.30 sq. cm. with a top of 47.79 sq. cm. of green-blue in E III. These differences appear less trifling, when the relatively small area of the whole figures is taken into account; and the results show that even this comparatively small increase of the area of the lighter colour in E III was sufficient to make it doubtful to many subjects whether this triangle was properly

balanced¹. The purely accidental and unpremeditated nature of this difference makes the evidence which it offers for the sensitiveness and fine adjustment of the weight-impression all the more valuable; and, though it cannot absolutely prove its existence, it is one of the strongest presumptions in its favour which the objective results in themselves can afford.

III. So far the weight-principle. It remains to review as briefly as possible those criteria which became active, either side by side with, or as a substitute for, the idea of weight, owing to the individual idiosyncracies of the subjects or the disturbing influence of the spatial elements of the figures.

1. The first of these principles on which, independently of any weight-impression, selections were made is what is best included under the name of *landscape-associations*. By this designation is meant the

¹ I would like to make here a remark to prevent a verbal misunderstanding, which arises from the lax use of the word 'balance.' If two material substances of the same specific gravity are to be balanced (in the ordinary sense of the word), they must, of course, be taken in equal quantities. In the case of colours, their luminosity might be regarded as equivalent to the specific gravity of material substances, and to be balanced, they would be required to be also in equal quantities, *i.e.* covering equal areas. It might be objected therefore that in E II *a* 98.04 sq. cm. of one colour could not possibly balance 47.79 sq. cm. of another. This is, no doubt, true; but here it is not a question of horizontal, but vertical balance; instead of vertical balance it would perhaps be better to say stability. Stability is assured by the low position of the centre of gravity, so that it was not balance in the ordinary sense of the word that made a triangle acceptable, but rather the preponderance of the lower section. Now in E III *a* the increased area of the lighter colour at the top would naturally, in spite of its increase, not balance horizontally the lower colour. But it balanced it nevertheless vertically, that is to say, it counteracted the effect of 'bottom-heaviness,' if I may use this expression as converse to 'top-heaviness,' and thereby produced the impression of instability of the whole figure.

It is further to be remarked that the text as above shows nothing beyond this; in particular it shows no reason why E III *b* should have appeared acceptable to so many subjects. In *b* the areas were identical, but the colours reversed, so that it contained 90.30 sq. cm. of green-blue at the base and 47.79 sq. cm. of red-purple at the top. This, however, is very misleading as it stands, for in spite of its large area the green-blue base was vertically much smaller, *i.e.* lower than the apex of red-purple. As a result, since it was a question of stability, the figure appeared less top-heavy than it would have been had the base been even very much larger, *i.e.* had the distance of the dividing-line from the base been greater, because the top of red-purple was much longer and the centre of gravity placed lower than was the case in other plates. Hence the effect of top-heaviness was lessened, which I think partly accounts for the number of preferences for *b*.

Lastly it should be remembered that the results of these triangle-series cannot be directly applied to the effect of a wall painted two different colours, because the same spatial conditions do not obtain with a wall as with a triangle, since a wall possesses both horizontal and vertical extension in equal degrees, while in the triangle the vertical extension predominates so markedly over the horizontal.

