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## ANAMORPHIC IMAGES ON THE HISTORICAL BACKGROUND ALONG WITH THEIR CLASSIFICATION AND SOME SELECTED EXAMPLES

## OBRASY ANAMORFICZNE NA TLE HISTORYCZNYM WRAZ Z KLASYFIKACJĄ I WYBRANYMI PRZYKŁADAMI

### Abstract

Art based on optical illusions has accompanied the everyday life of a human being since ancient times, until today. Primarily, it played a specific role as an artistic game and manifested the artists' own mastery, while often playing the serviceable role of an artistic advertisement. This study presents a detailed definition of anamorphic images together with their precise classification, and provides a description of the methods used for their construction. The problems discussed here have been presented on a historical background. The examples of particularly chosen anamorphic images have been presented together with their visualised images. The theoretical background, how one can create such anamorphic images, provides the basis for further design and development of anamorphic images to be created both in an urban space of a town, and in the interiors of public use..

**Keywords:** transformation, anamorphic image, visualisation of anamorphic images, reflective surfaces

### Streszczenie

Sztuka oparta na złudzeniu optycznym istniała od starożytności. Przede wszystkim jako swoista zabawa artystów manifestująca własne mistrzostwo, a często także w roli usługowej, pełniąc zadanie reklamy. Niestety opracowanie obejmuje precyzyjną definicję anamorfów wraz ze szczegółową klasyfikacją i metodami konstruowania obrazów anamorficznych. Zagadnienia te przedstawiono na tle historycznym. Wybrane przykładowe anamoryfy zaprezentowano wraz z ich obrazami zrestytuowanymi. Powyższe rozwiązania dają możliwość precyzyjnego projektowania obrazów anamorficznych w zurbanizowanej przestrzeni miejskiej oraz architektonicznych wnętrzach przestrzeni publicznej.

**Słowa kluczowe:** przekształcenie, restytucja, anamorfa, powierzchnie refleksywne

## **1. Introduction**

The issue of anamorphism has been extensively described, among others, in the book entitled *Anamorfozy* [2], which presented the problem from the historical perspective, illustrated with prints and painting reproductions. According to the author, "Anamorphosis is not a deviation from the norm, in which reality is tamed by the mind's vision. It is an optical trick, in which the visible covers the real. The elements of this system are ingeniously linked together". Today, anamorphic images are experiencing returns and rebirths. They appear in public as a planar, colourful and surprising compositions, visualised in an appropriate way.

It should be noted that, in 1981, the National Museum in Warsaw opened an exhibition entitled "Perspective, illusion, illusionism." Numerous departments presented different ways of viewing and understanding illusion in art.

Coherent articles related to the topic of anamorphs, published for years, have described a collection of geometric analyses and thoughts associated with their creation and visualisation: [1–9]. They define and record complex rules of geometric transformation of real images into anamorphic images.

This study presents a detailed classification and naming of the distinguished categories in their particular groups.

This paper also aims at broadening the knowledge with methods and simplification of creating complex geometric deformations of anamorphic images and their restoration. The examples of anamorphic images created in a traditional way, both intuitive and using the authors' own digital method, were presented. These studies may be an indication for architects and artists to become interested in this forgotten form of art.

## **2. Definition and classification of graphic anamorphs**

### **2.1. Definition of graphic anamorphs**

Nowadays, the word anamorphosis has become widespread and popular in many areas. For instance, botany and zoology use this term to describe certain shapes and forms of animals that have been transformed under the influence of environmental conditions or organ mutations. In 1970, J.C. Emery gave the name "Anamorphosis" to a collection of literary texts. In music, the word "anamorphosis" is the title of a musical piece called so by F. Morel in 1974. In 20<sup>th</sup>-century cinema, anamorphosis as a technique allowing to save a good-quality widescreen image on a typical film tape was applied as well. This technique was used for recording and restoring the image with the correct proportions.

Anamorphosis became of high interest of psychoanalysts as well. In the course of time, the perspective transformed with anamorphosis stopped referring only to reality, and became a tool for creating illusions on the border of hallucination [2].

The definition of an anamorph developed by A. Zdziarski [6] is quoted below:

*An anamorphic image is an image created through the deliberate, geometric transforming of its proportion in such a way that the correct reading was possible only after looking from a fixed position or in the reflection in the appropriate mirror.*

## 2.2. Classification of graphic anamorphs

According to their ways of visualisation, anamorphic images can be separated into two basic groups:

- 1) **surface anamorphoses** – the visualisation of which does not require the use of mirrors;
- 2) **reflective anamorphoses** – the visualisation of which will take place in a suitable mirror surface.

The group of **surface anamorphoses** includes:

- 1a) flat surface or planar anamorphoses – anamorphic images arranged on the same plane, the visualisation of which requires observation from a particular position.
- 1b) collapsible surface or collapsible planar anamorphoses – are created on the expanded grid of a specific spatial figure. Their restoration requires the assembly of a specific figure from a given grid and observation from a specific direction.

