NATIONAL COLLEGE OF ART AND DESIGN

FINE ART (PAINTING) YEAR 4

Title : "Archaic and Technical Optics"

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Introduction : "Archaic & Technical Optics"

Illusions have fascinated man throughout recorded history. Philosophers have speculated over their causes ; charlatans have manipulated them to deceive the naive, and artists have recorded their many instances of occurrence. With such a legacy of interest it is surprising that the scientific study of visual illusions appeared so late. What are called the geometrical optical illusions only received this label in the middle of the nineteenth century, and much work has been done by psychologists in the meantime. However, these illusions - which involve distortions of size, shape or orientation have rarely been used by artists.

In the early ´60´s, however, a new movement concerned specifically with generating optical distortions, came about ; this was, called the Op-Art-movement. These Op Artists used a variety of visual phenomena that occur constantly in our everyday perception but which are usually overlooked or ignored. Their skill has been to make these minor abberations glaringly obvious to us in the paintings they have produced. These abberations will be discussed throughout this thesis, along with many illustrative examples of how they can be rendered more readily apparent.

The first chapter provides a historical background and will hopefully give the reader a better awareness of how the movement emerged into the art world.

Chapter Two deals with 'Perception', the main types, how we perceive things, different phenomena. This is a vital inclusion in this thesis because how we perceive an object or a painting must be clearly understood in order to understand and hopefully be able to fully appreciate the artists of the Op movement.

The third chapter deals with the more circumscribed area of geometrical optical illusions as they are studied by psychologists and artists alike. Indeed the term itself has a rather archaic ring to it, echoing the mid-nineteenth century Teutonic desire for precision. More frequently they are referred to as geometrical or spatial illusions, with the term optical describing the broader class of illusions involving 'tricks of light'. Here illusions refer to the phenomena involving specific and systematic errors of perception which occur when insufficient evidence for correct perception is provided. The figures illustrating the geometrical illusions are bland in comparison to those of Op-Art. Also, in Chapter Three I have tried to reconcile the areas of Op Art and geometrical illusions, hence the title Op-tical Illusions.

The aim of this thesis is not to brace and plot out point by point what Op Art is, but to be selective in picking out areas that concern the development, of my own work and ideas. I also hope to span the gap between the artists' and the scientists' approach to visual illusions.

Chapter 1 : Historical Background

Why, you may ask, when artists have always been conscious of optical effects to some extent, did Op Art not come about earlier ? The answer to this is, that as long as painting was concerned with pictorial representation, colour, shape, etc. were not used for their own sake any concern with their optical properties was likely to be subservient to representation also. So the evolution of Abstract Art was a preliminary step towards the development of optical painting. Certain directions lead more immediately towards Op Painting, and it is with these that my main concerns lie.

Most writers trace the origins of Op Art back to Turner and the Impressionists but they could be traced back further still, to Decacroix at least. Contributions consisted in the partial emancipation of colour from form, that is the breaking up of form in light. Soto, one of the early Op Artists, sees Turner as someone far in advance of the Impressionists. He says :"He wanted to show the total destruction of solids and all figurative matter by light. Turner is the first and greatest of the Impressionists". (1, p.7)

Figure No. 1 J.R. Soto "Cube of Ambibuous Space"

1969, 98 x 98 inches.

Denis Rene Gallery, Paris.

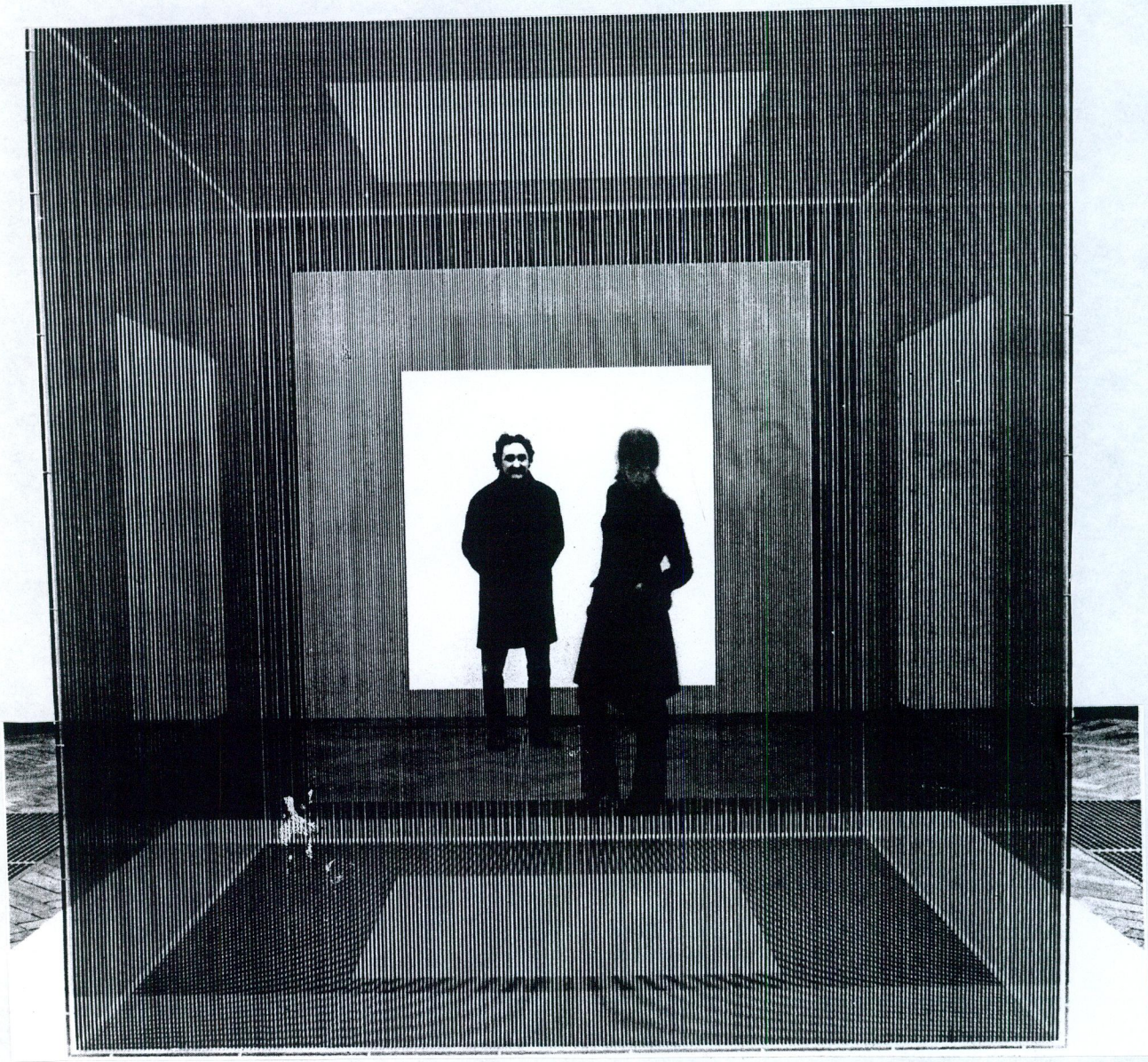


Figure No. 2 Kandinsky, Wassily

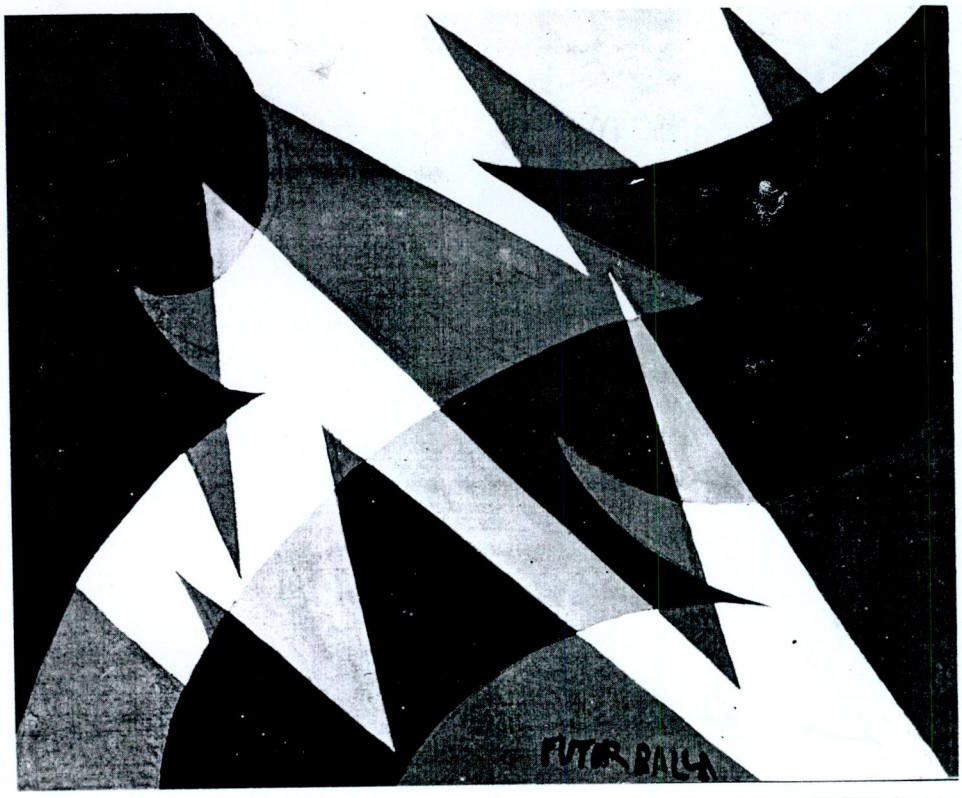
IN THE BLACK SQUARE, 1923.
THE SOLOMON R. GUGGENHEIM MUSEUM, NEW YORK.