association of a revived visual image of a land- or seascape with the actually perceived figure, or, more accurately expressed, the interpretation of the figure in the sense of such a land- or seascape or of part of it. Interpreting a triangle as any concrete material object, viz. as a sugar-loaf with its lower half wrapped round with paper, or as a pyramid, built of a darker and a lighter material, is not to be classed under landscape-associations, not so much because a sugar-loaf or a pyramid is not a landscape, as because there the characteristic of such associations is missing, namely the illusion of a perspective or the division of the figure into a fore- and a background. This illusion of the third dimension is the distinctive feature of this class. Landscape-associations were fairly numerous even among subjects who otherwise followed the weight-principle; already in no. 1 I met with them, and in one or two cases they almost became the dominant factor. It is interesting, however, that very many subjects were entirely free from them and that even, when the possibility of interpreting some plates in this manner was pointed out to them, they still confessed that they were unable to look upon them in that light. (Might it not be conceivable that subjects who formed these associations belong to the 'visual type,' and that the absence of visual imagery prevented others from seeing landscapes in the figures? Unfortunately I had no opportunity of specially testing the imagery of the subjects apart from the experiments.) These associations occurred most commonly in the circle-series and among these again most frequently in D III. This plate lent itself indeed most naturally to that interpretation, being composed of dark and light blue and thus forming in *a* a circular picture of the sea with a pale-blue sky above, the division-line representing the horizon. Wherever associations were met with, this was one of them, being found in nos. 1, 11, 12, 18, 21, 25, 26, 28, 35, 37, 40, 43 and 48; and knowing from other experiments the obstinate persistency of landscape-associations which have a tendency to monopolise everything and to become a perfect obsession to the subject, I took care after the first few tests never to show this plate until quite at the end of the series. For if once the possibility of constructing a landscape out of a figure is discovered, there is no end to it and every combination of colours, however unnatural, is treated on the same pattern, as long as with the wildest stretch of imagination a landscape can be made out of it. Among the square-series, landscape-associations never occurred, with one solitary exception, namely no. 40 in C II (dark green and light green), which both in *a* and *b* appeared

to him as the slope of a hill with a dark or light sky behind it, in spite of the fact that neither the dark nor the light green was a suitable colour for any sky. The only really noteworthy feature about these otherwise uninteresting cases was the occurrence of landscape-associations with the triangles. There were only four cases of it, namely no. 18 (A I II, B IV, E IV), no. 21 (A I II IV VI, B I II IV VI, E III IV), no. 37 (A III), and no. 40 (A I II), and Table III shows that these associations produced selections both of *a* and *b*, but mostly *b*'s, which accounts for some of the apparent irregularities of these records. Both nos. 18 and 21 agreed in stating that in their opinion the triangular shape of the figures was in itself conducive to landscape-associations by suggesting the idea of perspective, the reason being, I suppose, that the attention naturally travels from the base of the triangles to the apex in the same way as it extends from the fore-ground to the background of a landscape. But the absence of associations in the triangles with the majority of other subjects who formed them with the circles, shows that this is only an individual peculiarity of these few exceptional instances.

2. Considerably more numerous were selections made on the basis of a preference for one of the two colours composing a figure. Even in cases following the weight-principle this criterion was occasionally applied, especially in its negative aspect, *i.e.* one figure was rejected, because containing a larger amount of an unpleasant colour than the other. This was notably the case with plate E VI (yellow and bright blue), where *b* was chosen as containing less of the objectionable blue. Sporadically instances of such colour-preferences are to be found in the greater part of all the records; I simply noted them without making any attempt to obtain an explanation of the preferences themselves, which I considered as lying outside the range of the tests. In one case at least (no. 7) *all* preferences throughout all the series were made on this principle (which accounts for the confusion in that record) and in several other instances the greater part of the selections is due to the same reason, as in nos. 22 and 47. The most interesting point about this class is that it falls into two divisions which are fairly constantly separated. The more usual course was to select that triangle in which the preferred colour occupied the larger area, that is to say the base, "because there was more of it." This would, I think, represent the aesthetically crudest form of criterion used. The other, however, is distinctly superior and shows a far finer aesthetic appreciation; it consisted in selecting that figure in which the preferred colour was

placed in the apex of the triangle. Though covering a much smaller area than the other colour, it was felt to receive a special prominence by occupying the top of the triangle, which is its most characteristic feature. Selections of this kind show, therefore, not simply the crude motive of *quantity* of the preferred colour, but reveal a marked appreciation of the qualitative differences of its position and a sense of its spatial application. Instances of this manner of choosing are: nos. 16 (A IV V VI), 24 (A V), 29 (A III), and 40 (E IV). Selections of the square- and circle-series on this principle of colour-preferences, one would have expected to be theoretically impossible, since both figures in these series contained both colours in equal quantities. They were however also made, though in limited numbers, involving often illusions presently to be mentioned.

