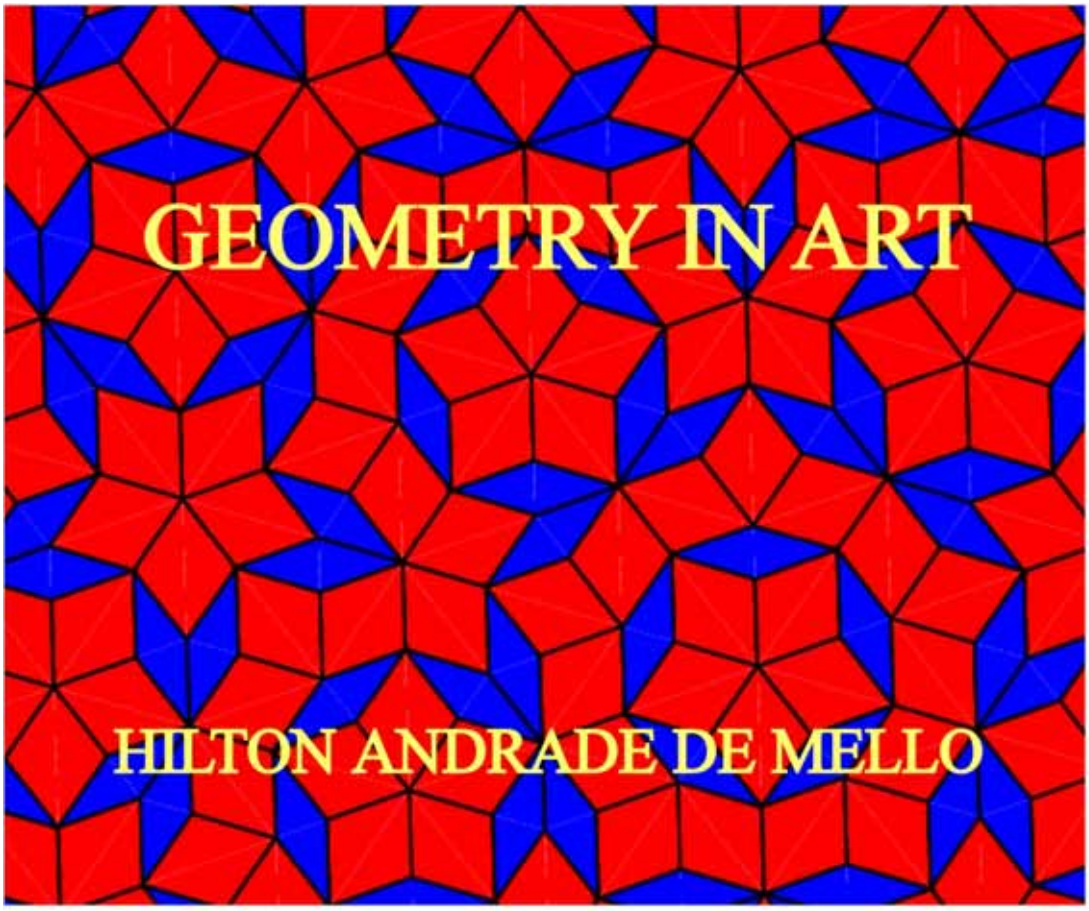
GEOMETRY IN ART
HILTON ANDRADE DE MELLO

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Hilton Andrade de Mello

Translated from the Portuguese, “Geometria nas Artes”, by
Marcelo R. M. Crespo da Silva, Ph.D.
Professor Emeritus of Aerospace and Mechanical Engineering,
Rensselaer Polytechnic Institute

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To Leonardo, Rafael, Ana Clara and Dominique, whose joy and creativity inspired me throughout this work.

And to the memory of Paula, that enlightened and extraordinary spirit that guided our paths with joy.

HAM (Hamello)

Do not let enter anyone who has no knowledge of geometry

In 387 BC Plato started his academy of philosophy in Athens, which existed until closed by Emperor Justinian in 529 AD. The words above were at the entrance to the academy.