In the group of **reflective anamorphoses**, the following can be distinguished according to the visualising mirror surface:

- 2a) **Flat reflective anamorphoses:**
  - ▷ **single** – with one visualising mirror;
  - ▷ **complex** – with a larger number of flat visualising mirrors;
  - ▷ **pyramidal** (pyramid) restoring mirrors having a common point.
- 2b) **Reflective cylindrical (tubular) anamorphoses**, including:
  - ▷ **convex**;
  - ▷ **concave**.
- 2c) **Reflective conical anamorphoses**, including:
  - ▷ **convex**;
  - ▷ **concave**.
- 2d) **Reflective anamorphoses implemented using any reflective surface** (sphere, ellipsoid, and others).

Irrespective of the classification above, we can distinguish anamorphoses created:

- ▷ traditionally (intuitive sketches, geometric constructions, mechanical methods – pentagraph);
- ▷ digitally<sup>1</sup>.

The classification of anamorphs (open catalogue) in tabular form (with graphical interpretation) is presented below.

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<sup>1</sup> Specialized graphic software – yet the Authors of this study specialise in the method of generating anamorphic images created in MS Excel.

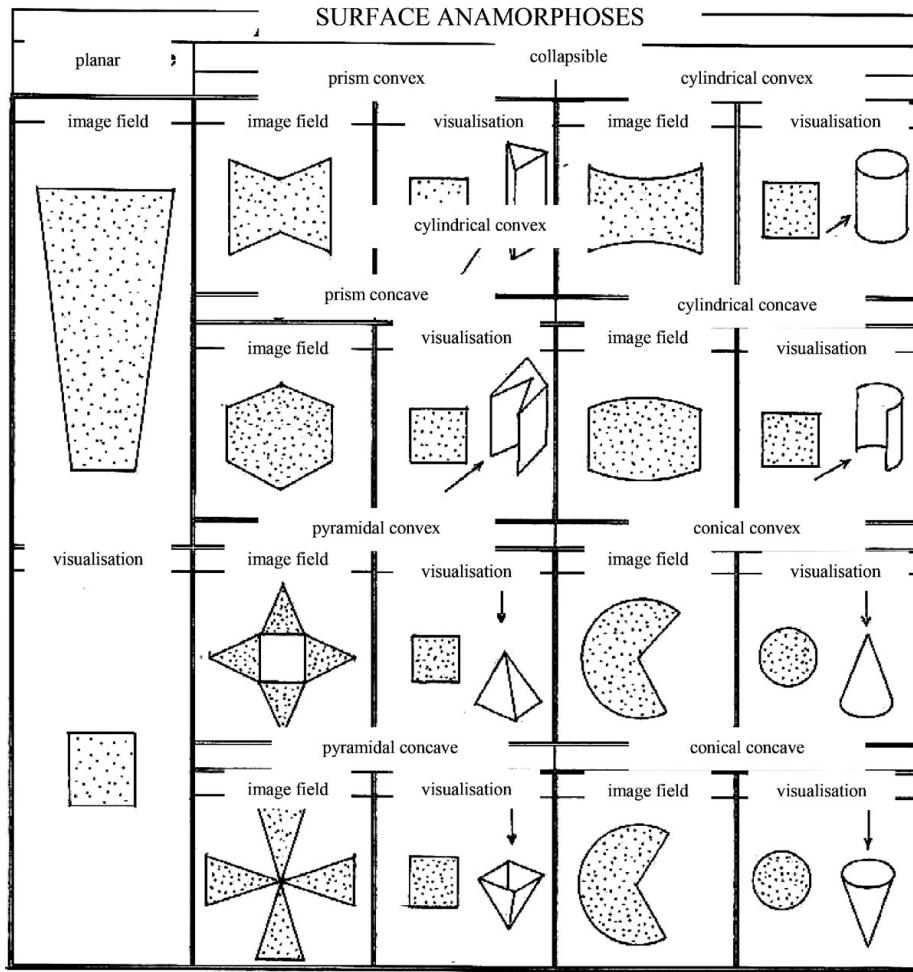


Fig. 1. Surface anamorphs – classification (compiled by A. Zdziarski)

