



A Critical Account of Some of Josef Albers' Concepts of Color

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A CRITICAL ACCOUNT OF SOME OF JOSEF ALBERS' CONCEPTS OF COLOR

Alan Lee*

Abstract—*Joseph Albers' book Interaction of Color is widely influential but, according to Lee, has not received close critical attention. Lee undertakes to refute Albers' general claims about colour experience (that colour deceives continually) and to show that Albers' system of perceptual education is fundamentally misleading (Albers 'places practice before theory'). Four topics in Albers' account of colour are examined critically: additive and subtractive colour mixture, the tonal relations of colours, the Weber-Fechner Law and simultaneous contrast. In each case Albers is shown to have made fundamental errors with serious consequences for his general claims about colour and his pedagogical method. It is suggested that Albers' belief in the importance of colour deception is related to a misconception about aesthetic appreciation (that it depends upon some kind of confusion about visual perception). It is suggested that the scientific colour hypothesis of Edwin H. Land should be considered in lieu of the concepts held by Albers. Finally, there are implications for a reassessment of Albers' artworks that might follow a loss of faith in his colour concepts that seem to have been their foundation.*

I. INTRODUCTION

In this paper my concern is to provide a critical account of certain concepts of colour presented by Josef Albers (1888–1976) in his book *Interaction of Color* [1]. The book was first published in 1963 as an extensively illustrated edition and is more widely available today as a modest pocket edition. The critical account given here does, I believe, have implications for a reassessment of his artworks, but I shall not pursue them deeply here. The implications can, however, be made plausible by noting just one way in which Albers' artworks and colour concepts seem to be related: His reputation as an artist and his reputation as a theorist and teacher seem to me to be mutually supportive. Those critics and writers who have praised his 'Homage to the Square' paintings have usually interpreted them in the light of his statements on colour, which they have accepted seemingly without challenge. Also the continuing widespread employment of his book by visual art and design teachers is lent support by his fame as an artist. His present influence upon such education is still strong. In view of his widespread influence, *Interaction of Color* has not received adequate critical attention. (Both an interview with Josef Albers and a tribute to him have been published in *Leonardo* [2,3].)

Albers presents several general claims in the book's Introduction [1, p.1]: 'In visual perception a color is almost never seen as it really is—as it physically is. This fact makes color the most

relative medium in art.' His concepts about colour are closely bound up with a pedagogical method, the purpose of which is 'to develop—through experience—by trial and error—an eye for color'. With regard to his method, he claims: 'This book, therefore, does not follow an academic conception of 'theory and practice'. It reverses this order and places practice before theory, which, after all, is the conclusion of practice.'

I shall return to consider these general claims after examining in detail four of his concepts about colour upon which the general claims depend. Discussion of these four concepts is sufficient for this critical account, although the book provides many other points that are vulnerable to criticism.

II. ADDITIVE AND SUBTRACTIVE COLOUR MIXTURE

In Part XIII (p. 33) of his book, Albers introduces his discussion of the Bezold effect by making this claim: 'From the impressionist painters we have learned that they never presented, let us say, green by itself. Instead of using green paint mixed mechanically from yellow and blue, they applied yellow and blue unmixed in small dots, so that they became mixed only in our perception—as an impression.'

There is a significant error here. Small interspersed dots of blue and yellow when seen from normal picture viewing distance produce grey (which may be yellowish or bluish if either colour predominates). This is the *additive mixture* of blue and yellow. It is by mixing blue and yellow

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pigments or by passing daylight through a yellow and blue filter that one gets green as the *subtractive mixture* of blue and yellow. An understanding of the difference between additive and subtractive colour mixture is surely basic for a painter.

It is surprising that an artist and teacher who actively 'experimented' with colour seems not to have been tempted to put down little unmixed dots of blue and yellow and to observe that their interaction produces greys and not greens. Albers clearly shared a widespread mistaken belief about impressionist painting. A clear account of the history of this error and a correction of it can be found in an article first published in the *College Art Journal* in 1944, when Albers was already teaching in the U.S.A. [4]. An even more widely circulated account of the additive mixture of blue and yellow was presented, with a colour demonstration, in the popular magazine *Life* at about the same time [5]. A comprehensive account of the subject (and how blue and yellow make grey, not green) can be found in a book by Ogden N. Rood called *Modern Chromatics* [6]. This book was first published in 1879 and in its French translation was studied by the impressionists themselves. I mention the above publications to make it clear that Albers was wrong about a significant topic in colour that had been familiar to many artists and others for decades.