Table of Contents

Acknowledgments viii
About the author ix
Introduction x

Chapter:
1 Abstraction and Geometry 1

2 Planar geometric forms 9
2.1 Euclid of Alexandria 10
2.2 The axiomatic method of Aristotle 10
2.3 Primitive concepts of Euclidean Geometry 11
2.4 Polygons 13
2.4.1 Definition 13
2.4.2 Polygon types 14
2.4.3 Polygon names 16
2.4.4 Triangles 16
2.4.5 Quadrilaterals 17
2.4.5.1 Parallelograms 17
2.4.5.2 Trapezoids 20
2.5 Circumference and circle 20
2.6 Inscribed and circumscribed polygons 22
2.7 Stars 23
2.8 Rosaceae 27
2.9 Spirals 30
2.9.1 Archimedes' spiral 30
2.9.2 Bernoulli's spiral 30
2.9.3 Spirals in our lives 31

3 Polyhedrons 33
3.1 Introduction 34
3.2 Convex and concave polyhedrons 35
3.3 Interesting families of polyhedrons 35
3.3.1 Platonic solids 35
3.3.2 Archimedean solids 36
3.3.3 Star solids 37
3.4. Other polyhedrons 39
3.4.1 Pyramid 39
3.4.2. Truncated pyramid 41
3.4.3 Straight prism 42
3.5 Polyhedrons and the great masters 43
3.6 Polyhedrons and informatics 45
3.7 Closing comments on polyhedrons 45

4 Other spatial figures 46
4.1 Sphere 47
4.2 Cone of revolution 49
4.3 Cylinder of revolution 51

4.4 Conics 52
4.4.1 Generalities 52
4.4.2 Ellipse and ellipsoid of revolution 53
4.4.3 Parabola and paraboloid of revolution 55
4.4.4 Hyperbola and hyperboloid of revolution 56
4.5 The conics and Paul Cézanne 58
4.6 Helices and helicoids 59
4.6.1 Helices 59
4.6.2 Helicoids 59

5 Composing a canvas with polygons: Tesselations 62
5.1 General concepts 63
5.2 Tessellations with regular polygons 63
5.3 Tessellations with irregular polygons 65
5.4 Tessellations and nature 66
5.5 Penrose tessellations (or tilings) 66
5.6 Final considerations 68

6 Perspective 69
6.1 Introduction 70
6.2 After all, what is a linear perspective? 71
6.3 Perspective with two vanishing points 74
6.4 Perspective with a larger number of vanishing points 75
6.5 Linear perspective and color perspective 79
6.6 Final considerations 79

7 The golden ratio 80
7.1 Fundamentals of the golden ratio 81
7.2 Golden geometric figures 82
7.2.1 Golden rectangles 82
7.2.2 Golden triangles 82
7.3 Mathematics of the golden ratio 83
7.4 The golden ratio in art and in nature 84
7.4.1 The golden ratio in architeture and in art 84
7.4.2 The golden ratio in nature 89
7.5 The golden ratio in aesthetics 89
7.6 Conclusions 90

8 Symmetry and specular image 91
8.1 Symmetry 92
8.2 Specular image 94
8.3 Symmetry in nature 95

9 Geometry and Symbolisms 97
9.1 The “Vesica Piscis” 98
9.2 Mandalas 100
9.3 Yantras 102
9.4 Labyrinths 103
9.5 The star of David, pentagrams, and hexagrams 104
9.6 Spirals and Symbolisms 106
9.7 Additional symbols to be investigated 106

9.8 Polyhedrons and symbolism: Platonic solids and the elements 107

10 Informatics and the arts 108
10.1 Introduction 109
10.2 Searching information on the Internet 109
10.3 Geometry software 109

11 Bibliography 110

12 Virtual references 113

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Obviously, no justice is done to the importance of their work by viewing only one or two of their artwork, as they are, without any doubt, the exponents of the art in Brazil.