3. The final point to be noticed is two forms of optical illusion which I simply mention, because I am unable to offer any explanation of them. They were largely instrumental in deciding doubtful cases, though in some instances they remained apparently without influence on the preferences and were merely incidentally noticed. They comprise either *apparent differences in identical colours* according to their position in the figures, or *apparent differences in the shape of identical figures* according to the position of the colours of which they were composed. The first of these illusions is represented by nos. 3 and 24, who both stated that in G I (square, red and blue) the red appeared less dazzling in *b* than in *a*, while no. 15 maintained that the blue seemed less glaring in *b*. Objectively neither the one nor the other difference between the colours can have existed, since both colours were cut from the same strips of paper. Similarly in regard to C II both nos. 20 and 26 agreed in saying that the dark green appeared darker in *b* than in *a*; no. 30 said that in E II the blue-purple was less glaring in *a*, and the red in E IV darker in *b*; though in all these cases, for the same reason as before, these differences cannot have had any objective foundation. Other cases are: nos. 19 (H II), 26 (G II), 29 (E I VI), 31 (G III, A IV), 34 (E I), 41 (D II), and 42 (H II). Being found mostly in the squares and circles, these illusionary differences furnished a welcome motive for selection, where the weight-impression failed.

Under this same head might also be classed a very obscure statement which seems similarly to depend on the position of the colours relatively to each other, namely that in one of the two figures the colours "blend better," with the result that this figure is selected. What this "blending" consisted in, or what was actually meant by it,

I have not been able to find out; no. 16 also used the expression that the colours were "more confluent." The number of subjects who noticed this feature was very small: nos. 16 (E I *a*, D I *a*, H I *b*), 18 (E II *b*, G II *a*), 29 (E V *a*) and 41 (A I *b*, D II *b*); if it were not for the presence of H IV *b* and A I *b*, one would be inclined to take this "blending" simply as a periphrase of the weight-impression, *i.e.* as the result of that order of the colours which was felt to be the most natural (E II *b* being in any case a doubtful plate); but as it is, this explanation is somewhat questionable.

Equally unaccountable was the reason given by no. 16 for his selection of C III *b* and D II *b*, in which, he said, the contrast between the colours was more marked in *b* than in *a*, unless this again means that the inversion of the natural sequence of the colours produced a more pronounced contrast in *b*. But being the only instance of this reason, and therefore, without parallel cases, it is also an obscure point.

The second form of illusion concerns the shape of the figures, and refers exclusively to the series D and H, thus offering a criterion for selection from these figures, which, apart from the weight-principle and landscape-associations, would all have been equivalent to each other. I have mentioned already earlier the usual optical illusion, that, owing to the diameter being visible, the circles appeared as horizontal ellipses; but they did so in varying degrees, sometimes *a*, sometimes *b* seeming to be more flattened at the poles than the other circles. Thus to no. 3 H I *b* and III *a* appeared flatter than I *a* or III *b*, while to no. 22 H I *b* seemed rounder than *a*. In a similar way figure *a* often appeared larger than *b* to some subjects: nos. 20 (D IV), 26 (D I, H I IV), 27 (D IV, H I, IV), 30 (D I, IV, H I). Here again it is hardly possible that an objective reason can have existed to render the impression anything but a subjective illusion.

And this is especially true of the most important and striking illusion which occurred in the circle-series, namely the *illusion of relief* or *convexity*. It was a rule without exception that in many of the circles, *b* produced the effect of a ball or globe, while *a* in that case always appeared as a flat disk. This accounts for the very frequent preferences for *b* in D and H, even in cases which otherwise adopt the weight-principle. If the plates were turned 180°, the effect still persisted, but then the original *a* appeared in relief, so that the illusion is quite undoubtedly due to the position of the darker colour above the lighter one. Not every subject experienced this illusion, but a fair number noticed it: 16 (D IV, H I), 18 (H I), 20 (D I, H I), 22 (H I),

36 (D I II, H IV), 31 (H I), 39 (D II IV, H I), 42 (D I III, IV, H I), 44 (D IV), 46 (H I II, D IV), 47 (D I II III) and 48 (D I II IV, H I IV). I am unable to offer any explanation, why the dark colour above should produce this impression, nor have any of the subjects suggested any possible ground for this effect.