Soto saw Turner as being altogether more remarkable than the Impressionists who were still attached to figuration and he believed that after Turner, one can move directly to pure abstraction, - to Kandinsky, for example. Soto might be right here because however much the Impressionists were concerned with light and colour, their main concern was figuration, with the colour of objects, with light as reflected from objects. I have included two illustrations by the forementioned Artist to familiarize the reader with the type of work he will encounter while reading this text, (Fig. No. 1 & 2).

However the Impressionist took on an intuitive rather than a theoretical approach. Seurat and the Neo-Impressionists came closer to the roots of the Op Art movement in their systematic manner of painting. Their systematic use of colour was called 'pointillism' and it consisted in the use of tiny dots of colour unrelated to local colour, which use or mix optically to produce the required chromatic effect. Small quantities of different colours, take as an example red and green, will reinforce one another and increase intensity if seen from a distance. When viewed from a greater distance they fuse to form a common colour, grey. It was through the Post-Impressionists, particularity Van Gogh, Matisse, and the Fauves, Delaunay and Kandinsky that the exploration of pure colour, which would eventually lead to Op, was made.

Optical Art is also concerned with form and structure. This aspect of Op art grew out of the Geometrical abstractions of Mondrian and Constructivism generally. The part played by Cubism was indirect, and is relevant only to the extent that it introduced a new psychological outlook and led to abstraction.

Figure No. 3 Balla, Giaconno. "Electric Lamp" 1909

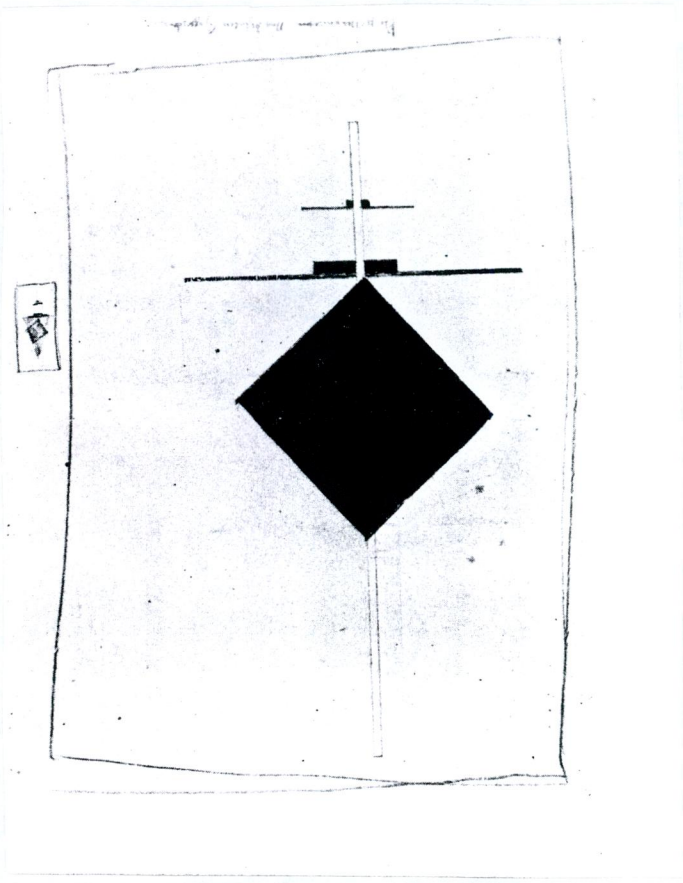


Futurism on the other hand both theoretically by its insistence on the importance of conveying movement - and by its techniques had a direct bearing and perhaps the earliest Op painting was by Futurist, Giaconno Balla. In his 'electric lamp' (visual No. 3) he used arrowheads of both centripetal, and divided concentric, brush strokes to suggest the vibrancy of light. So strong is the optical flicker in this picture that, if the lamp - standard and crescent moon could be eliminated the central section might pass for an Op painting.

Orphism was a crucial stage and was directly linked with Seurat and Neo-Impressionism. The artists in question are the Delaunays (Robert and Sonia), Picabia and Kupka. Their form of Cubism was given the title 'Orphism' or Orphic Cubism by Apollinaire. The feature of Orphism which distinguished it from other forms of Cubism was, according to Apollinaire is purity. It was an art of painting new structures which have not been borrowed from the visible world, but have been created by the artist himself - what we could call abstract.

In 1913 similar developments were taking place in Russia, there, there was a proliferation of movements and 'isms'. Of these two have a bearing on the evolution of Op ; the Suprematism of Malevich and Lissitsky, and Rayonism, associated with the names of Larionov and Natalia Goncharova. Malevich describes Suprematism as the

Figure No. 4 : Malevich, Kasamir. "Black Square"
1917, 16 x 11 inches.
Stedelijk Museum, Amsterdam.



supremacy of 'pure sensibility in Art'. Like the Orphists he rejects representation and motifs drawn from nature as irrelevant to art though he concludes, their presence may not preclude a work from having high artistic value. But what counts is sensibility, and this, he says, is the last thing the public looks for. Also in 1913 Malevich produced what he considered the purest expression of his sensibility when he painted a black square, (Fig. No. 4) on a white canvas. His most amusing account deserves to be quoted at length, because it hits off the reaction to his square very accurately :-

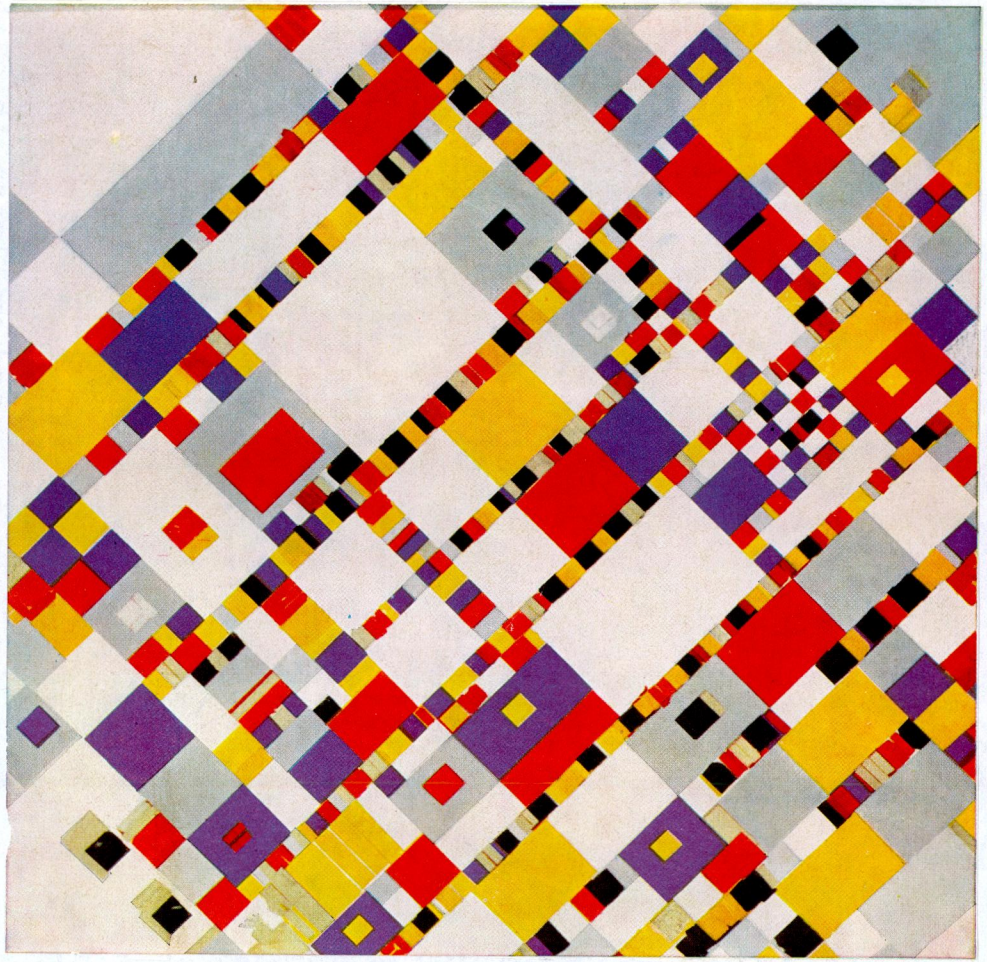
"When, in 1913, I made my desperate attempt to deliver art from the dead weight of the object, I sought refuge in the shape of the square... The critics, and with them the public, burst into lamentation, crying : "All that we loved is lost - we are in a desert, faced with a black square on a white ground" (2 p.11)

Malevich's black square and his subsequent white square on a white ground painting were a very important turning point for Art as we know it. These paintings had a huge if not immediate effect on the development of abstract art. This was abstract art as bold as brass and for some pushed right to its limits. If abstraction was a prerequisite for the evolution of Op, and a hard-edged geometrical abstraction with forms lying flat on the surface, not the painterly brush strokes of the Orphists, then the place in the evolution is obvious. However Victor, Vasarely, the founding father of Op Art, had this to say of Malevick's

black square ; "that Malevich's square is, in the end only a stage-set without drama. However, not all Op Artists agreed with Vasarely's views either, but his ideas did have an important effect on the development of Op.

One group of Artists that also had an important effect on the development of the Op Art movement were the artist that taught at the Bauhaus from the twenties on. Perhaps it's most fundamental contribution to the evolution of Op was the attitude to art which was inculcated in the preliminary courses. This is stated clearly by Albers, who took over the course when the Bauhaus moved to Dessau in 1925 : quote "Our start is not retrospection, nor the ambition to illustrate, to embellish or to express something. We try to learn, i.e. to see, that every visible thing has form and that every form has meaning - and we learn this by producing form. Therefore, our workshops are laboratories rather than ateliers, studios or lecture rooms". (3 p. 68)

Art was, thus initially investigation and experiment. The point of departure was not nature but materials and the basic elements of a picture, form and colour. The immediate object was not to reproduce or analyze nature, nor to express an idea, nor was it self-expression, nor even creative expression, but the discovery of what can be done with materials and basic elements.