I am indebted to João Carlos Galvão, for making it possible for me to establish the contacts I have in the art world.

From abroad, I acknowledge the significant contributions I received from Dick Termes, Barry Stevens, George Hart, Philippe Hurbain, Russel Towle, Steve Frisby, and Dar Freeland.

My thanks to all, hoping that I have contributed to the dissemination of geometric art.

HAM (Hamello)

About the author

Hilton Andrade de Mello is a graduate of the Federal University of Rio de Janeiro, Brazil, from which he received his electrical/electronics engineering degree, and his Nuclear Engineering degree, both in 1962. He also holds graduate degrees from Stanford University, U.S.A., where he majored in Electrical Engineering, concentrating in electronics. His scientific career has been, since graduation, at the National Nuclear Energy Commission ("Comissão Nacional de Energia Nuclear"), in Brazil, and he is the author and co-author of several electronics textbooks (listed in www.hamello.com.br). At present he is devoted to the Plastic Arts, and has many paintings to his credit.

Introduction

Having participated in many educational activities, I had the opportunity to observe that newcomers to plastic arts, especially those interested in geometric abstraction, are generally unfamiliar with concepts related to geometric forms. There are a number of technical books on the subject matter but they are generally not written for those who are plastic artists. Such books generally do not show the relationship between geometric forms and the different nuances of the art.

It is my intention in this book to "cruise the geometric forms world" in order to familiarize the reader with such an area of knowledge. That area, which is based on the work of the Greek mathematician Euclid, gave birth to the so-called *Euclidean Geometry*.

Our journey starts in Chapter 1 with Manet and the impressionists around the second half of the 19th century. Their objective was not to paint a true copy of either an object or a landscape, but to stress the sensations of motion and light in their work. We then proceed to Russia, at the time of Lenin, where we notice the importance of the works of Wassili Kandinsky and Kasimir Malevich. Passing briefly through The Netherlands we get acquainted with the work of Piet Mondrian, the "Stijl group", and with the manifest of the *Concrete Art* of Theo Van Doesburg. We also get acquainted, in Paris, with the "Circle and Square" movement lead by the Belgian art critic and artist Michel Seuphor, and by the Uruguayan painter Joaquim Torres Garcia.

We then leave Europe and travel to Brazil, in time for the opening of the São Paulo Museum of Modern Art. While in São Paulo we will also visit the 1st São Paulo Art Biennial, where the work of several Brazilian artists were exhibited, and witness the award ceremonies for Max Bill (celebrating one of his innovative sculptures) and for Ivan Serpa (celebrating his work entitled "Forms"), and see the intriguing kinechromatic work of Abraham Palatnik.

While in São Paulo we will also visit Samson Flexor's "Atelier Abstração", and meet the Noigandres and Ruptura groups. Traveling to Rio de Janeiro we will meet the "Grupo Frente" and witness the birth of the "Manifesto da Arte Neo-Concreta".

We end this first leg of our journey by getting acquainted with several works by other Brazilian artists who were involved in the initial phase of the concrete art in Brazil.

In Chapter 2, the abstract concepts involving point, straight line, and plane, and geometric forms such as polygons, circles, stars, rosaceae, and spirals are presented. The works of several artists involving such forms are presented in that chapter.

In Chapter 3 the most important types of polyhedrons are presented, with especial attention given to the so-called Platonic Solids, known as such because they were investigated by the philosopher Plato. Examples of their use in the arts are presented.

Surfaces of revolution are presented in Chapter 4. They include spheres, cylinders, cones, conic surfaces and their associated solids, like the ellipsoid, the paraboloid, and the hyperboloid. Helices and helicoids are also presented. That chapter ends with a presentation of important works by Ascânio MMM.

In Chapter 5 it is shown how a planar surface, such as a canvas or a panel, can be completely filled leaving no void space on it. Such is the case of tessellations (also known as tilings), an example of which is a patchwork quilt.