This concludes the list of principles or criteria which were operative in the selections, as far as they have come to my notice, and I believe that with their help most of the preferences, recorded in Table III, are explicable. As illustration I subjoin here the analysis of one of the most complex cases, uniting nearly all the varieties of motives which occurred more or less separately in other instances. It is no. 18:

A		E	
I b II b III — IV a V b VI a	landscape do. weight-impression preference for pink weight-impression	I a II b III a IV b V a VI b	weight-impression better blending weight-impression landscape weight-impression less blue in b
C		D	
I a II a III a IV —	weight-impression do. do. do.	I b II a III a IV b	appears higher than a weight-impression seascape landscape
G		H	
I a II a III a IV a	weight-impression better blending weight-impression do.	I b II b III b IV b	relief colours not in same plane relief? [in a more restful than a

4. Conclusion.

The point that darker colours appear heavier than lighter colours being decided, the question, *why they should do so*, still awaits an answer.

In the course of the tests I asked several of the subjects what in their opinion the reason for such an impression might be. The majority admitted having never considered the question; and the rest, if they

were disposed to suggest a reason at all, mostly answered that it was "due to association." So undoubtedly it is; but the word 'association,' in spite of its supposed omnipotence to solve all problems, brings hardly any enlightenment. For the point is: what is it that is associated with the colours to produce the effect of heaviness? Those subjects who ventured beyond the statement that its cause was association, suggested that, being constantly surrounded by natural objects which were of a darker colour below than above, we had contracted the habit of considering this arrangement as typical and expected to find it conformed to also in objects which, as the triangles for instance, do not form part of our customary environment. That is, custom has bred in us the normative idea that darker colours should stand below lighter ones, and the lower part of an object being generally heavier (to preserve stability), the impression that dark colours are heavier was the joint outcome of habit and inference. Trees for instance, one said, are always darker at the base than at the crown, and a mountain, another suggested, shows the same feature: in short, it is the association of visual memory-images of natural objects with the perceived colour-arrangements that produces the weight-effect of darker colours.

There are two objections to be made to this explanation. Firstly the correctness of the assertion that natural objects, possessing the particular colour-arrangement in question, are to be found in sufficient quantity to allow the necessary habit to become so fixed, that it is at once and quasi-instinctively applied to any other object, however widely different from natural objects both in shape and colouring. That trees, for instance, are darker at the base than at the crown, apart from the changing shadows cast by the foliage, seems to me very questionable. Mountains, especially high ones, are indeed of a fainter colour at the top than at the foot, owing to aerial perspective; but the difference is relatively small, and not many people are likely to be sufficiently impressed by it, to deduce a normative idea from it. Many instances of natural objects, as the light sky over a wood or the sea, in fact over any landscape, are not admissible, though presenting the required combination of two colours in the most constant form; for the landscape and the sky appear as two different things, situated in different planes, and not as mere qualitative differences of one flat surface, as the triangles appeared in the tests, as long as landscape-associations were absent. Looking about us in nature, the colour-arrangements seem quite accidental. We may find a corn-field in the fore-ground with a dark wood behind it quite as often as a meadow

with a corn- or clover-field beyond; there are white cottages with thatched or tiled roofs and flower-borders with dark shrubs behind them. I have since tried to find a sufficient number of natural objects exhibiting the required colour-combination with some definiteness and constancy, but I have not been able to convince myself as yet that the preference for darker colours below lighter ones can in any way be referred to a habit contracted from our environment.

The second point which speaks very strongly against an association with visual images of natural objects, is the curious antagonism in which the weight-principle seemed to stand to the landscape-associations in the tests. The two were never, except in a very few cases, applied to the same figure by the same individual; in the few exceptional instances, when it was done, it always produced opposite results. The two methods of selection represented evidently two entirely different mental processes; the one was the apperception of a geometrical figure as figure, the other the interpretation of the figure as possessing a 'meaning,' as representing something else than a mere figure, namely a landscape. As no. 40 said in the case of C II: "If I take this to be the slope of a hill, I have no preference; if I take it simply as a figure, I prefer *b*." The two principles, the weight-principle and the landscape-association, seemed to be irreconcilable.