Albers' misunderstanding about additive and subtractive colour mixture is shown also in the account he gives of after-images in Part VII (p. 23): 'Staring at red will fatigue the red sensitive parts (of the retina), so that with a sudden shift to white (which again consists of red, yellow and blue), only the mixture of yellow and blue occurs. And this is green, the complement of red.'

In Part X, entitled Factual Mixtures—Additive and Subtractive (p. 27), Albers addresses himself directly to the description of the two kinds of colour mixture. He puts the matter this way: 'There are 2 kinds of physical mixture: (a) Direct mixture of projected light, (b) Indirect mixture of reflected light.'

Then under the first sub-heading (a) Albers correctly describes the projection of two coloured lights onto a screen as producing an additive mixture. However, under the second sub-heading (b) he gives examples of processes that are of both kinds. First, he mentions the mixture of pigment or of paint as a subtractive mixture. This is basically correct but not simply so, because, for example, the production of purple from a red and a blue paint mixture must be an additive, not a subtractive result. But Albers also includes under this heading the results of optically mixing sectors of colours on a rotating disc. This is exclusively a case of additive colour mixture. Albers seems to use the incorrect criterion that those mixtures that produce colours lighter than the parent colours are additive mixtures while those that produce colours darker than the parent colours are subtractive.

III. THE LIGHTNESS ATTRIBUTE OF COLOUR

Part V (p. 12) of his book begins with the following: 'If one is not able to distinguish the difference between a higher tone and a lower tone, one probably should not make music. If a parallel conclusion were to be applied to color, almost everyone would prove incompetent for its proper use. Very few are able to distinguish higher and lower light intensity (usually called higher and lower value) between different hues.'

Part V is devoted to the problem of determining which of two colours of quite different hue is darker. Part XIII (p. 63) is devoted to what Albers believes is the most difficult task of all: searching for colours that have 'equal value'. 'It is confined to adjacent, neighboring colors and depends most decisively on equal "light intensity". Only real equality in lightness or an equivalent real equality in darkness produces the effect here aimed at and searched for.' (In his book the terms *tone*, *intensity*, *value* and *lightness* are used synonymously.)

Albers claims that this equality is the 'most exciting of all color phenomena', but it seems from his account that it is not an easy thing to discover. 'Thus, we can safely state that very few people—including many colorists and painters—have ever seen 2 adjacent colors of true equal light value—that is, of exact equality in light, of the same level of light, or, in a sense, the same altitude of light.'

Readers of the above statements may indeed become perplexed if they do not consider the possibility that there are, in principle, no correct answers about the precise differences in lightness between colours of different hues. It is good to clarify here the meaning of lightness. Is it an attribute that concerns the sensations or does it concern definable properties of surfaces and light that can be measured? Albers conflates the two aspects and seems unaware of the confusion that results. I shall now consider the two aspects in turn before reconsidering Albers' position.

Imagine that in a darkened room a red and a green light beam are projected onto a white screen to form two adjacent rectangles of colour and that means are available for varying sensitively the brightness of each light. If the red light is set at an arbitrary level, can one adjust the green light so that it is exactly as bright? And, if it can be done to one person's satisfaction, will others necessarily agree? (In this experiment the wattage of the lamps, the intensity of the light produced by them as measured with light meters, and the optical properties of the colour filters employed are of no concern here.) What is of interest is whether the lightness of the red and of the green rectangles, in each of which perceptible minute variations can be produced, can be judged in relative magnitude one against the other. There is no *a priori* reason why this must be so: The

lightness perceptions of red and green may be incomensurable much as the pains of a sunburn and of a toothache are. One might be much more painful than the other, in which case this could be stated meaningfully. But in cases when neither pain seems much worse than the other, it might be possible to say only that the pains are different. Similarly, for certain lightnesses of red and of green, it may not be possible to see one colour as lighter than the other. A red may be found to be not noticeably different in lightness from any one of several greens of the same hue but clearly different lightness.

I believe the uncertainty of lightness judgements of colour is universal among humans. To understand that this is not a failing in the powers of perception it is necessary to realize that lightness is not a precisely defined objective attribute. This can be made clear by considering the possibility of using photography as a means to give an objective measure of lightness.