In Chapter 6 the concept of linear perspective is presented and it is shown how such a technique enriched important works during the Renaissance. The basic concept of perspective is expanded in the creative spheres of Dick Termes, which are presented in that chapter.

Chapter 7 deals with the *Fibonacci sequence* and the *golden ratio*. Several artists may have used such concepts in their work, and examples by Da Vinci, including the famous Vitruvian Man, based on the studies of the roman architect Marcus Vitruvius Pollio, are presented. The golden ratio apparently appears in several species in nature, and that is also illustrated in that chapter.

Chapter 8 deals with the concepts of symmetry and of specular image, and of how the interpretation of an image can change when the image is seen through its specular form.

Our journey is now near its end and, at this point, it is shown in Chapter 9 how geometric forms and symbolisms are related to each other. For this, several studies are presented in that chapter. These include the *Vesica Piscis*, from which the symbol of ancient Christianity originates, the Pentagrams and the Hexagrams, the Labyrinths, and the Mandalas, with their spiritual association.

The journey then ends with a short introduction to informatics in Chapter 10, concentrating on information search on the Internet. Several computer programs one can use to learn more about geometric forms are listed. A number of references that were consulted by this author are listed at the end of the book.

It should be noted that this is not a book about art history, and that it does not deal with detailed study of any artistic movement or any artist. It only presents some of the work that involves geometry.

HAM (Hamello)

1

Abstraction and Geometry

Figure 1.1 Untitled - Hamello

For several centuries, art was seen as a representation of the real world, be them objects, forms in nature, or people. During that time many artists supported themselves by painting important nobility, especially those connected to the Royal House.

With the advent of the Renaissance, works by artists such as Leonardo Da Vinci and Michelangelo started to appear, emphasizing more and more the notion of perfection. Perspective also appeared at that time, which is a method to represent 3-dimensional space on a flat surface.

The first artistic attempts to depart from an exact reproduction of reality were introduced by the "impressionists", who at first shocked the French society with their boldness and characteristic manner of representing objects, people and scenery.

Perhaps Edouard Manet (1832-1883) was the first of such artists who, instead of painting exactly what was seen, tried to reinforce other details such as light and motion. Several other artists followed Manet's idea in stressing the effects of light, which requires the observation of the object to be painted during several times of the day. In addition, to capture the effect of light on a scene it was imperative to use rapid strokes on the canvas, mixing the primary colors on the canvas instead of preparing the desired color on a palette. However, such a technique was not adopted by all the artists in Manet's group.

Figure 1.2 shows a work by Claude Monet (1840-1926) depicting a port seen through the morning fog. Monet was one of the artists in Manet's group, and became one of the best-known impressionist artists.