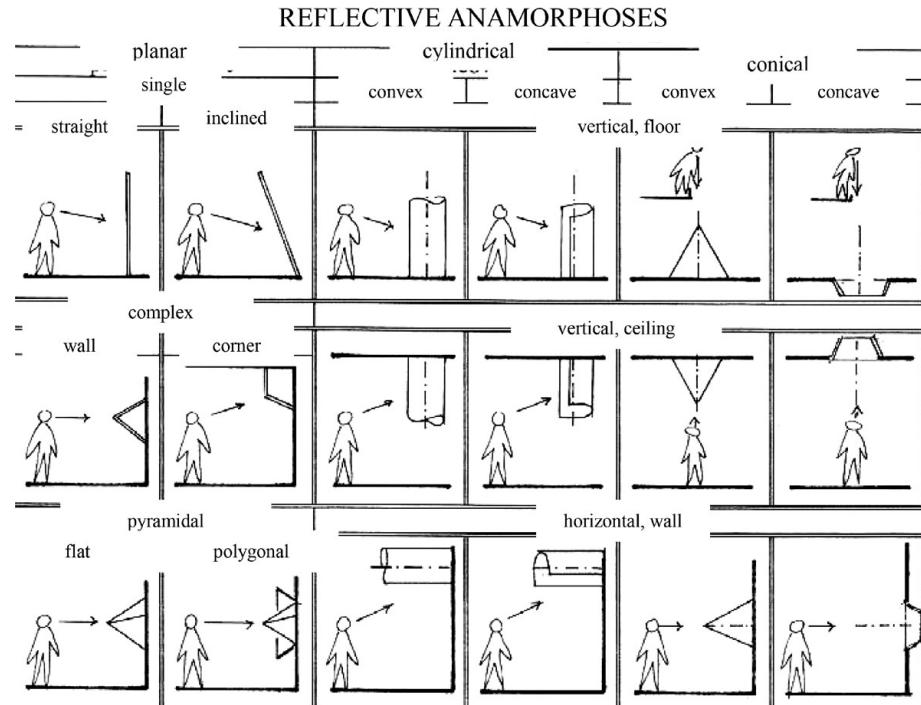


Fig. 2. Reflective anamorphs – classification (compiled by A. Zdziarski)

### 3. Historical outline of anamorphs

It is known that, in the first decades of the 15<sup>th</sup> century, Florentine avant-garde artists were trying to find the basics of optics in painting and create a theory of vision in order to raise painting to the status of knowledge. The image could simulate reality on the basis of certain rules. The field of view, as claimed by *Euclid* in the 7<sup>th</sup> century BC, can be regarded as a pyramid whose apex is in the eye of the observer. It was this principle that architect and art theoretician Leon Battista Alberti based his famous definition of the picture in 1435, according to which **the picture is a cross-section of the pyramid of vision.**

It is likely that it was Leonardo da Vinci and also Albrecht Durer who were the creators or originators of amorphous deformations, yet the very term “anamorphosis” was only coined in the 17<sup>th</sup> century from the Greek word “to transform”. Anamorphosis has its foundations in the classical perspective, which is why its development as an increased knowledge of the perspective is reasonably justified.

In the 16<sup>th</sup> century, a system of anamorphisms was developed, which was considered “a miracle in art,” and its secret was guarded for some time. The first use of the term in the literature dates back to the 17<sup>th</sup> century in the work of Jean-François Niceron entitled *La perspective curieuse ... (Curious Perspectives)* [4]. In European painting, anamorphoses were often used as evidence of the artist’s craftsmanship and mastery.

Probably the most famous example is a skull used by the German painter Hans Holbein in his painting from 1533, entitled *The Ambassadors* (Figs. 3 and 4). By painting a skull as a symbol of vanity hidden in an anamorphosis, the author introduced a philosophical message to his greatest work. This image probably hung on the staircase in Dinteville’s palace. Therefore, while climbing stairs, the recipient was often surprised by the proper content introducing them to reflection and reverie.



Fig. 3. Hans Holbein, 1533, *The Ambassadors*, oil on panel with an anamorphic image of a skull in the bottom of the image

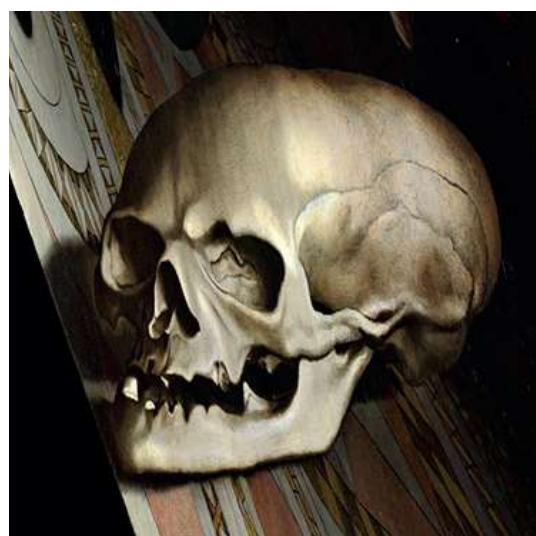


Fig. 4. The Skull – visualisation of the flat surface anamorph from *The Ambassadors*

Difficult to identify from the place where we view the image, a strange object emerges from the floor in Holbein's picture. Reading the meaning of this strange form requires the adoption of a special viewpoint of the observer. This point is located in the direction of the longitudinal axis of the figure, very close to the image plane. Watching the image from such a hidden position, a human skull, the symbol of a spiritual message, emerges from this seemingly not representative form. It was only in 1873, over three hundred years after painting this image, when this object was defined as an anamorphosis. There is an interpretation of a painted skull as the author's signature hidden in the pun-like image. A skull was also present in Dintevile's coat of arms.

In his comprehensive study *Perspektywa malaraska* ("Painting perspective"), Professor Kazimierz Bartel describes the painting by Hans Holbein in the following way:

*About 26 years younger than Dürer, Hans Holbein left one work, among others, which is particularly interesting from the perspective position: "The Ambassadors."*

*What is intriguing in this picture is the element that represents a mysterious object, located diagonally, and supported with one part against the floor. The mystery is solved only when the picture is watched from the left side in the length direction of the mysterious object, keeping the eye very close to the picture. It turns out that there is a strongly anaformic image of the human skull, created – perhaps – by reflecting it in a concave cylindrical mirror. This is an example of the influence of the type of observation on the content of visual sensation.*

The author of this description uses the term *anaform* that should be considered in as synonymous with the notion *anamorph* in this case. In the light of the geometrical considerations provided in this study, the assumption that the deformation is due to the reflection in the concave mirror and, therefore, that it is a reflective anamorphosis, may be clarified and defined as a planar anamorphosis, which does not require the use of mirrors during the construction of image distortion or its visualisation.