In the case of the red and green lights, why should not a black and white photograph of the red and green areas be made and the resulting lightnesses of the photographic images be compared? The answer is that the sensitivity of the eye for light of various colours does not match that of available photographic films. The so-called 'panchromatic' films are intended to approximate human vision, but even these are sensitive to ultraviolet radiation, and the human eye is not. Of course an arbitrary measure of lightness could be devised with the use of a 'standard' black and white film, but the measure would not be one of a visual attribute. Furthermore, in the case of surface colours, such as painted red and green areas, the measurement of lightness would be influenced by the particular characteristics of the illumination (incandescent lamp light, fluorescent lamp light, direct sunlight, sky light, etc.) of the areas. Here the measurement could be standardized by using an arbitrary light source. From considerations, such as those above, it will become clear that an objective measure of lightness cannot be made unencumbered by an arbitrary choice of a standard of measurement.

It seems from the many things Albers says about lightness [for example, his own rejection of the authority of photographic evidence (pp. 14, 15)] that he is considering some subjective quality. Yet he also designates the quality as one upon which everyone (having sensitive and trained vision) should agree in judgement. It becomes clear, however, from his attempts to describe this quality that his ultimate authority is his own judgement, for he provides no coherent way for others to judge for themselves. Consider, for example, his suggestion (pp. 13, 14) that difficult cases can be resolved by making use of an after-image test: 'In cases where a decision seems impossible an after-image effect may be helpful. 2 color sheets are put on top of each other in this way [(Fig. 1)]:

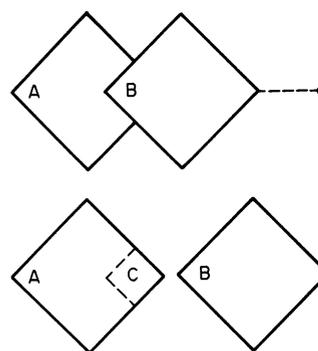


Fig. 1.

'Focus longer than the eye wants to on the covering corner (B) of the upper paper then quickly remove this upper sheet. If area (C) now appears lighter than area (A), then the upper paper is the darker—and vice versa. After this, repeat the experiment with the papers in the reverse order. Frequently only 1 of the 2 reversed comparisons reveals the true relationship.'

One might ask, for those cases where two answers are obtained, which is the correct answer? This was what the test was supposed to resolve. Even, if the test always did give an unequivocal answer, why should it indicate which is the darker colour? Might not red after-images just tend to be stronger than green ones? (Might not the relief experienced after a sunburn cure tend to be stronger than the relief experienced after a toothache cure?)

Although Albers does not give any workable test that will decide the matter, he still claims for himself the ability to decide without error, while his students are, by the standard of his own judgement, more often wrong than right. On p. 13 he reports: 'Though there have always been advanced painting students in the basic color class, the result of this test has remained constant for a number of years: 60% of the answers are wrong and only 40% are right, not counting the undecided cases.' The students were asked not to choose if they were in doubt; thus the less than 50% success from a binary choice is even more surprising. Albers does not even claim that his students came to agree with him as a result of his teaching.

What can be concluded from all this? The above arguments concerning the lightness of perceived colours might be encapsulated in the following hypothesis: Across large differences in hue, colours are not precisely ordered with respect to lightness (unless by some arbitrarily chosen objective standard requiring a measurement independent of subjective judgement).

It seems reasonable to suggest that Albers was both confused and wrong on this subject and that his confusion arose from his unjustified conviction that a light beam or a painted area has a particular lightness in colour. He seems also to have failed to have considered the alternative hypothesis that

it does not. The judgement of Albers' students (and his observation, quoted above, that very few people are able to distinguish higher and lower lightnesses correctly), which he construes as evidence for the uniqueness of his discriminatory power, is much more plausibly interpreted as evidence against his conviction that the lightness of a surface colour, for example, is a fixed quality.

The general claim made in the Introduction of his book that theory would follow practice, as its conclusion, is clearly not borne out. Albers seems blind to evidence that contradicts the concepts he adopted unquestioned from the beginning.

Albers' emphasis in his teaching on the lightness relations of colours might be construed as an inducement to develop more sensitive colour perception (this is his stated aim). A capacity to judge relative lightness (within normal limitations) would be very useful in the visual arts and in design. However, an attempt to develop such a capacity on the basis of Albers' incorrect concepts would, I think, end in failure.