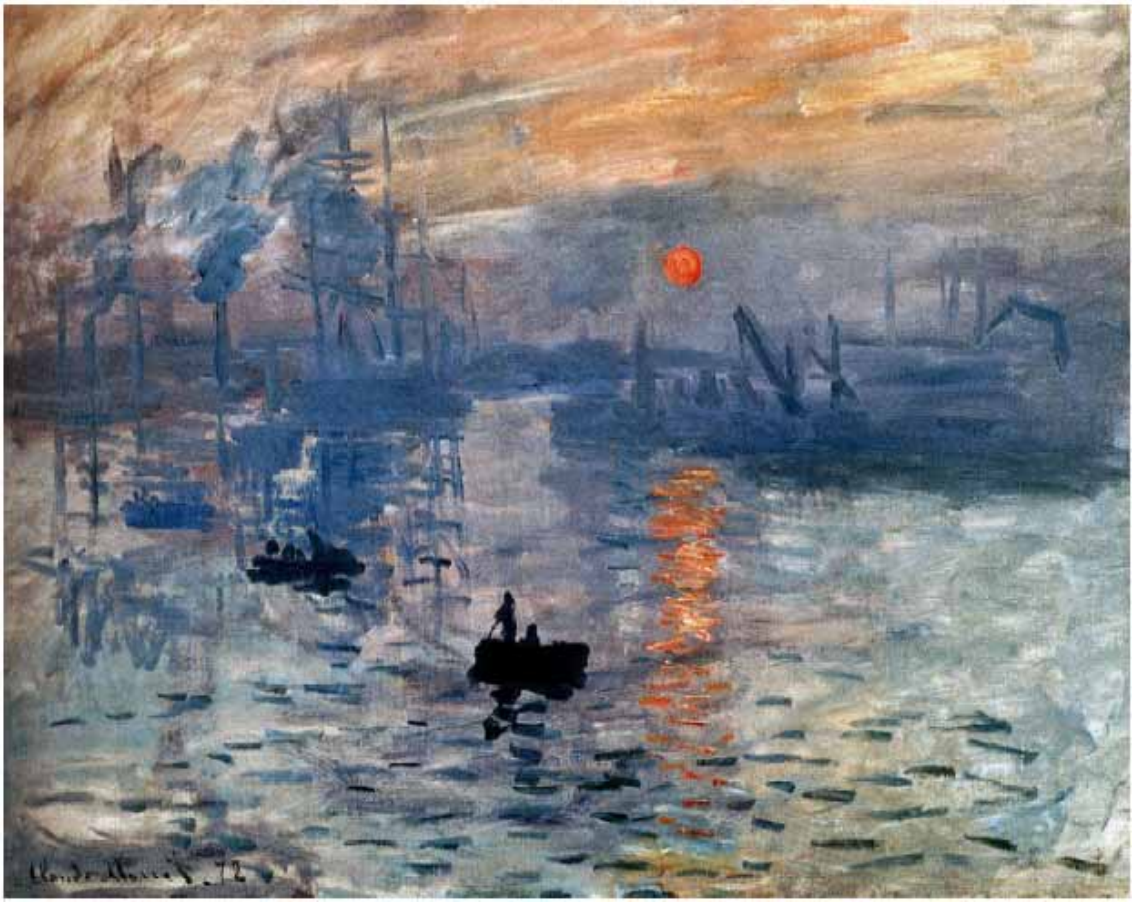

Figure 1.2 Sunrise - Claude Monet - Oil on canvas - Marmottan Monet Museum, Paris, France

Interestingly, when Monet's work shown in Figure 1.2 was shown in public in 1874, the catalog listed it as "Impression: the sunrise". This gave rise to the term impressionism, first used on April 15, 1874, by Louis Leroy in the Charivari magazine and meant as an insult to that group for presenting such an "exotic work"! The artists, however, did not take offense in that designation, and started to refer themselves as the

impressionists. As can be seen in Figure 1.2, real life objects such as boats, people, clouds, etc, still can be identified.

The departure from reality came later with the Russian painter Wassili Kandinsky (1866-1944) who created what became known as abstract art. In such an art form, he no longer sought to represent any existing object or form; instead, he used colors and lines to cause a sensorial impact at the viewer. This is illustrated in Figure 1.1.

At about the same time of Kandinsky, another Russian artist, Kasimir Malevich (1878-1935), introduced a more radical idea for abstract art. For him objects did not have any significance per se, and one should seek the "supremacy of pure sensation in creative art" as he himself described. That school of thought is known as Suprematism. Among his best-known works during that phase of his life are the "Black Square" (1915), shown in Figure 1.3, and the "White Square on a White Background" (1918).