Itten, who inaugurated the preliminary course, had studied under Holzel at Stuttgart in 1913 - 16 and had produced a number of abstract studies during that period. Holzel, a member of the new Dachau Jugesdstil group, had long been interested in colour harmony and the expressive qualities of colour and had made a number of experiments in the application of abstract colour in design and decoration. To these ideas Itten added those of Kandinsky, and as a result the early years of the Bauhaus were considerably affected by Expressionism, and had not the cool detachment implied in the quotation from Albers. However, Itten's investigations into the possibilities of colour relations published in The Art of Colour (1961) were and still are of interest, even for those who do not share his romanticism.

Figure No. 5 **Mondrian, Piet. "The Victory Boogie Woogie-those Lights !**

With the Orphists exploring abstract colour contrasts and the Suprematists placing geometrical shapes flat on the canvas we have, by 1913 at least, the ingredients which were to go into the making of Op. Some of these ingredients are also to be found in the geometrical abstractions of Neo-Plasticism. Unlike the Suprematists and Orphists Mondrians progress towards abstraction was gradual if relentless. He did not reject nature and naturalistic representation in the brusque way they did. Mondrian arrived at abstraction in an attempt to reach nature at its most universal. 'The task of art' he writes "is to express a clear vision of reality..... particularities of form obscure pure reality." (4 p.12) Mondrian was one of the most thorough going Platonists in the history of Art, and somehow, had managed by the 'twenties to reach a pure form of abstraction. In Mondrian's last works, ' The Victory Boogie-Woogie-those-lights ! (Fig No. 5). Here we see the beginning of vibration in painting. Soto commented on this by saying that, "It seemed to me that he had made a sudden leap in the direction of purely dynamic painting, realized through optical means that he was about to make the image move optically." (5 p. 114)

We have now looked at and familiarized ourselves with the movements and elements that brought about the Op Art movement. Of parallel importance is the psychology behind many works of this kind. One of the initial stages in the

perceptual process involves differentiating a figure from its background and isolating the related parts of the figure. The group of psychologists who attempted to describe these aspects of perceptual organisation in most detail were called 'Gestallists' because of their emphasis of the holistic nature of perception. They formulated descriptive rules for the perceptual grouping of elements rather than any properties of the visual system, although they did not argue paradoxically that the perceptual organisation were innate grouping in patterns of elements was said to be dependent upon the nearness or proximity of elements, their similarity to one another, whether they were symmetrically arranged or fell along continuous lines. The Gestalt school retained the structuralist emphasis on the phenomenology of the observer, while rejecting the atomistic assumptions. The configuration rather than any element within it, served as a unit of analysis.

Since, for the Gestalt psychologist, all perception involved a non-correspondence between the conscious representation and the physical array and, for the behaviourists, simple stimulus registration and overt response rather than the conscious experience were to be the only proper study of psychology, no room for the study of illusions remained. For the Gestalt psychologist, an illusion was merely another manifestation of normal perception whereas for the behaviourist, an illusion was a content of consciousness and hence not available for study.

The hundreds of illusion - producing configurations and the dozens of theories used to explain them were all discarded or de-emphasised as research in this area went into a dramatic decline in the second decade of this century.

In this brief historical survey I have attempted to set the context our of which the contemporary study of illusions emanates. Many of the themes that emerged throughout the early theorizing on illusion's recur in contemporary speculation and I will draw upon them in Chapters Two and Three.

Chapter 2 : "The Importance of Perception"

It is an extraordinary paradox that the Gestaltists, who created a good descriptive classification of grouping principles, did not provide the best examples of perceptual grouping. Rather, artists working with freer and more intuitive organizational principles have filled the pictorial niche, and this applies particularity to various Op Artists who will fall under scrutiny later on. The three main concerns in my own work are movement, optical space and illusions. These I will be discussing from an Optical point of view but firstly how we perceive an object or a painting must be clearly understood in order to understand and hopefully be able to fully appreciate artists like - Bridget Riley, Vasarely, Larry Poons, Peter Sedgley to name a few.

Our perception of this world includes four elements :-

1. Light energy , the source of energy ;
2. Material and its response to that energy ;
3. The eye, the receptor of light, (the eye is so sensitive to light that one candle can be seen at five miles distance) ;
4. The brain, the interpreter of the received signal.

Light is the raw material for our cosmology, the medium of consciousness. We therefore dwell at some length upon the

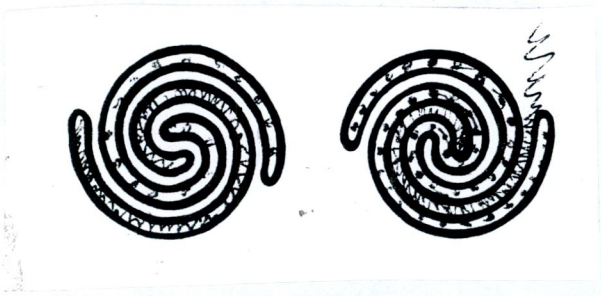
mechanisms of perception, not merely to catalogue items of relevance to the perception of diagrams, but also to use the selected items of examples of model-making. As we move into the electronic age, we are only beginning to understand the full implications of our immersion in light, this medium of electro-magnetic-radiation which is capable of causing skin cancer and even affecting deep rooted organs and glands. We should be cautious of ruling ourselves free from the disturbing physiological effects observed in experiments with other creatures of inappropriate light sources or length of exposure to light. We are also ruled by a biological clock.

The eye, which selects and interprets the electro-magnetic stimulus, is a sophisticated instrument. It has two mutually irreconcilable functions, visual sensitivity (threshold of stimulation) and visual acuity (resolution). The eye permits an optimum combination of these two functions, in operation the stronger of the two inhibits the other. There are millions of cells in the eye with different functions. The cells of the visual striate area are arranged in columns perpendicular to the surface. Each cell column has many specialized cells which can be loosely grouped into three types :- Simple cells, complex cells and hypercomplex cells. Simple cells respond only to a specific orientation and a specific position in the cells receptive field. Complex cells also respond to line or edge in a specific orientation but are particularly susceptible to movement and less particular about the position in the receptive field. Hypercomplex cells have no response to unlimited edges but respond to particular length of edge.

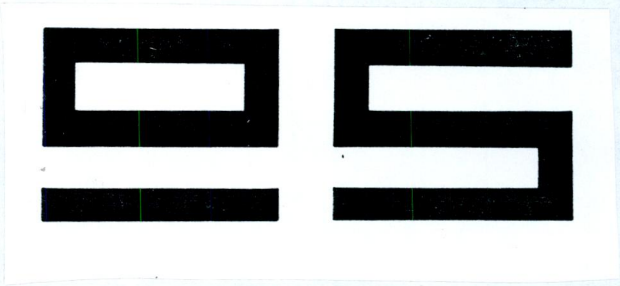
To sum up, the visual cortex appears to have a rich assortment of functions. It arranges the input from the lateral geniculate body in a way that makes lines and contours the most important stimulus. Experiments have shown that there is a distinct preference for verticals and horizontals. Movement is also an important stimulus factor. Each cell only responds to a particular rate and direction of movement. Therefore the features extracted

Figure No. 6 : 'Learning to see'

Pair A



Pair B



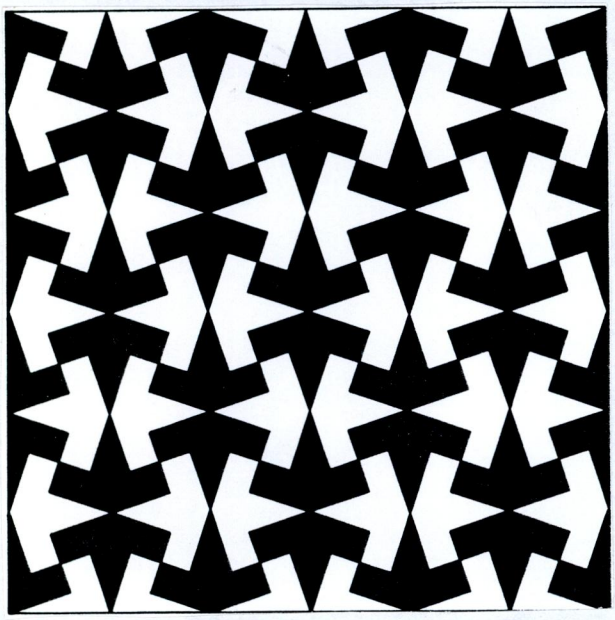
from the visual field are those that we are programmed to extract. Of course prior conditioning does on occasions override the physical response and the conflict of data which may then be experienced will generate misinterpretation or an illusion.

Even the phenomena of perception can come in pairs (vis. No. 6). The two accompanying illustrations will demonstrate the difference between pure and cognitive perception. To discriminate between them requires conscious effort, concentration and even a tracing of the form to understand its structure. The second pair of figures requires no conscious effort to read. The connectiveness or lack of it, is immediately evident. This is pure perception of the generalized recognition of whole figures.

The limitations of pure perception become obvious in perceiving the connectiveness of more complex patterns which can result in an overloading of the perceptual system. We can relate the data-processing of pure perception to the mode of thinking associated with spontaneous responses, and we can relate the data-processing of cognitive perception to the mode of concentrative responses.

Another way of describing the differences between the duals in perception is to classify certain types of perception as physiological and others as psychological. Various test figures have been used to demonstrate the differences and the interactions of these aspects. Test figures which generate illusions are frequently used. Some illusions stem from what can be ascribed to a purely physiological response or a malfunction of the mechanism of pure perception, some are part physiological and part psychological and some are purely psychological and are the result of a faulty hypothesis, or an inappropriate cognitive response. This may all sound very complicated but what is generally meant by a psychological response is that in which the viewer brings to the percept information which is additional to the processes of the mechanism, that is information which is not physically available in the contemporary stimulus.