Another known anamorphosis is a portrait of King Edward VI by William Scrots (Figs. 5 and 6) as a flat surface anamorph.



Fig. 5. William Scrots, 1546, Edward VI, oil on panel. **Flat surface** anamorph



Fig. 6. Visualisation

In 1546, Hans Holbein's student, William Scrots, painted a portrait of an English duke Edward VI in a planar anamorphosis (Fig. 5) on wood, using the oil technique. The author puts a strongly deformed head of a boy on the panoramic landscape. When looking at the picture from the right side through the tiny hole cut in the frame specifically for this purpose, the viewer sees an undeformed portrait of the prince "coming out" from the frames and from the picture's plane (Fig. 6).

The procedure for the creation of anamorphs ceased to be a mystery in the course of time. However, these were mainly flat surface anamorphoses, the visualisation of which only required looking at them from a certain direction. The content conveyed by the artists through anamorphosis was then largely erotic, philosophical, and theological, with their readings reserved for insiders who knew the direction of observation of the way of visualisation, as well as those whose location even forced the possibility of reading an undeformed image. Emmanuel Mignan (Figs. 7 and 8) painted a large fresco on the arcade wall of the monastery of the Holy Trinity on the Hill in Rome, imposing the restoration direction of its hidden content for the viewers passing the arcade, locating on the arcade axis. Serving as a decoration of one of the walls of the monastery cloisters, it is a huge composition with a length of 20 m and a height of 3.5 m. A life-size figure of St. Francis (Fig. 8), the founder of the Order of Friars Minor in Rome, is shown in the image. It is probably the only anamorphic fresco preserved to this day. The viewer passing the corridor is surprised by the reality of the image viewed, especially given the fact that the figure seems to emerge from the wall, disturbing the corridor's perspective. The upcoming observer can notice a greater detail of the work and be surprised by its different content again. The habit of the saint now becomes a landscape full of wind fallen trees, cliffs, hills covered in trees, strolling people, and the boat floating on the lake.

In the first half of the 17<sup>th</sup> century, anamorphic images restored with the use of various mirrors appeared in Europe. The main themes of these compositions based on a mirror anamorph, widespread on both sides of the Alps up to England, were camouflaged portraits,



Fig. 7. Emmanuel Maignan, an anamorphic fresco, 1642, the view from the visualisation direction. Assembling a flat planar anamorph with a planar cylindrical anamorph

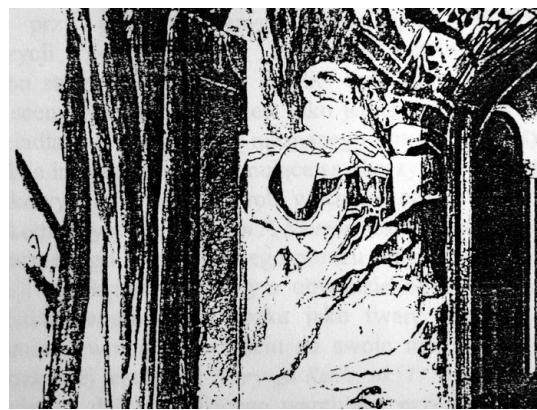


Fig. 8. Visualised part of E. Maignan's fresco – the figure of St. Francis



Fig. 9. China, 16<sup>th</sup> century, author unknown, reflective cylindrical convex anamorph of a sexually explicit content



Fig. 10. Jean F. Niceron, 17<sup>th</sup> century, a conical anamorphosis *The Girl with a Bird on a Wire*

images of saints, and biblical scenes. A 16<sup>th</sup>-century Chinese mirror anamorphosis of an erotic content, made by an unknown author (Fig. 9), is known as one of the oldest images of this kind.

Anamorphic images restored with conical mirrors are particularly interesting and fascinating. Such an image appears to be torn apart, astonishing us with its surprising composition (Fig. 10) Jean F. Niceron *The Girl with a Bird on a Wire*, 17<sup>th</sup> century. The visualisation of this anamorphic image is presented in its centre. Fuzzy contours, stretched around the perimeter of the image, are reflected in a field close to the top of the cone as the girl's face. The absurdly twisted arms go back into place in the reflection.

An example of a pyramidal anamorph (Fig. 11) is the work of *Henry Kettle, oil on panel, 1770–80, Leyde, History Museum*. In the pyramid with mirrored walls, there are four especially composed facial images, each reflecting in one wall, building one undeformed play portrait for the viewer looking from above.

In the 17<sup>th</sup> century, the age of the treatises, essays and anamorphic offices, the themes of compositions also included gardens, cities, and the whole of nature. In Western Europe, oil paintings by renowned masters were often converted in the reflection of cylindrical or conical mirrors. 18<sup>th</sup>-century works of unknown authors are an example of transmitting religious and symbolic contents. In the 19<sup>th</sup> century, anamorphosis moved away from the metaphysical motif and became mainly a technique, a skill, and an artistic perversion, while the intellectual overtones were moved away.