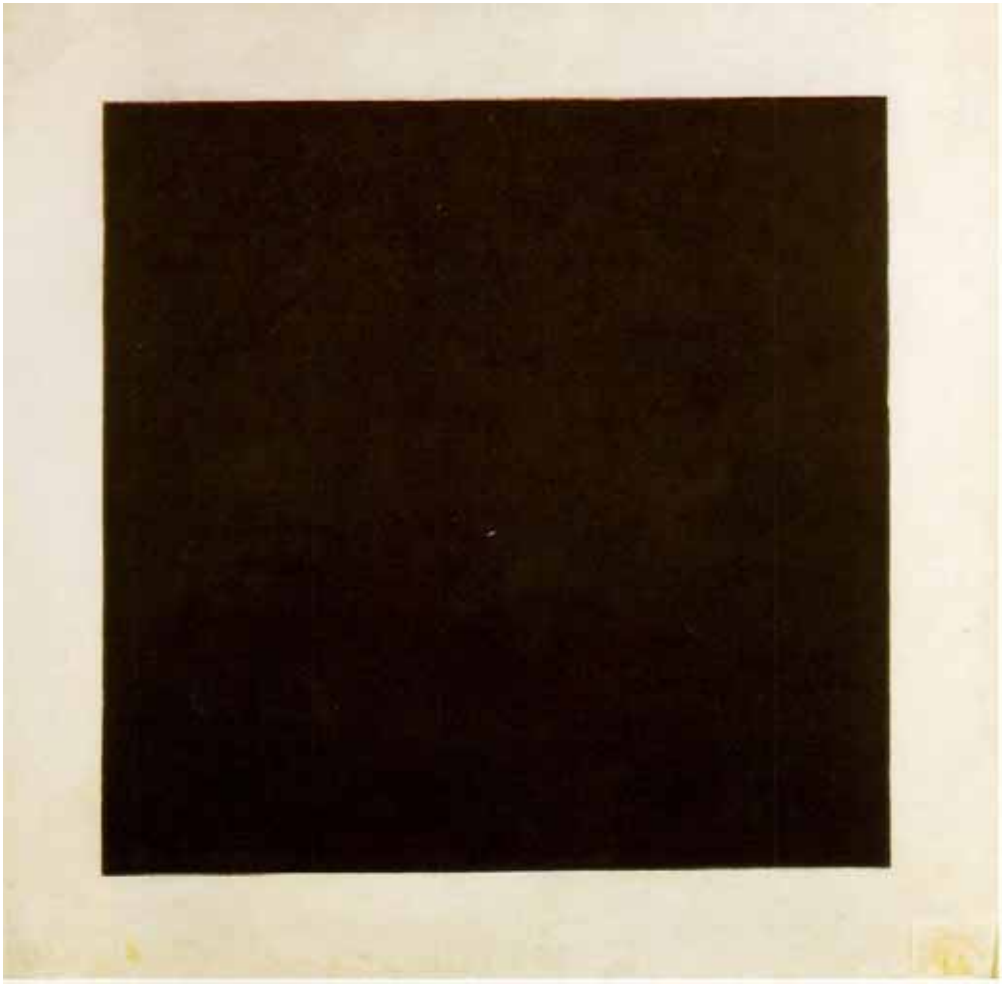

Figure 1.3 Black square - Malevich - Oil on canvas - Hermitage Museum, St. Petersburg, Russia

The Suprematism art, also known by some as geometric abstraction, caused serious problems for Malevich because for Lenin, who was in power at that time in Russia, art should be used for communication with the masses and not for advancing complex and innovative ideas to the people.

At this point one could ask why geometry was used to create abstract work?

When studying geometry we will see that it defines mathematical entities that are actually an idealization as one is really unable to paint a point, for example, since a point has no dimensions. The "point" that is drawn will have a finite dimension no matter how fine a pencil or a brush tip is. All geometric elements are actually abstract entities. Even in nature, when one looks at a flower and describes it as circular,

such a description is only an approximation because the ever-present irregularities prevent it from being a perfect circle.

As our senses are limited, it is understandable that one can look at an object and describe it is a square, a triangle, or a circle, for example.

Returning to the topic of abstract art, the use of geometric forms creating what is known as "geometric abstraction" is a perfectly valid process for an artist to "free himself/herself" from the real world.