IV. THE WEBER-FECHNER LAW

In Part XX (pp. 54 to 58) Albers gives his account of the Weber-Fechner law as it applies to visual perception and construes it as an example of how 'psychic effects' can be different from 'physical facts'. He states that if one has a scale of greys in equal steps (that is, equal according to an objective measure of light reflectance) from black to white, then these steps will not look equal. This is true and it can be demonstrated simply and impressively. If a disc on which are painted white and black halves is rotated at a high enough speed (as on a motor shaft) the white and black will blur to produce a mid-grey (50% light reflectance) in daylight illumination. This grey, however, seems remarkably pale. When the effect is first seen, it almost seems as if the black disappears as soon as the disc starts to rotate. By varying the areas of black and white sectors on the disc and by mixing grey paint to match the grey of the spinning disc, one can prepare a grey scale of easily calculated reflectances. It can be demonstrated, for example, that a grey that absorbs 10% of the light is almost indistinguishable from white, while a grey that reflects 10% of the light is easily distinguished from black. Putting this in Albers' terms, one might say that the same physical change in reflectance at the two ends of the scale produces a different psychological effect. This observation can be used, I believe, as a (somewhat indirect) demonstration of the general psychophysical principle known as the Weber-Fechner law: 'When stimuli vary in geometrical progression, sensations vary in arithmetical progression' [7]. Applying the principle to visual perception, Evans expressed it as follows: 'The eye tends to indicate a constant change when the stimulus is changed in a constant ratio' [8]. While Albers asserts that the law 'leads to a new insight into color mixture' (p. 54), he

suggests no direct use a painter or a viewer of paintings can make of it.

It seems misleading for Albers to infer (p. 55) that an illusion or error is involved because the difference (the 'surprising discrepancy') is between something perceived and something knowable (usually) only through special measurements.

The lightness judgements that people can make are consistent: What they judge as equally discriminable lightness steps (that is, in arithmetical progression) correlates with reflectance steps in geometrical progression. I believe that Albers is in error in not confronting the conceptual problem of his central claim that the (alleged) gap between physical fact and psychic effect is of major importance to painters. I shall not dwell on this error, because he makes a much more serious and revealing one in his proposed classroom demonstration that would lead to misleading observations.

Albers does not use the spinning disc technique described above, nor does he describe a way for measuring the reflectance of surfaces. However, he claims, incorrectly, that equal steps (in arithmetical progression) can be produced by putting successively 1, 2, 3, 4, . . . layers of a translucent coloured sheet (for example, acetate sheet), or equal layers of diluted black ink, onto white paper (p. 57). Such a procedure will result in a geometrical progression of lightness, however. For example, if one sheet transmits $\frac{3}{4}$ of the light falling upon it, then two sheets will transmit only $\frac{3}{4}$ of $\frac{3}{4}$ (equal to $\frac{9}{16}$), and three sheets will transmit $\frac{3}{4}$ of $\frac{3}{4}$ of $\frac{3}{4}$ (equal to $\frac{27}{64}$). This is a geometrical progression. Albers says incorrectly that to produce a geometrical progression it is necessary to overlay successively 1, 2, 4, 8, 16, . . . sheets.

If Albers' method were followed, the Weber-Fechner law would not be demonstrated: The equal steps would not be perceived. Presumably Albers had this trouble himself because some of his comments about the matter take on an ironic twist (p. 57): 'Such studies, of course, are only theoretically true. Because of slight material imprecisions, the studies show occasional aberrations from the rule' and (p. 58) 'It is surprising and unfortunate that the Weber-Fechner law is almost unknown among colorists.' Perhaps one can include Albers among these colourists. This is a further example of how he is able to modify or distort his observations so that they comply with an incorrect concept that he has uncritically adopted.