Fig. 11. Henry Kettle, 18<sup>th</sup> century, a pyramidal anamorphosis *The Portrait of a Man*

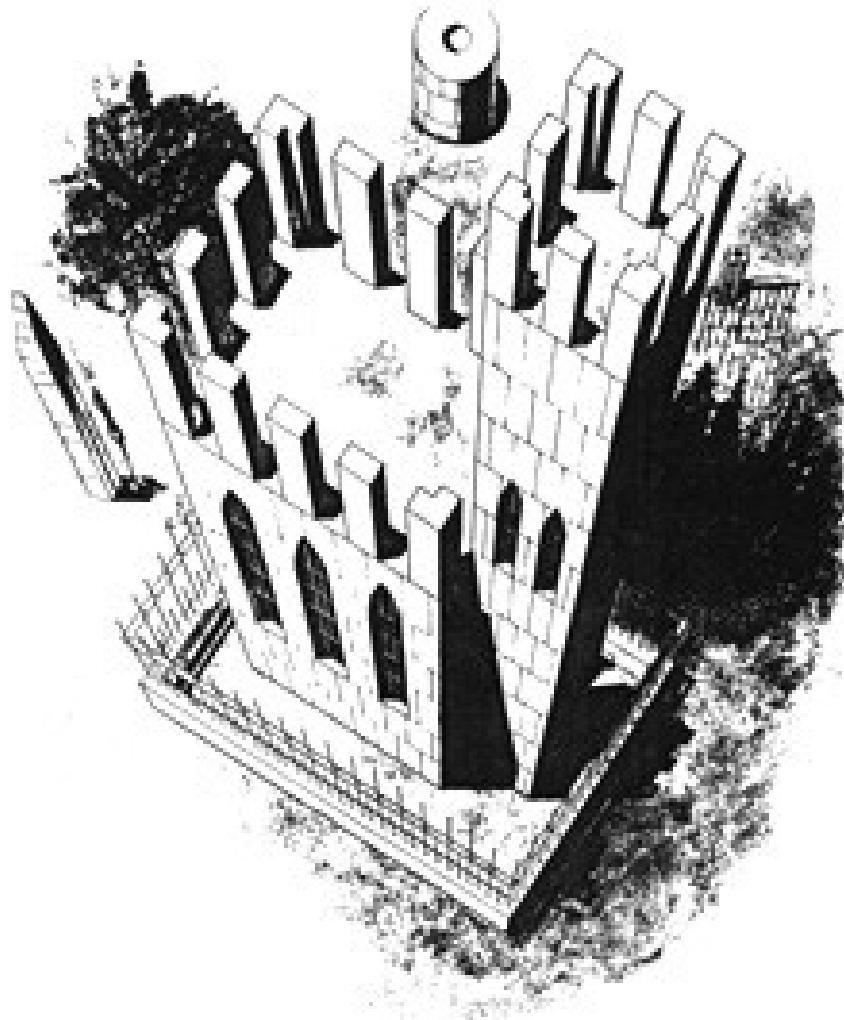


Fig. 12. *The Castle* – a planar anamorphosis, 1870, author unknown

A return to the magical and metaphysical context of mystery occurred in the era of Romanticism. A work by an anonymous Dutch author from 1870 shows the castle shown diagrammatically in a planar anamorphosis. The unusual characteristics of anamorphosis were used in a special way here. The properly viewed composition seems to rise from a two-dimensional surface of paper (Fig. 12).

In his paper entitled *Demon de l'Analogie* (1975), Roland Barthes states that analogy is a curse of artists, who are trying to oppose it in two ways: either by faithful reproduction (hyperrealism) or by creating **anamorphisms** through deformation according to strict rules.

#### 4. Examples of anamorphs created today

Nowadays, there are examples indicating the maintenance of other practical function of anamorphosis. First of all, the group of surface anamorphoses includes applicable planar anamorphic images. A wide range of horizontal road signs can be identified as typical examples of modern planar anamorphoses. (Fig. 13 and 14).

Generally, in a public space, planar anamorphs appear on city squares. They are more or less successful paintings, which, viewed from a certain point, enable the viewer to see an attractive image. The selected examples of anamorphs created in the urban or rural space are presented below.

**Example 1.** An anamorphic image of a cycling path pictogram – defined as a surface planar anamorph in the classification.



Fig. 13. Surface anamorph (photo by A. Zdziarski)



Fig. 14. Visualised anamorph (photo by A. Zdziarski)

**Example 2.** A planar anamorph on the market in Wieliczka (Figs. 15 and 16) made by Ryszard Paprocki – defined as a surface planar anamorph in the classification.



Fig. 15. Surface anamorph (photo by M. Jonak)



Fig. 16. Visualised anamorph (photo by M. Jonak)

**Example 3.** A planar anamorph at the dam in Czorsztyn.

An image entitled *Moc Żywiołów* (“Power of the Elements”) was created by Ryszard Paprocki and Zbigniew Wojkowy at the top pedestrian part of the dam in Niedzica. Viewed from a certain point, this large painting (measuring 34 m in length) gives the opportunity to see a flowing river, a waterfall and raging whirlpools (Fig. 17), as well as a hydro-technical detail – a turbine. (Figs. 18 and 19).

