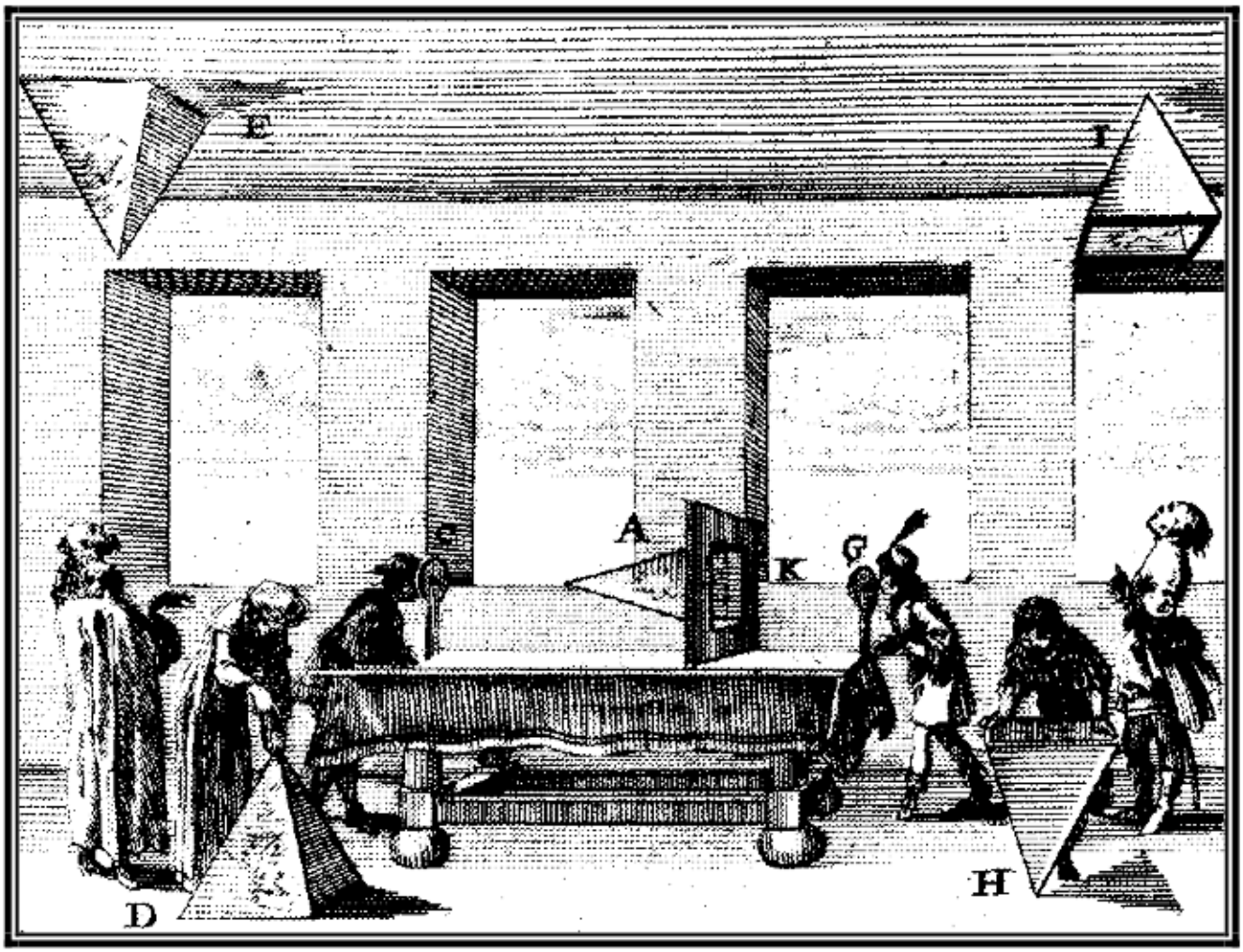
ART OF ANAMORPHOSIS



"Cabinet of pyramidal anamorphoses" by Jean Du Breuil, 1649

ANAMORPHOSIS: AN UNCONVENTIONAL WAY OF SEEING

> ***Anamorphosis***: *A distorted or monstrous projection or representation of an image on a plane or curved surface, which, when viewed from a certain point, or as reflected from a curved mirror or through a polyhedron, appears regular and in proportion.* (*Webster's Dictionary*)
>
> *Anamorphosis* is pronounced like "metamorphosis", the plural form is *anamorphoses* (pronounce "…oh-sees"), and the adjective *anamorphic*. Literally, the word is based on the Greek for "to form again".

350 years ago, the French scholar Jean Du Breuil created wonderful images of rooms ("cabinets") filled with anamorphoses attached to the walls, floors and ceilings.

This exhibition is a modest recreation of that idea. You can see here different kinds of anamorphic designs, some of which rely on being looked at from a particular position, whilst others use mirrors of unusual shapes.

By moving around, try to work out for yourself the right viewing position for each anamorphosis; it will help if you keep one eye closed whilst you do this.

You will find a computer program, called *Anamorph Me!*, which allows you to make your own anamorphoses.

You will find information about the art, science and history of anamorphosis in these wall panels, the books and the video tapes.

The exhibition has a companion web site — www.anamorphosis.com — where you will find all of the information presented here, and more, and where you can download your own free copy of the *Anamorph Me!* computer program.

Anamorphoses may seem "magical" but a much better word for them is *unconventional*. They are based on precise mathematical and physical rules — the same rules that apply to the construction of all two-dimensional representations of the three-dimensional world — but the rules are applied in ways that are a deliberate break from the usual and conventional.

To understand something about these rules, and how anamorphosis works, we will begin with the Italian Renaissance, 600 years ago.

THE RENAISSANCE, THE REDISCOVERY OF PERSPECTIVE, AND THE ORIGINS OF ANAMORPHOSIS