Another very important element of Op Art is figure / ground perception. The result of the differentiation of figure from ground, feature from field, provides us with another example of duality in the process of perception. The figure, once identified within the visual field is always read as being above, or in front of, the ground. Following from this, any feature that moves in relation to the field becomes the figure in front of the ground.



The arrow pattern (Fig. No 7) is seen as composed of either black figures on a white ground, or white figures on a black ground. The brain is spontaneously generating two alternating hypotheses. Which it could be said is of primary importance to many Optical Artists working in this manner. Figure 8 offers an example of this alternating hypotheses in the field of Optical art.

I will now return to one of the most important factors of my own work and the artists I admire, MOVEMENT ! how we perceive it and use it to our advantage in paintings. The complex relationship of the viewer to the viewed is most clearly demonstrated in the peculiarities of our perception of movement. As we walk down a street the buildings appear static. We do not perceive them in the blurred streaks they would create on the retina if we compared the eye to the camera. The eye transforms the flow of complex stimuli into a structured world of objects, each seen clearly. We know from the study of less advanced forms that movement perception might be described as the eye´s most important function, essential for the specie´s survival.
If an object is apparently moving relative to a static visual field, then clearly the visual field is assumed to be static to the viewer. As obvious as this phenomenon may

Figure No. 8 : Vasarely, Victor. 'Zebras', 1932 - 42

51 x 45 inches.

Denis Rene Gallery, Paris.

8

seem, the assumption can lead to a misinterpretation of available data - such as occurs in the illusion generated while sitting in a railway carriage, looking at an adjacent coach which on moving generates the feeling in the viewer that it is he who is moving. Usually this illusion occurs because the moving train masks other information regarding the static visual field, and in fact becomes the visual field. As we have seen, if the visual field move, we assume ourselves to be moving. This illusion also confirms the close relationship of vision and the physical senses because not only is this illusion visual but we often actually feel that the train we are in is actually moving. Equally disturbing or amusing are the many illusions generated by motion-parallax. When sitting in a moving train objects in the foreground appear to move more quickly than distant ones. This effect is accentuated when our attention is held by the distant object.

Paintings as visual communication combine diffused (montage), trigger (stimuli) and, in specific instances, transfer modes (trompe l'oeil). As such the painting activates a spectrum of thinking-functions, from 'sensation' through 'synthesis' to 'analysis' and 'analogy' to change within the act of perceiving the painting, the states of mind of the viewer. The painting is usually dependant on, and certainly stimulates, the long as well as short-term memory. It may also activate through synaesthetic sensations deeper levels of the mind. It

usually depends upon some knowledge in the viewer of its conventions, certainly of its function. The rewarding painting is usually one which maintains a balance of the A and B type extremes and contrives to communicate using tricks´ of illusion, perspective, etc. to hold and increase the attention of the viewer. The perception of a painting is not primarily dependent upon a compilation of items but upon field perception, generalization etc, against or in which items find their relationship to each other and their place in the whole. Factors of orientation, of distance, of viewer from viewed, ambient light, etc, all have potent effects upon the percept of the viewer.

There are at least three ways in which movement can enter into painting. First there is the representation of movement or alternatively the representation of objects as seen by a moving spectator. Interest in the latter is of comparatively recent origin, being tackled in systematic fashion by the Cubists and Fuburists. But apart from the representation of movement there is also a kind of movement that is common to all painting, whether the object represented is moving or static, or whether there is any object in the strict sense or not. This might be called ´formal´ movement. It has to do with the composition of the painting and its elements. This is sometimes referred to as the rhythm of the composition. We speak of "flowing" lines "receding space, etc. Thirdly, there is what has been called ´virtual´ or ´apparent´ movement. Here the picture surface or parts of it appears to move, to heave

Figure No. 9 : Riley, Bridget. 'Intake', 1964.
(70 x 70 inches).
Collection - John Power, U.S.A.

and thrust, advance and recede and alter position. No doubt something of this sort happens in all paintings though to a degree that passes unnoticed. It is more than a suggestion of movement, as in the case of a flowing line, it is more an 'illusion of movement'. This kind of movement is peculiar to Op Art to the extent that it might almost be called its defining characteristic. It has already been noted that this kind of movement is not always apparent at once. It usually requires a certain amount of concentration of the picture before it takes place and will vary from picture to picture. Bridget Riley's painting 'Intake' (Fig. No. 9) affords a good example of two of these kinds of movement. There is not only the overall rhythm of the composition but also the movement of the flowing wavy lines. And after one has concentrated on the picture for some time, the third type, virtual movement begins to take place. The surface begins to heave and billow, and great troughs appear and become more and more cavernous.

Virtual movement introduces the 'time factor' in all paintings, just as there is movement in all painting. The picture itself may not alter - to that extend it is static - but time is required to apprehend its contents. For me and a large proportion of my work virtual movement is of prime importance as I believe no picture of real value reveals itself at one. In Op Art a third temporal factor enter in.

This is referred to as the 'optical development'. As we all know, a certain amount of concentration is required before optical effects occur and when they do we experience visually something which is not on the canvas or happening on the canvas. In 'Intake' the surface does not actually heave and buckle yet it appears to do so. It is not just that we observe something which we could not have observed before, since a period of concentrated looking is required for this phenomenon to happen. And once it has begun it continues to happen, that is, the appearance of the picture continues to change ; the direction, depth and speed of the movement continually varies. Even, qualitatively different changes may occur. In 'Intake', as with other pictures we have considered , colour may appear, in this case a blue band at one point of contact between the black and white wavy lines and a orange band at the other side. Thus the work, the object of our attention, is changing, developing, evolving all the time, rather like a film or a piece of music. An Op painting is as Seitz says, less an object than a generator of responses, successive, controlled, programmed responses.

Another characteristic of Op painting and the second of my concerns follows directly from the preceding one and like it , is almost a defining characteristic ; this is the kind of space it creates. There is a great variety of ways in which a painting may convey an impression of depth. We have a natural tendency to see areas of different colour or

tone as figure and ground, that is, as lying on top of one another. Where one form overlaps another we see it as being in front of whatever it overlaps. Or again, where perspective is employed, we have a strong impression of depth and distance, and we may even see certain parts of the picture as stretching away to infinity. The space created by perspective is usually homogenous, that is, the objects seen in it are in a coherent relationship to one another as if viewed from a single viewpoint.

Towards the end of the last century painters were beginning to concentrate their attention more and more on the picture plane and hence reduce the pictorial space of their pictures. This tendency is said to be expressed by Maurice Denis's will know remark "A picture, before it is a war horse, a naked woman or some anecdote, is essentially a flat surface covered with colours arranged in a certain order" (6, p. 207). One device for flattening pictorial space used extensively by the Cubists, was ambiguous perspective. A typical Cubist picture is so constructed that it is impossible to view all the objects in it from a single viewpoint. This continual shift of viewpoint makes us conscious of the picture plane, or, to put it another way of the process of projecting the objects into pictorial space which passes unnoticed where single viewpoint perspective is employed.

There are, then, two features of pictorial space as it has been considered so far :-

1. it recedes from the picture plane even if this recession is limited and the eye is continually being recalled to the picture plane and even to the picture surface.

2. it is a matter of interpretation, of seeing the objects as receding from the picture plane, falling in behind one another.

In abstract painting the first of these two features sometimes disappears. An abstract painting is very rarely like a scene viewed through a window. Nor though, do the forms necessarily lie on the picture plane. But the tendency to relate them as figure and ground, to regard overlapping forms as lying in front of the forms they overlap, still operates. In some cases even perspective devices may be employed. But the picture plane in so far as it can be established need no longer be the forward limit, so to speak of the pictorial space : the forms - indeed, the whole picture, as in the case of a Rothko, may appear to advance towards us and even to envelope us. In some cases the spatial relationships between the forms will remain relatively fixed and unambiguous. However in others, as for example in some of the organic abstracts by Arp or the geometrical abstracts of Stella, where the figure - ground relationship is ambiguous, there will be a continuous shift in spatial relationships and the advance and recession of the various forms. In all cases, however,

Figure No. 10 : O'Brien Fintan. "Electro-Magnetic-Radiation. (1992) 72in x 36in

it is a matter of interpretation, of seeing a form now as figure, now a ground, now forward, now back. Optical space is when the whole picture and / or its elements appear to move about advance and recede, undulate and change position. My own painting "Electro-Magnetic-Radiation" (Fig. No. 10) is heavily reliant on Optical space and is a good example demonstrating this type of space. It differs from other kinds of pictorial space in being the result not of an interpretation of the elements in the painting but of a certain transformation occurring in the optical system but in fact a failure or an inability to interpret the elements. It carries forward developments begun by other abstract optical painters, namely the forward or outward advance of pictorial space from the picture plane or surface. This differs from other kinds of abstraction, where the picture still keeps its distance so to speak. It is always possible to measure with the eye one´s physical distance from the picture, seeing it as a flat surface covered with pigment a certain number of feet away. But this is not always the case with an Op painting. Once the optical effects have begun to work, the precise location of the picture in physical space may become difficult to determine. You have a sensation similar to that which is sometimes experienced while driving along a road in fading light when the road in front of you looks like its rising up like a wall or a distant object for a split second appears to be only a few yards away. If one is to look very closely at some of Soto´s works you might even bump

your nose on one of them while trying to locate it physically in space.

Though it is usual to speak of Op art as an art which operates with or creates optical illusions, it should by now be clear that this is true within certain carefully defined limits. Op art is not illusionistic, in the ordinary sense of the word. Nor is all art in which Optical illusions are used Op Art. Cubism and certain forms of abstract art within what I have called the Cubist tradition use optical illusions, and are still not Op. It might not be out of place, therefore, to consider what is meant by illusion and what application it has to art.