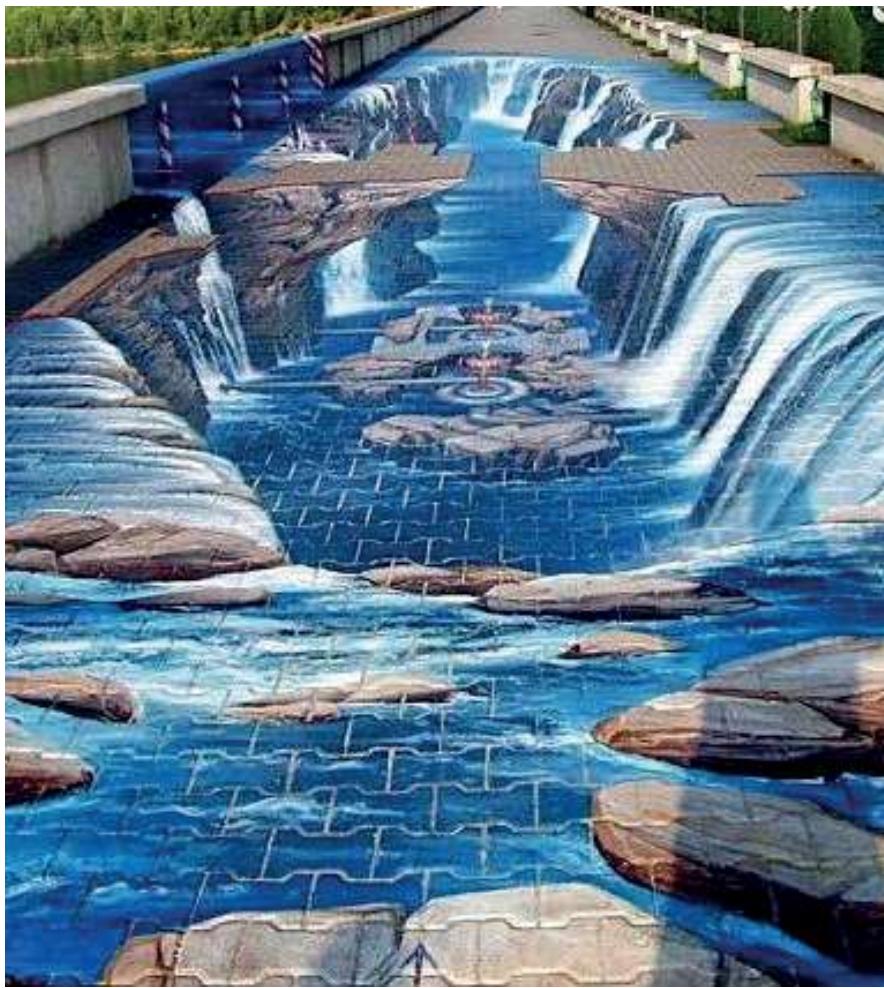


Fig. 17. The painting on the dam in Czorsztyn, a planar anamorph (source: [www.niedzica.pl](http://www.niedzica.pl))



Fig. 18. A turbine on the painting in Czorsztyn.  
Surface anamorph



Fig. 19. Visualisation of the anamorph from Fig. 18

**Example 4.** Many examples of anamorphs created by architects or artists using conventional means, depicting various technical objects, e.g. a groin vault – Figs. 6 and 7) can be identified.

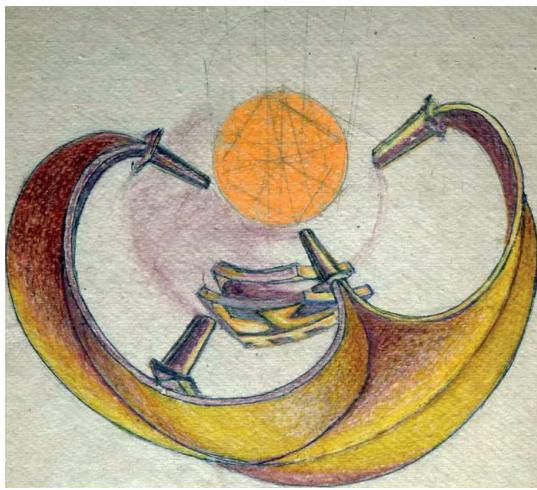


Fig. 20. Groin vault – a reflective cylindrical anamorphosis (by A. Zdziarski)

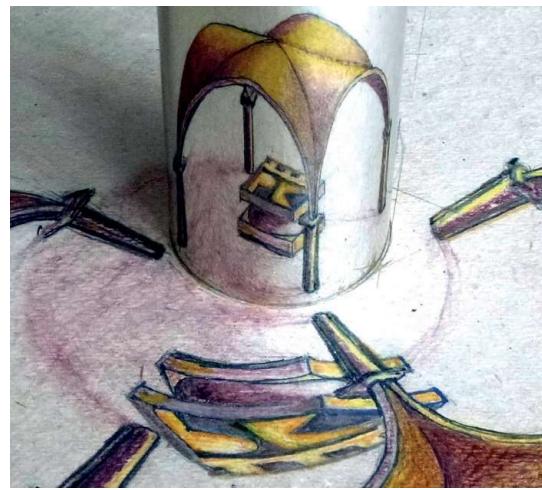


Fig. 21. Visualisation of the anamorph from Fig. 20

Tedious and monotonous construction of anamorphs inspired researchers to seek the opportunities for its mechanical assistance. Hence, A. Zdziarski came up with an idea of a prototype apparatus allowing the mechanisation of drawing operations with the help of a device called a pentagraph. The apparatus consists of eight arms connected appropriately with either rotary or rotary-sliding joints. Based on the geometric scheme (Fig. 21), see [7], the apparatus allows to set the anamorph  $A^a$  of a desired designed point  $A^a$  (Figs. 22 and 23). The apparatus was developed for the reflective cylindrical anamorph type.