Probably the Dutch painter Piet Mondrian (1872-1944) was the most influential geometric artist of his time. He adopted rigidly defined rules associated with geometric forms, such as using only black, white, and primary colors to obtain a great visual purity. Mondrian was part of a Dutch group called "De Stijl" (The Style), started by Theo Van Doesburg with several other Dutch artists. Van Doesburg also started in 1917 a periodical by the same name. The works of that group are important to the art world and we suggest the reader to consult an art history book for more details.

Like everything else that evolves with time, the ideas outlined above were not definitive, and Van Doesburg wrote, in 1930, the "Concrete Art Manifesto" in which he dismissed any symbolic or lyric connotation with art; in other words, a work of art embedding colors, lines, and other forms, should not have any special meaning but only its intrinsic value.

For Doesburg, the terms ***concrete*** and ***abstract*** meant very different things, despite being indiscriminately used, since, in his opinion, nothing is more concrete than a line, a color, or a surface.

Another art movement, the "Circle and Square", appeared in Paris in 1929 lead by the Belgian critic and artist Michel Seuphor (1901-1999) and by the Uruguayan painter Joaquim Torres-Garcia (1875-1949). In a periodical called *Circle and Square*, these artists published a manifesto proposing the regrouping of constructive artists, which included Wassily Kandinsky, Fernand Leger, Jean Arp, Le Corbusier, and others.

In Brazil, modern art started its penetration in the art world at the end of the 1940 decade, essentially with the creation of the São Paulo Museum of Modern Art in 1948 by Francisco Matarazzo Sobrinho. Its first director was Léon Degand, a Frenchman art critic who was a strong advocate of abstract art. The museum was officially inaugurated in 1949 with the exposition named "Do figurativismo ao Abstracionismo" ("From Figurativism to Abstractionism"). After several disturbing years, when it was even disbanded, the São Paulo Museum of Modern Art was reopened in 1969 at the Ibirapuera Park.

In Rio de Janeiro, a Museum of Modern Art was also established in 1948 at the then "Ministério de Educação e Cultura" (Department of Education and Culture), and substituted, in 1952, by a new museum in a portion of the borough of Flamengo that was reclaimed from the sea. Sadly, a fire destroyed the building and its contents in 1978.

The year 1951 saw the first São Paulo Art Biennial with the participation of many Brazilian artists, including Waldemar Cordeiro, Antonio Maluf, Abraham Palatnik and Ivan Serpa. Several artists were awarded international prizes, such as:

-Max Bill (1908-1994) won the International Grand Prize for Sculpture.

-Abraham Palatnik, who was born in Natal, Brazil, surprised the jury with a kinechromatic work that did not fit in any of the categories of the exposition, namely, painting, sculpture, etching, or drawing.

-Ivan Serpa won a Young Painter award for his work "Forms".

Still in 1951, in São Paulo, Samson Flexor (1907-1971), born in Bessarabia, Imperial Russia, founded the Atelier "Abstração" (Abstraction). Him and his students participated in the second art biennial in São Paulo.

In 1952, the poet Décio Pignatari, with Haroldo de Campos, Augusto de Campos and several others, created the "Noigandres Group", while Waldemar Cordeiro, Geraldo de Barros, Luiz Sacilotto, Lothar Charoux, Anatol Wladyslaw, among others, created the "Ruptura Group", which had its first art exposition in December 1952 in the São Paulo Museum of Modern Art.

Another group, called "Grupo Frente", appeared in Rio de Janeiro in 1954 with the participation of Ferreira Gullar and Mario Pedrosa and other artists such as Ivan Serpa, Aluisio Carvão, Décio Vieira, Carlos Val, Lygia Clark, Lygia Pape, João José da Silva Costa. Other artists, such as Helio Oiticica, César Oiticica, Franz Weissmann, Abraham Palatnik, and Rubem Ludolf, to name a few, also joined that group.