V. SIMULTANEOUS CONTRAST

The effects of simultaneous contrast are the most impressive aspects of Albers' series of colour illustrations for classroom demonstrations [1]. The series provides perhaps the most important key to an understanding of his concepts about

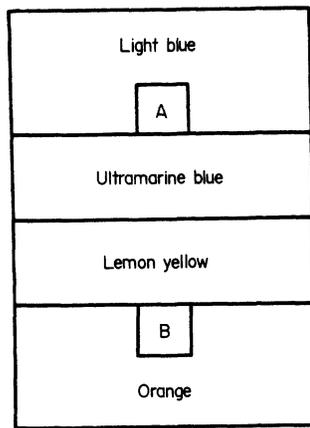


Fig. 2.

colour. The original edition of the book shows the complete series in colour (silk-screen prints). The lay-out of one of the illustrations is shown in Fig. 2, which is used in colour as the cover illustration of the more recent pocket edition. In its original form this illustration, like many of the others, was made as a working model: The horizontal band coloured in ultramarine blue and lemon yellow can be folded back to reveal that the two small squares, A and B, are the end portions of one long *uniformly* coloured rectangle of yellow ochre. When the ochre squares are seen in their different coloured environments, they look distinctly different (the square on the blue ground seems lighter). Other illustrations show ingenious variations of this *simultaneous contrast* effect. Of course Albers did not discover this effect, but it is hard to imagine more striking illustrations of it than those he has produced.

After seeing these illustrations and having one's interest aroused, one might hope to find in his text: (1) some explanation of the effect and (2) some account of how artists can make use of an understanding of the effect.

Albers' explanation is to be found in Part VIII under the title *Why Color Perception?—After-Image, Simultaneous Contrast* (p. 22). The section begins with this statement: 'For a better understanding of why colors read differently from what they really (physically) are, we show now the cause of most color illusions.' This is followed by a careful description of how one can produce *after-images*, in this case by staring first at a red circle on a black ground 'for up to half a minute', then at a white circle also on a black ground. After these instructions he says: 'The phenomenon of seeing green (in this case) instead of white is called after-image, or simultaneous contrast.'

He does not identify and explain these two phenomena separately but simply claims that they are the same thing. While there may be no very satisfactory explanation of the effect called simultaneous contrast, it is distinct from the effect called after-image. For example, after-images can be seen only after staring fixedly for many seconds at a coloured area while simultaneous contrast is immediately apparent and is equally

apparent to a roving gaze as it is to a fixed stare.

One might put aside this distinct error (for he is not a colour scientist) and look rather to see what he believes painters and viewers of paintings can do with a knowledge of these effects. He primarily construes the effect as further evidence of the general claim made in his Introduction, that 'in visual perception a color is almost never seen as it really is' or, as he puts the point (p. 23): 'The fact that the after-image or simultaneous contrast is a psycho-physiological phenomenon should prove that no normal eye, not even the most trained one, is foolproof against color deception. He who claims to see colors independent of their illusionary changes fools only himself, and no one else.'

While it might be hoped that such 'colour deception' can be overcome, perhaps by learning the conditions in which it occurs, Albers claims explicitly here that there is no such hope. The only suggestion he makes as to how the effect might be used is to be found in allegorical form near the end of the book (Part XXV, p. 73). He suggests that colours can be like actors taking different roles. '... actors who present only themselves remain always the same. They may appear interesting, but they do not act. In our terms they remain factual. However, when an actor is able to appear as Henry VIII, so that we overlook or forget who he factually is, and when he also can be expected to play Henry IX or Henry X, then he is a real actor, able to give up his own identity and present someone else's appearance and personality. Color acts in a similar way. Because of the after-image (the simultaneous contrast), colors influence and change each other forth and back. They continuously interact—in our perception.'

Even if painters and viewers of paintings want to follow him in his fancy, of what use can it really be to them with regard to any particular picture? When one views paintings, one is not provided with the equivalent of a theatre program. One does not usually have an independent information source to tell one that the colour in a certain area is actually the same as that in another area and that it is the same colour seen in a previous painting (from the theatre program one may learn that the butler and the detective were played by the same actor and that he also played Hamlet last week.) It would seem a somewhat trivial extension of one's appreciation of paintings to discover (by masking off individual colours) what each colour is in isolation. Experienced painters adjust colours until they look as they want them in the colour environment in which they are put. They do this commonly without having an explicit understanding of simultaneous contrast.

VI. DISCUSSION

Albers makes the bold (and perhaps naive) claim that his book 'places practice before theory, which is, after all, the conclusion of practice'

(p. 1). However, in the cases of the additive mixture of blue and yellow, the lightness of colours, the demonstration of the Weber–Fechner law and the explanation of simultaneous contrast, Albers' observations were shown to be compliant to the needs of incorrect concepts he had adopted uncritically.