**Example 5.** An anamorph created using a pentagraph

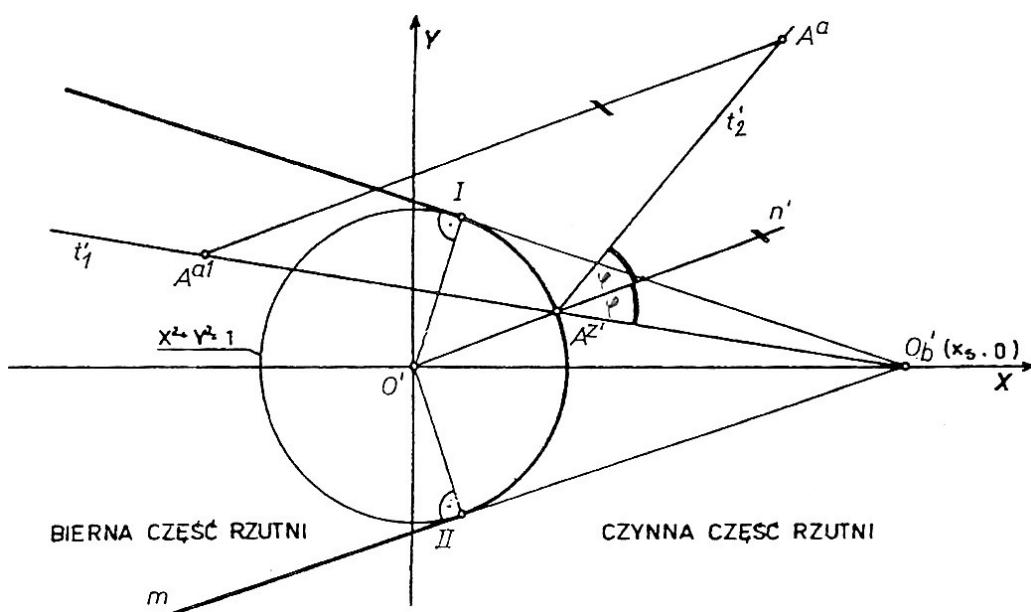


Fig. 22. A diagrammatical method of transformation

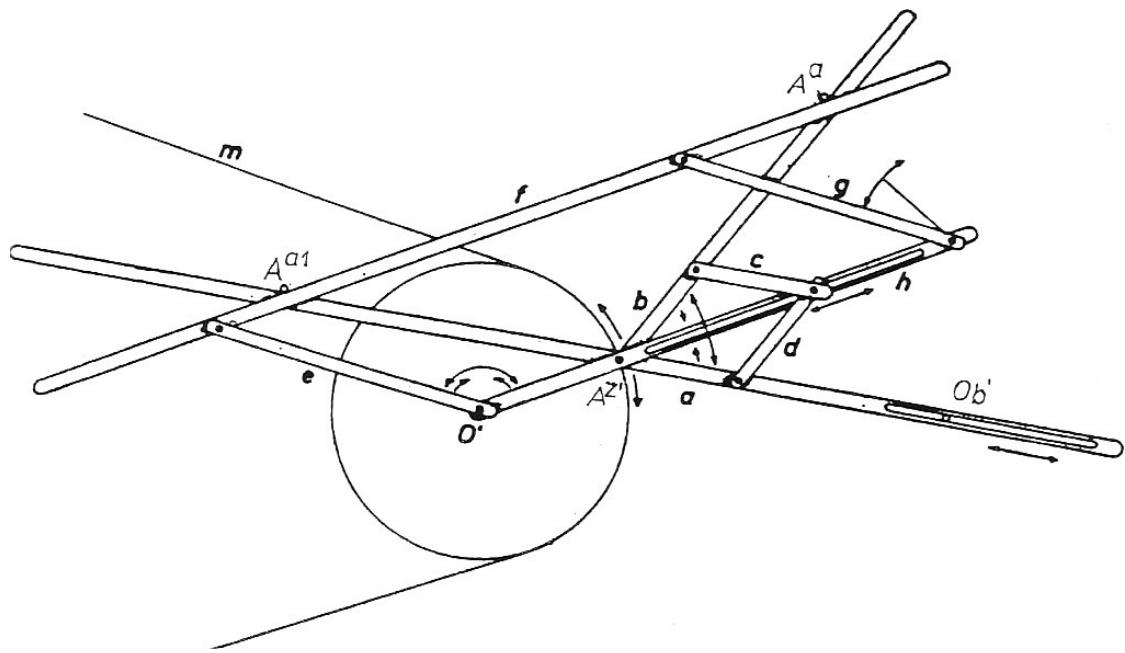


Fig. 23. Schematic diagram of the tool

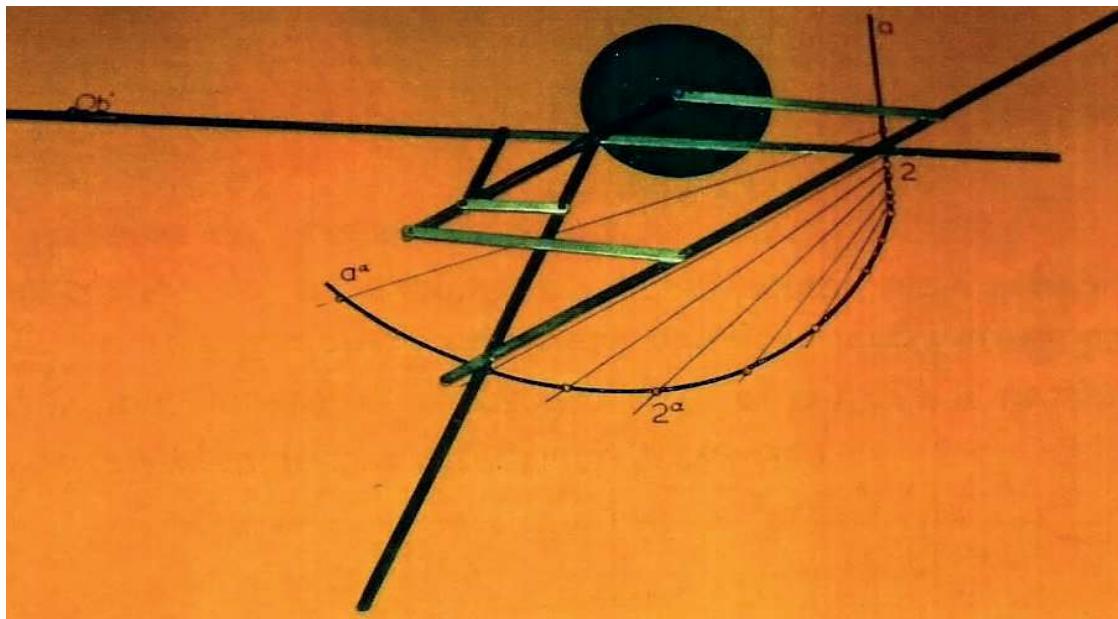


Fig. 24. A prototype of an apparatus for the mechanical determination of the anamorphic images

## 5. Examples of anamorphs created digitally with a visual intervention

As already mentioned, the authors deal with the digital method using MS Excel [10]. Two examples of a reflective cylindrical anamorph and a reflective conical anamorph from the convex group created on prototypical mirrors are presented below.

Visual effects were achieved by means of colour and graphical objects.

**Example 6.** A digitally created reflective cylindrical anamorph – MS Excel – defined as a reflective cylindrical convex anamorph in the classification.

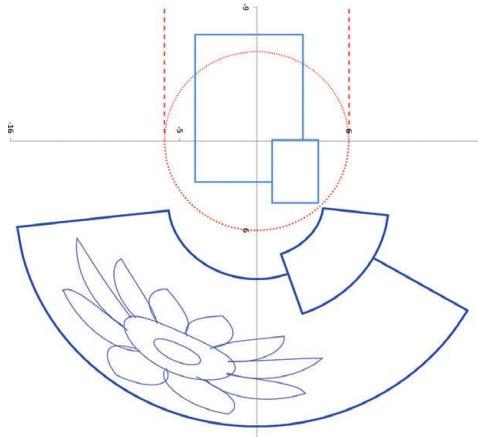


Fig. 25. *The Sunflower*, a reflective cylindrical anamorph. Digitally generated anamorph template