Chapter 3 : Illusionism & Optical Illusions

The illustrations in this chapter attempt to combine aspects of Op designs and of geometrical illusions - hence the title "Op-tical Illusions". The distortions studied under the rubric of geometrical illusions are embedded in backgrounds that can either influence them or generate a variety of op effects.

Section I - of this chapter, will discuss 'Geometrical Optical Illusions' and will have a look at one of the major theorists of the 19th century in the field of Illusions.

Section II - will look at five selected features about illusions that pose general problems for theorists and artists alike.

Section III - will take on board the dominant strategy employed by psychologists for unravelling the knot of visual illusions. It will look once again to examples of the Muller-Lyer illusion, Victor Vasarely and Bridget Riley.

Section IV - is somewhat of a departure in the sense that I will be looking at some of the arguments put forward against Op Art by critics and the media alike.

Visual illusions reveal visual truths (7, p. 34) stated Jan Evangellista Purkinje, one of the most astute observers in the history of visual science. Whether such confidence would still have been voiced some 160 years later seems

doubtful. The belief that illusions hold the key to unlock the mysteries of vision has been maintained in the face of mounting evidence to the contrary. The alternative and to my mind more defensible, reason for studying illusions is their inherent fascination.

Section I

Geometrical illusions are relatively small distortions of visual space. The distortions can relate to size, shape, direction or movement. They are called illusions because the configurations all contain the potential information that could lead to correct spatial perception, but this does not occur. Rather, systematic errors are made that can be shown to be due to the presence of specific distorting elements. This class of illusions has been labelled 'geometrical optical' by Oppel in 1855. Some twenty years earlier a different type of illusion was reported by a Swiss crystallographer called Necher. He drew attention to the perceptual fluctuations that occurred when observing drawings of simple three dimensional structures - they show perspective reversals. Many flat outline drawings have this tendency to be perceived in ambiguous depth. The depth is ambiguous in so far as insufficient information is provided for stable perception. These are treated together with another class of figures that provide conflicting depth information over their surface such they could not be constructed in three

dimensions - hence the label 'impossible figures'. Reversing and impossible figures will be presented following illustration and discussion of the geometrical optical illusions.

The study of geometrical optical illusions would be assisted greatly by the existence of unambiguous taxonomy - some grouping that would hopefully assist in any general explanation of their basis. Unfortunately, no system of classification has emerged that is not fraught with exceptions, with the consequent uncertainty regarding the scope encompassed by the various theoretical approaches. The illusions need to be demonstrated prior to examining their interpretations and in the next section we will be looking at the Muller-Lyer illusion for further explanation.

The old fashioned term for geometrical illusion is Geometrical Optical Illusions but specific illusions have generally been named after those individuals who first reported their occurrence. Even the briefest journey into the study of visual illusions is bound to bring one into contact with the pattern shown in Fig. 11A. This configuration was first presented by Muller-Lyer (8, p. 30) and bears his name. More work has been done on this illusion than on virtually all other illusion configurations combined. One of the reasons for the

popularity of this figure is the tremendous strength of the distortion. The apparently longer segment is usually seen as 25% to 30% longer than the apparently shorter segment. There are myriad variations of this figure Fig. 11B shows the most popular variant, which was first introduced by Brentano (1892). Fig. 11C shows how variations in the

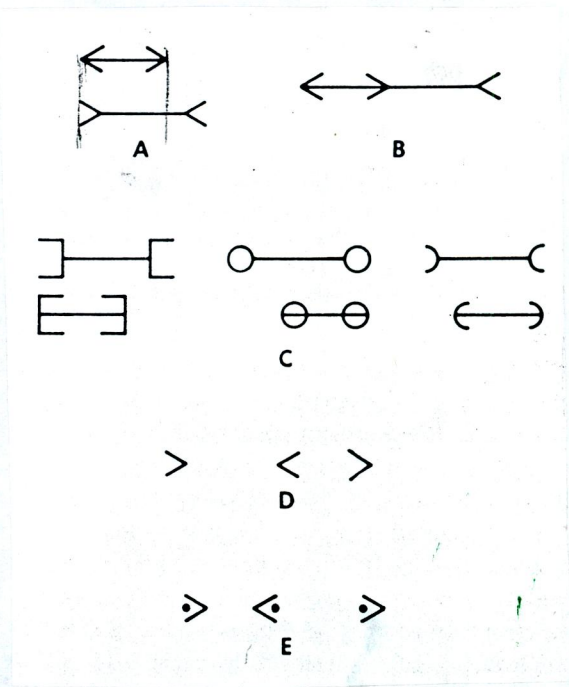
Figure No. 11, parts A,B,C,D. Lyer Muller. (1889)

(a) The horizontal shaft with wings turned out appears to be longer than with the wings turned in.

(b) The Brentano form of the illusion.

(c) Variations in wing shape alter illusion magnitude.

(d) The illusion still occurs with the shaft removed.



shape of the wing affect the size of the distortion. In general, as the wings become less angular, the distortion decreases. Fig. 11D shows that the distortion apparently involves an alteration in the extent of the space between the vertices of the angles, since the illusion is still present when the horizontal shafts are removed.

However consider the configuration shown in Fig. 11D. One would predict that the distance between the left-hand dot and the middle dot would appear to be longer than the distance between the right-hand dot and the middle dot. (the distances are in fact equal). Yet in this interesting figure created by Ebbinghaus in 1902, the opposite effect occurs.

Variations in the size of the angle between the wings also effects the illusion strength dramatically. Although there is some disagreement about the size that produces the maximal distortion, in general the evidence indicates that smaller angles produce greater over - and underestimation than do larger angles.

Altering the length of the wings also affects the strength of the distortion. The size of the illusion increases as wing length increases, up to some optimal length. Increases in wing length beyond this point lead to a decrease in illusion strength. The strongest effect is obtained when the length of the wings is between 20 and 35

percent of the length of the shaft. The Muller-Lyer figure reappears many times in other theories on illusion. It is a favourite of illusion theorists and often their downfall.

Section II

There are many features about illusions that pose general problems for all the theories presented. First, some illusions are reduced in magnitude with repeated testing. This aspect has been used by some theorists, to provide an index of the ´cognitive´ components in illusions. That is, they suggest that the reduction in illusion magnitude with practice reflects the strategy applied by the observer when inspecting the figure ; with repeated observation the eye movements are said to scan the patterns more accurately so that the inducing lines exert less influence. If the strategy of observation is so changed it is strange that the decrement tends to be restricted to the specific configuration used in practice. Second, various illusions change in magnitude with the age of the observer. The developmental trend is not consistent, showing increases with some illusions and decreases with others. Third, certain cultural differences in illusions have been found, thought these seem to be relatively independent of the visual environment in which the cultural groups live. It has been suggested that the differences are related to the extend of retinal pigmentation in the eyes of the different groups. Dense retinal pigmentation would reduce the

effective contract of the illusion figures with a consequent decline in the magnitude of illusions consisting of intersecting lines. A similar interpretation has been advanced for the age trends in the perception of illusions. Fourth, spatial illusions occur in other sensory modalities. The Muller-Lyer illusion can be induced by pressing an outline of the configuration onto the skin or by tracing over a relief model with the finder tips. All the theories proposed so far have been addresses to visual spatial illusions alone, and could not account for such tactile illusions. Fifth, illusions have been found to occur within many other species like fish, birds, and monkeys when appropriate testing procedures are employed.

These facts, together with others of greater detail, have led many researchers to abandon the quest for a general theory of illusions. Rather than try to determine the factors involved generally in illusions and to resolve their relative weighting in specific illusions. Thus it is less frequently argued that a particular illusion has a single basis, but that several interacting factors may be involved. In so far as this is the state common to practically all aspects of perception, the geometrical illusions join the large band of phenomena awaiting adequate explanation.

Section III

The next illustrations in this chapter combine aspects of OP designs and geometrical illusions, hence the title op-tical illusions.

The dominant strategy employed by psychologists for unravelling the knot of visual illusions has been systematic simplification. Figures are bared to their inductive essentials and beyond. The aim seems to be to destroy the illusions - to find a figure that would still be considered an instance of X's illusion but without its occurrence. Needless to say this has proved exceedingly difficult. The illusions can easily be manipulated but not so readily obliterated. Here no attempt is made to follow the course of illusionary destruction, rather they are nurtured in figures that are active in the OP sense. That is to be op-tical illusions - to show a variety of OP aberrations as well as geometrical distortions. There is, of course, no guarantee that this approach towards complexity will succeed where simplicity has failed. It does however, provide an alternative avenue that offers hope for solutions and from which useful insights might arise.

The Muller-Lyer illusion can be seen in a number of variations as I mentioned earlier, some of which utilise straight and others curved ends. It is not essential to

Figure No. 12 : Wade, Nicholas - Example Illustration.