Art was experiencing a period of evolution during the 1950 decade and, in 1959, during an exposition at the Rio de Janeiro Museum of Modern Art a group of artists wrote a Neo-Concrete art manifesto involving painting, sculpture, etching, poetry, and prose. Such a group had the participation of Ferreira Gullar, Amílcar de Castro, Franz Weissmann, Lygia Clark, Lygia Pape, Reynaldo Jardim, and Theon Spanúdis.

Although the themes Concrete and Neo-concrete art are only briefly mentioned in this book, they should be studied in detail by those who are art aficionados since such themes are of fundamental importance to the art world and, in particular, to the evolution of the arts in Brazil. We call the reader attention to this because images of a number of paintings are presented in this book without any artistic analysis of them, and some readers might think that the geometric forms in those works were used without a specific purpose for them. It is necessary to grasp the real meaning and the message embedded in the work of the artists.

We pay tribute to some of the artists who participated in the initial phase of the concrete art in Brazil by showing images of their work in Figures 1.4 to 1.13.

Figure 1.4 “Composição” - Luiz Sacilotto - Oil on asbestos cement - 1948

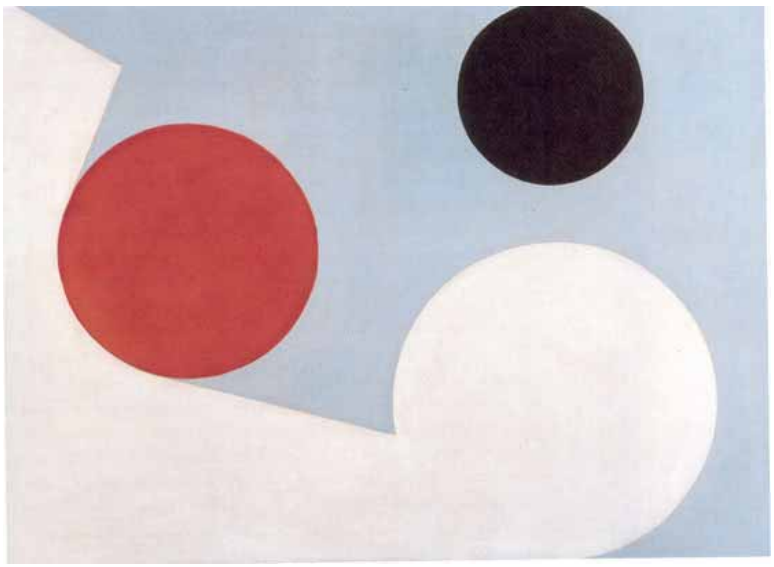

Figure 1.5 “Formas” - Ivan Serpa - Oil on canvas - Young Painter Acquisition Prize, First São Paulo Art Biennial - 1951

Figure 1.6 “Composição em Vermelho e Preto” - Aluisio Carvão - Oil on canvas - 1950 decade

Figure 1.7 “Equação dos desenvolvimentos com círculos” - Antonio Maluf - 1951

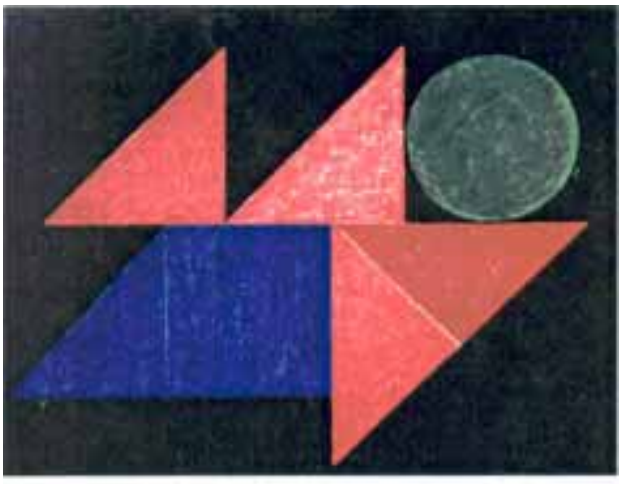

Figure 1.8 Untitled - Decio Vieira - 1980 decade

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