The establishment of a dichotomy between the way colours are perceived and the way they really are is a theme throughout his book. Yet, insofar as I am able to believe Albers, I am left with an incoherent system. He believes that one is not enabled even by his system of colour education to overcome the colour deceptions one confronts. Nor does he suggest that in viewing paintings one should make use of devices, such as grey cards with peep-holes and spectrographic analysers, in order to appreciate the gap he claims exists between 'physical fact' and 'psychic effect'. Unlike his own illustrations, most paintings are not working models, revealing, with the lifting of a flap, their colour illusions. It seems unsatisfactory that one should have to be content with an abstract appreciation of the (alleged) general principle that 'colour deceives continually'.

Although Albers' text is vitiated by errors and misconceptions (of which I have pointed to several), one may be able to see his whole endeavour as depending upon a single fundamental misconception appearing in his account of aesthetic appreciation: 'In musical compositions, so long as we hear merely single tones, we do not hear music. Hearing music depends on the recognition of the in-between of the tones, of their placing and their spacing. In writing, a knowledge of spelling has nothing to do with an understanding of poetry. Equally, a factual identification of colors within a given painting has nothing to do with a sensitive seeing nor with an understanding of the color action within the painting. Our study of color differs fundamentally from a study which anatomically dissects colorants (pigments) and physical qualities (wavelength). Our concern is the interaction of color; that is seeing what happens between colors' (p. 5).

In responding to musical compositions, poems and paintings, one responds to the many parts of a work as related in various ways. Even though it may be hard to imagine how one might respond to each part as a separate unrelated entity, it seems reasonable to expect that, if one did respond to each in that way, one would not appreciate the artwork. But there is no reason to suppose that 'seeing the parts as related' involves any confusion between the parts. The ability to respond to them together is better characterized as a positive thing, a kind of imaginative and intellectual capacity, rather than as some kind of involuntary error in perception.

If this is a correct analysis of Albers' concept of aesthetic appreciation upon which his whole colour system depends, then it would seem that he has proceeded in the wrong direction. This is hard

to judge, because he does not develop his concept about aesthetic appreciation and its supposed relation to errors in perception in a connected way.

However, the part of his account of colour that I believe to be most in need of revision is the central part: the fundamental claim that one is always being deceived in the perception of colour.

First of all, one might reasonably feel that his colour illustrations provide too narrow a base from which to extrapolate to the whole of colour experience. If a person is looking at a cloudless sky or at the lacquer on a car, it seems absurd to ask 'What colour is it really?' Albers himself acknowledges the tenuous character of the effects he wants to explore when he gives careful advice about the proportions of colour areas that must be used in making colour charts in order not to destroy the sought-after illusions (pp. 10, 11). And on p. 9 it is made clear that much searching is required to find colours that will produce the illusions to a satisfactory degree.

His concepts on colour might be characterized as a pathology of colour perception, and, viewed in this way, it seems an unfortunate base upon which to try to build artistic practice.

I believe there is a more powerful alternative available to painters, namely, The Retinex Theory of Color Vision of Edwin H. Land [9]. Land's earlier experimental observations (published in 1959 [10]) about the characteristics of colour vision have become well known and are widely respected, though perhaps in different circles from those in which Albers' concepts have been accepted.

One might now consider how a loss of faith in Albers' colour concepts could affect the appreciation of his most highly regarded artworks, the 'Homage to the Square' paintings. If it were discovered that Georges Seurat had worked under the influence of incorrect colour concepts in producing 'La Grande Jatte', there would still be many ways to appreciate this complex work independent of a belief in the correctness of the artist's conception of colour. In Albers' 'Homage to the Square' paintings the design is constant, and each holds nothing more than a selection and ordering of four flat colours. If one came to believe that his work with colour was neither correct nor meaningful, in what other way could these paintings be appreciated?

Albers' *Interaction of Color* has found acceptance in what would seem to be an uncritical art world. Eleven years after the publication of the 1963 edition Albers was able to write in the Preface to the new edition: 'The text, beginning on page 1, remains the complete text of the original large edition, with a very few corrections of errors that have come to light over the years.'

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⁴ **The Technique of Impressionism: A Reappraisal**

J. Carson Webster

College Art Journal, Vol. 4, No. 1. (Nov., 1944), pp. 3-22.

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