If the reason of the apparent weight of darker colours is not due to the association of visual images with the colour-sensation, what is the reason? Suppose there are two stones, one twice as big as the other; merely looking at the stones, we say the second "looks" heavier than the first. Why? Because this stone is larger, has more volume or substance than the first; in short there is "more of it." Or, to use another analogy, if we have a glass containing a weak mixture of claret and water and a glass with a strong mixture before us, the second will appear to be heavier for the same reason, because it seems to contain more substance *i.e.* more claret than the first. I do not mean that it need actually *be* heavier, but that it only "*looks*" heavier. Just the same happens with colours. If we see pink and red side by side, the red looks heavier than the pink; why? Because there is, or there seems to be more substance in it than in the pink, there too is "more of it," not in the sense that it covers a larger area, as the bigger stone does relatively to the smaller, but in the sense that it contains more pigment, just as the strong mixture of claret and water contains more claret. Or to express it differently: if more pink were added to the pink, it would eventually become red, just as, if one added more stone

to the smaller stone it would ultimately become as big as the large one, or as by putting more claret into the mixture, it would finally become as dark as pure claret. So far the unsophisticated conception of the matter is right. If one adds more red to the pink, it will become redder and redder until it is a fully saturated red. At the same time the luminosity will decrease, *i.e.* the colour becomes darker, and the increasing darkness appears as the result of an addition of pigment to the original pink. But the luminosity which has continually fallen with the addition of pigment, can be decreased beyond the point of saturation, producing a still darker red. This again appears as the result of a further addition, not indeed of pigment, but of black: dark red therefore, compared with saturated red, has again this peculiar quality of 'more-ness,' it has again more substance, *i.e.* it appears heavier. Hence luminosity, not saturation is the true index of the weight of a colour.

There is, I think, little doubt that no one to whom a colour looks heavy, actually puts to himself the question: "of what is there more?" Whether the apparent increase of substance is due to the addition of pigment or of black, matters little to the weight-effect. Most people would probably say, it was, in *any* case, an increase of pigmenting substance; the main point is, that "there is more" of whatever it may be, and the effect is that of weight or consistency, density, solidity or impenetrability in all its various modifications.

That this effect is due to association is undoubtedly true, though not in a sense of an association of a visual image with the colour-sensation, but of an association of ideas of weight with the visually perceived object, *i.e.* a complex originating from two different sensational spheres, just as the 'look of heaviness' of a stone is such a complex. While on the one hand, it is quite unintelligible, how the casual reminiscences of natural objects could produce such a delicate discrimination as was observable in the tests, between the weights of colours which are perhaps even rarely met with in ordinary surroundings, nothing, on the other hand, could be more natural and obvious than these finely graduated impressions of differences on the basis of such a complication, which we have occasion to practise in various forms a hundred times a day. That the attribution of weight to colour is not made by means of any conscious inference, but is purely unreflective and immediate, need hardly be remarked; as the stone, so the colour simply "looks" heavy.

The weight-idea is naturally most marked, when relative, *i.e.* when

it is the result of the weight-differences between two colours seen side by side. But it also exists *absolutely*, *i.e.* in face of only one colour. Since the saturated colours are not all of the same luminosity, but yellow and green are of higher luminosity than blue and violet, yellow and green are also of apparently lighter weight than blue or violet, when seen singly. In a similar manner as the movement, tension and balance of geometrical figures, attributed to them or '*eingefühlt*' into them, form the basis of an interpretation of them as individual organisms, possessed of an inner life and a kind of distinctive personality, so the weight-impression of colours, at first merely designating, as it were, a physical aspect of them, is the intermediate step to the apprehension of colour-effects which are not inherent in colours as objective realities. A golden yellow *looks* light and it *is*, as an aesthetic reality, cheerful, energizing; a rich blue *looks* heavy and it *is* serious, easily even depressing. No doubt, in such an aesthetically anthropomorphic 'realisation' of colours the idea of weight plays only a small, even very small part (the main part falling to the share of the tone-element), but it is just this relatively insignificant contribution to aesthetic colour-effects that I wish thus briefly to point out, and thereby the connexion of the weight-impression with, and its bearing upon, the Aesthetics of Colour generally.