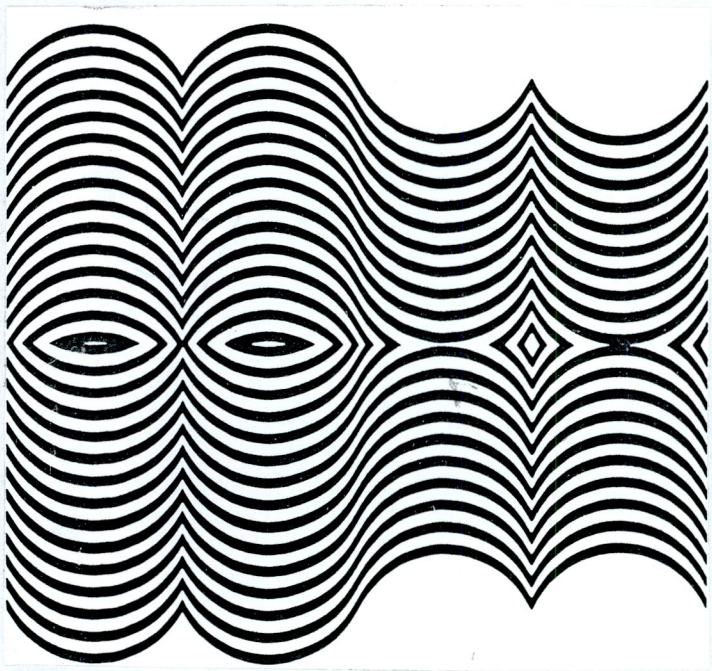


Figure No. 13 : Wade, Nicholas - Example Illustration

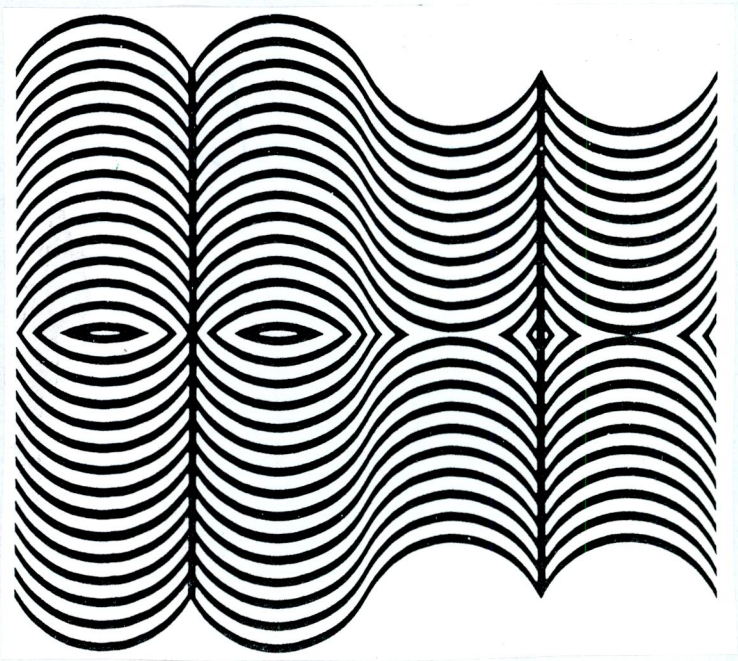


Figure No. 14 : Coren, Stanley - Example Illustration

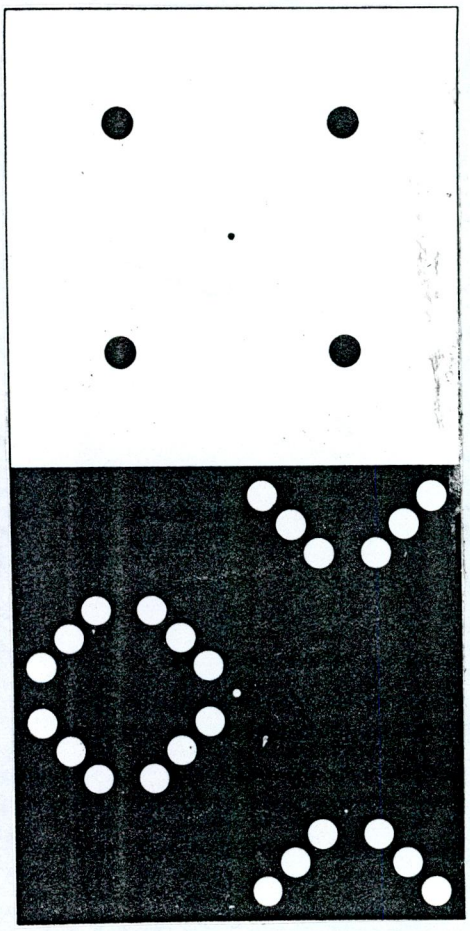


Figure No. 15 : Periodic Structure of Concentric Circles.

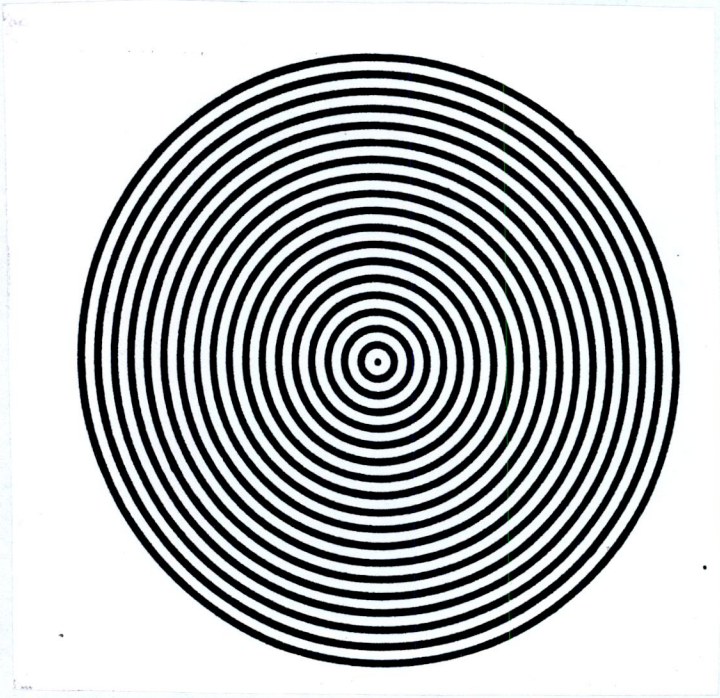


Figure No. 16 : Periodic structure in a spiral

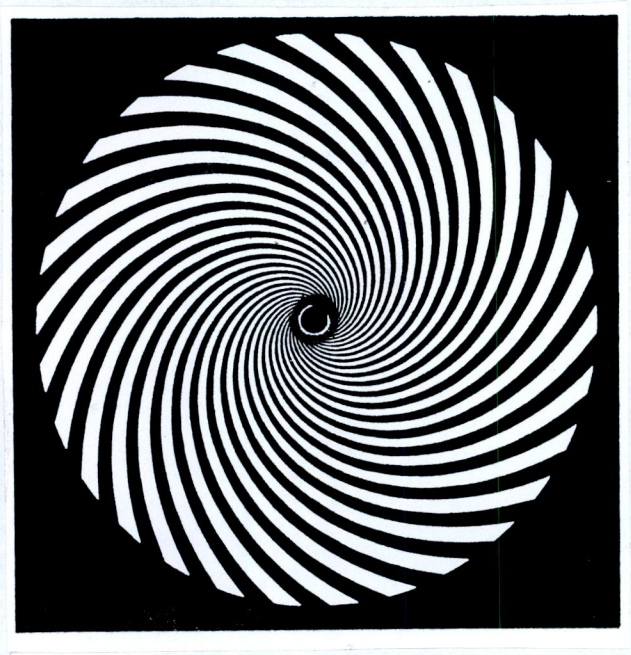
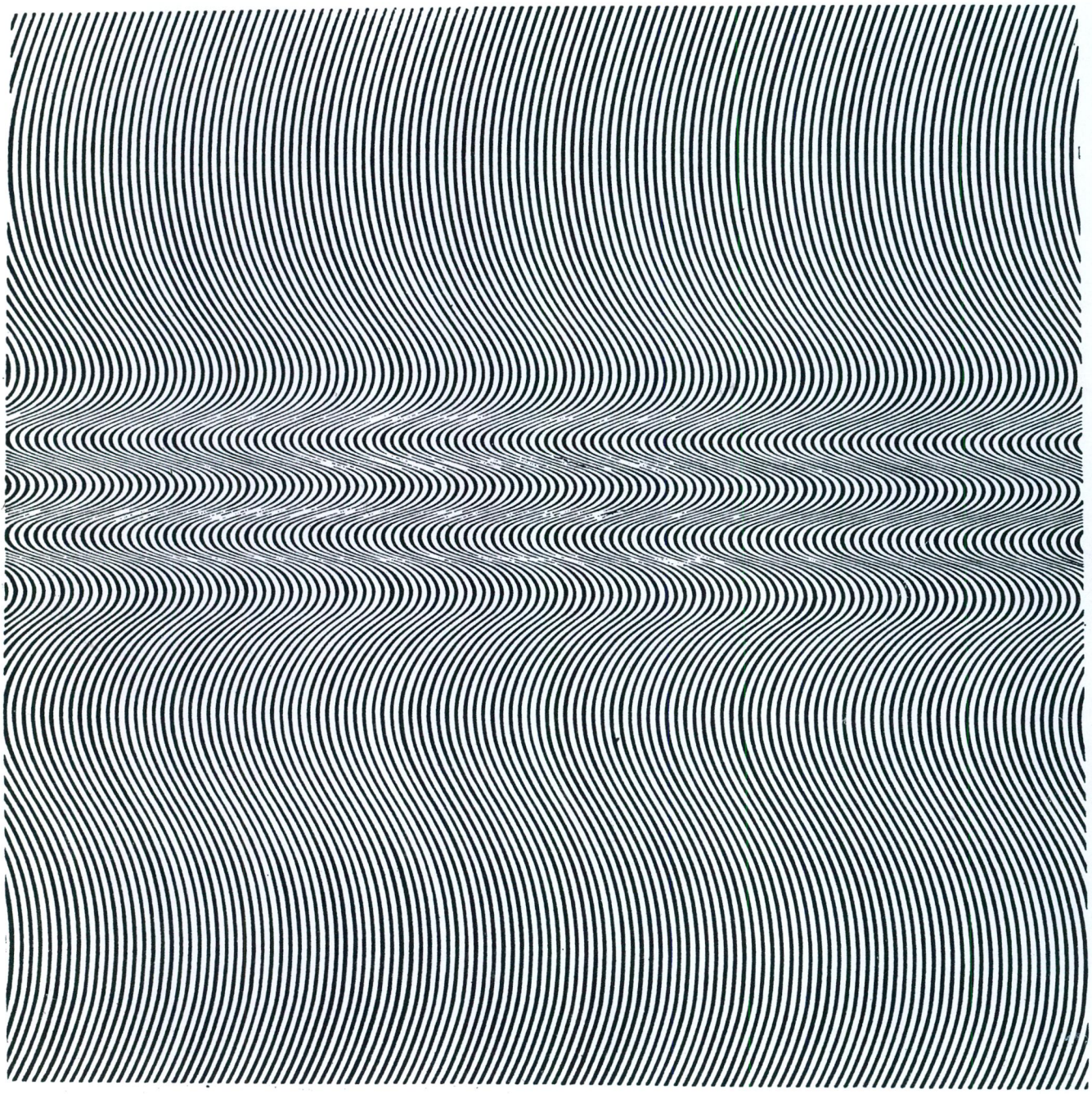