Fig. 26. *The Sunflower* – anamorph visualisation after a visual intervention

**Example 7.** A digitally created reflective conical anamorph – MS Excel – defined as a reflective conical convex anamorph in the classification.

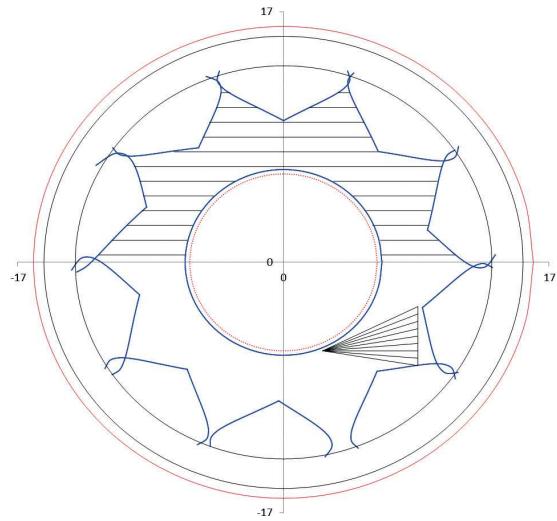


Fig. 27. *The Sunflower*, a reflective conical anamorph. Digitally generated template



Fig. 28. *The Sunflower* – anamorph visualisation after a visual intervention

## 6. Conclusion

The idea of anamorphism is the “destruction” of the object – the real image – and its presentation in an abstract and unclear form in order to read it properly by viewing it in a certain way or using a special mirror.

Anamorphic compositions contain the whole mechanism of illusion, pathos of abstraction and philosophy of artificially created reality. Anamorphosis is a rebus on the drawing plane. At the very beginning, skills and ways of drawing anamorphs were considered to be a kind of fun and a great mastery.

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