Figure No. 17 : Riley, Bridget, "Current" 1964,

58in x 58 in, Metropolitian Museum. N.Y.



have a line connecting the ends, as can be noted by comparing, FIG 12 and FIG 13. It is impossible to determine whether after images undergo variations in their apparent separation by means of figure 14. Fixation upon the black dot on the right for about 30 seconds will generate negative after images when the gaze is transferred to the small white dot on the left. The black discs are equally distant and appear so during initial fixation. The question is whether they so appear when visible as white discs (negative after-images) during observation of the left side. The afterimages may take a few seconds to develop and the eyes should be kept as steady as possible. Viewing the left figure for a similar duration will generate black disc after-images when the dot on the right is fixated. By this means one or other after-images can be maintained by alternating the gaze between the fixation points. The reason for demonstrating the after-image effect is because they occur over and over in Op art. The spokes which radiate from the concentric circles and spirals of (Fig. No. 15 & 16) and the horizontal lines which, detach themselves from the centre of Bridget Riley´s "Current" (Fig. No. 17) if not after-images are after-effects of stimulation a new pattern interacting with the hangover of the previous pattern.

By using variations of Muller Lyer´s illusion we have seen the sort of after-images one might come across in the Art world, primarily the Op art movement. We will now have a look at a few of these ´after-images´ at work in one of

Figure No. 18 : Vasarely, Victor. "Eridan III". 1956.
76 x 61 in. Denis Rene Gallery, Paris

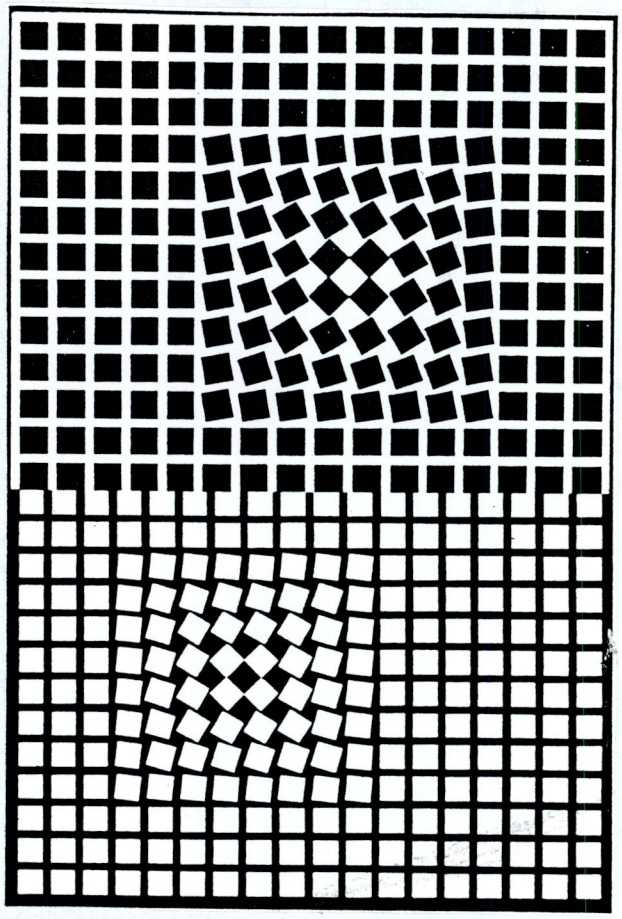
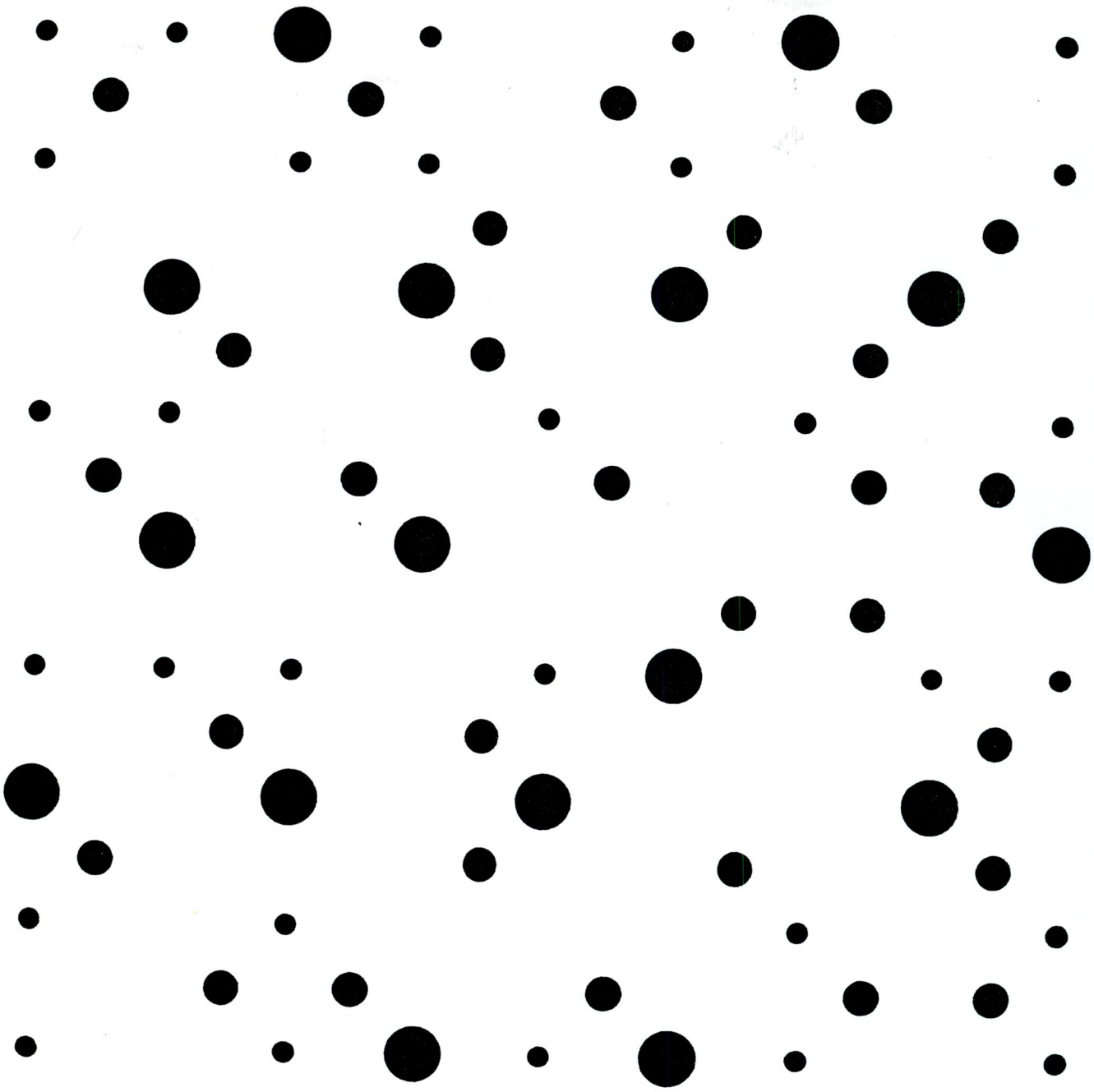


Figure No. 19 : Riley, Bridget "Fragment 6/9", 1965.

29 x 29 in. Robert Frazer Gallery, London



Vasarely's paintings and one of Bridget Riley's works. Vasarelys "Eridan III" (Fig. No. 18) is a good example of the use of positive and negative after-images. The top half of the painting is disturbed by grey squares jumping about optically, these are after images, and appear as tiny white spots flashing on and off in the bottom section. This movement appears to be independent of the general movement of the picture and acts as a sort of counterpoint to it. Maurice de Sausmarez describes Bridget Riley's 'Fragment 6/9' (Fig. No. 19) "the after-image begin to dance in and out among them. Then the whole surface becomes animated and the black shapes, still relatively stable float through an indeterminate space with their after images literally dancing attendance on them. (9, p. 73).

Section IV

At this point I will take on board the argument put forward by many critics that Optical Art is not expressive. In my opinion this may be true of those works which adhere rigidly to the principles of programmed art, but it is certainly not true of works by Soto, Vasarely, Bridget Riley, Group Zero, Stanczak, Kommodore, to name only a few who have made statements on the subject. What these and most Op artists are doing, is giving a visual equivalent of certain aspects of nature, heat, energy, the action of light by causing us to experience through visual and pictorial means something of the effects of these

Figure No. 20 : Vasarely, Victor "Supernovae" 1959.

Tate Gallery, London. 92 x 59 inches.

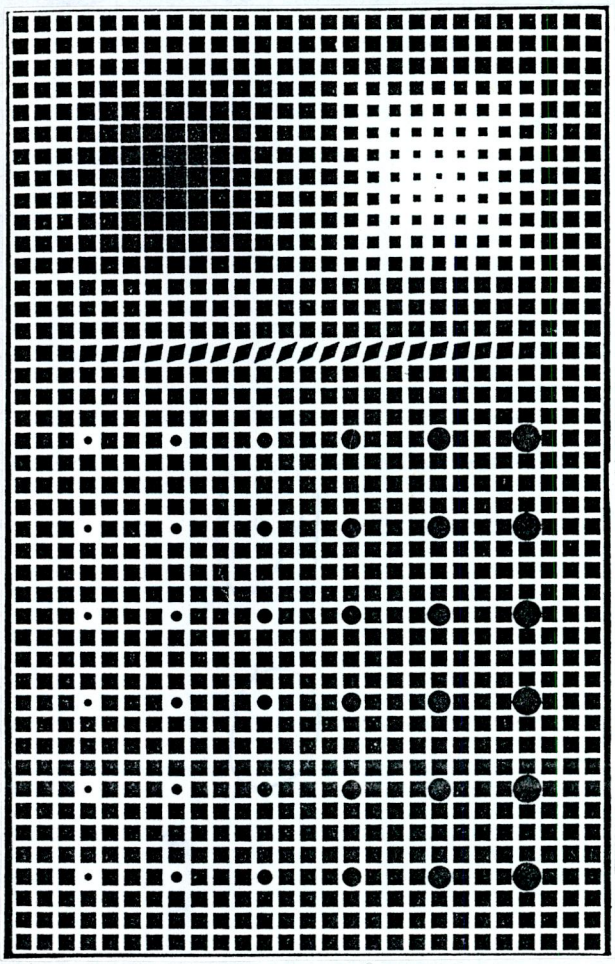
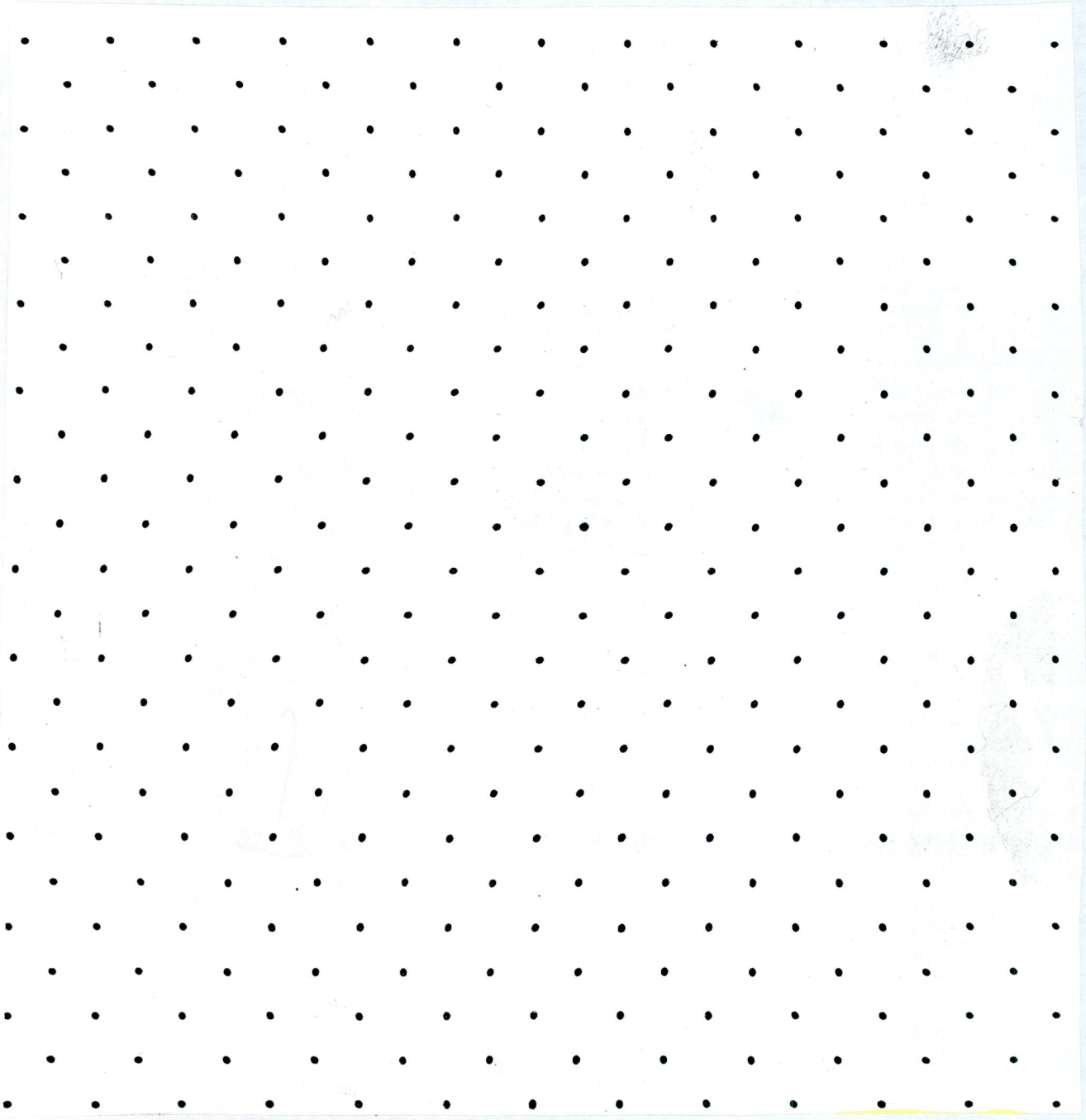


Figure No. 21 : Riley, Bridget, "Static" 1966, 90 x 90 inches, Power Collection, Australia.



´immaterial´ of invisible forces. We have seen this in the case of Soto´s ´Vibration Structures´, Vasarley´s ´Supernovae´ (Fig. No. 20), Bridget Riley´s ´Static´ (Fig. No. 21), and ´Late Morning´ and Veckers ´Spiral´ Stanczak sums up this aspect of Op art when he says :
"I do not try to imitate nature I use visual activities to run parallel it" (10, P. 94).

This brings us to one of the most serious objections posed by the critics, namely that Op Art destroys the picture place and hence is not strictly speaking, painting. This maybe true but it is beside the point, and hence not a valid criticism, unless some reason can be given why the violation of the picture plane must be regarded as a sort of artistic suicide. To say that something is not painting or not painterly is not in itself a condemnation unless it was the intention of the artist to make a ´painterly painting´. The mere fact that the artist puts paint on canvas does not commit him to make painterly-paintings. It may be extremely distasteful to his fellow artist to see him ´abuse´ the medium in this way, and it is not surprising that so many painters violently dislike Op Art. It is open to the Op artist in his turn to spurn the painter who adheres so lovingly to the picture plane. But the critic should do better than that. If his criticism is to stick, it must start with comprehension. What I mean by this - is it must be based on a knowledge of what the work is attempting to do, not on it´s failure to achieve what it never attempted.

The creation of this intangible world calls for co-operation on the part of the spectator, but the claim made by many artists and art critics that it makes him (the spectator) an active participant rather than a passive admirer can be greatly exaggerated.

There is a degree of active participation in viewing all forms of art. Of course this participation varies according to the training, experience, sensitivity and critical acumen of the viewer. In understanding any work of art, what is called active participation is merely a greater awareness of the processes which are at work. What I find interesting is not the degree of participation but the fact that the work has become more like an event than the finished piece.

I am certainly not trying to suggest that Op art is a superior form of visual art. Each art form deals with different visual phenomena and offers a different set of artistic possibilities. As far as I'm concerned it's what artists do with these possibilities that matters. It is equally absurd to dismiss Op as an inferior form of Art especially when we consider that it is a line of development that holds a fairly central position in Western art.

Conclusion

Artists have frequently adopted the ´scientist´s´ language, albeit idiosyncratically, to describe aspects of their work.

It is less common for scientists to adopt the visual ´language´ of the artist to address issues in their own domain. I have tried to follow this second course, that is to ask questions about the nature of perception graphically. The visual ´language´ espoused has been the relatively circumscribed one of Op art, because within this area there is a close phenomenal commonality between visual science and visual art. Essentially the same phenomena are incorporated into the complex designs of the Op Artists as are analyzed in simplified form within the visual laboratory.

It is my opinion that visual scientists have not adequately represented the subject matter of their own inquiry. The study of perception has been left to artists and the psychologists have become theorists absorbing ideas from related disciplines like neurophysiology and computer science. This flight to other disciplines attests to the difficulty in studying perception scientifically. Thus the visual scientist rarefies phenomena in the controlled conditions of the laboratory ; complexity is considered in

terms of summing all the isolated effects. On the other hand, the visual artist embraces complexity and, to a large degree harnesses it. In the context of visual illusions the scientific approach towards simplicity cannot be considered an unmitigated success - rather the reverse. With such a legacy it is not unreasonable to search for insights via pictorial complexity rather than simplicity. The questions addressed can remain simple. Throughout my thesis readers have been urged to examine their own perceptual experience. Although my ideas echo the approach to illusions adopted in the nineteenth century : (when illusions were not measured but they were demonstrated to occur in this or that configuration) these are by far the most understanding on the subject. The detailed measurement of illusions is a more recent preoccupation. The pictures and writing´s pose perceptual problems which, hopefully, might spur others to reconsider the nature of illusions and Optical Art and engage in the quantitative approach that I have eschewed.

FOOTNOTES :

Chapter One :

Ref. No. 1 J.R. Soto & Guy Brett ´Dialogue´ ´Signals´ (November 1965)

2 Kasamir Malevich. Barrett, C 1971 An intro. to Optical Art, Studio Vista, London.

3 Albers, Josef "Interaction of Colour" (1963), Yale University Press, New Haven.

4 Barrett, C "Op Art" (1970), Studio Vista, London.

5 Barrett, C "Op Art" (1970) Studio Vista, London.

Chapter Two :

Ref. No. 6 Popper, Frank. "Origins of Kinetic Art" (1968).

Chapter Three :

Ref. No. 7 Purkinje, Jan Evangellista. (1823) He wrote two monographs on subjective Visual phenomena.

8 Coren, Stanley & Joan, Stern Girgus. "Seeing is deceiving".

9 Riley, Bridget & Maurice de Sausmarez. ´A conversation about Riley´s work´ Art International, April 1967.

10 Stanczak, Julian. "Optical Art at the Modern" Art Int. 1967

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