> The Florentines were extremely proud of this invention [perspective], which they thought … was unknown to antiquity… But has it anything to do with civilisation? When it was first invented I think it had. The belief that one could represent a man in a real setting and calculate his position and arrange figures in a demonstrably harmonious order, expressed symbolically a new idea about man's place in the scheme of things and man's control over his own destiny. (Kenneth Clark, *Civilisation*)

Renaissance means re-birth, and the years between about 1400 and 1550, first in Italy and then spreading to other countries, are without doubt one of the most significant periods in the history of Europe. Renaissance artists—and especially Leonardo da Vinci, Michelangelo, and Raphael—are still today world-famous. It began in the city of Florence, where, under the rule of intelligent and enlightened leaders, there was a rediscovery of the ancient civilisations of Rome and Greece in all their aspects: politics, philosophy, science, literature, architecture, art. After centuries of cultural thought focused on the inadequacy of humanity relative to the divine, the Florentines celebrated the power of humanity: "Man is the measure of all things".

The art of *perspective*, the representation of 3-dimensional space on a flat surface, was certainly known in ancient times, but this knowledge was "lost and forgotten for centuries. Byzantium was the artistic centre of Christendom for 1,000 years, and in Byzantine art… the third dimension is eliminated… Figures and objects are flat abstract symbols set on flat neutral surfaces. A pictured man does not represent a physical body, but a human spirit, having no volume, depth or position in space. The real world no longer features in the background; there is no horizon" (Wright, *Perspective in Perspective*).

In Florence, over a period of about a hundred years, artists rediscovered the art of perspective, and learnt its geometrical rules. From the viewpoint of the 21st century, where we bathe constantly in a sea of static and moving images, we can hardly appreciate what a revolution in art this was. However, compare the following two views of a city: the first is painted in the Byzantine "flat surface" tradition; the second, by the Renaissance artist Piero della Francesca, uses a very precise perspective construction to create a feeling of spatial depth, of "reality", that is overwhelming.

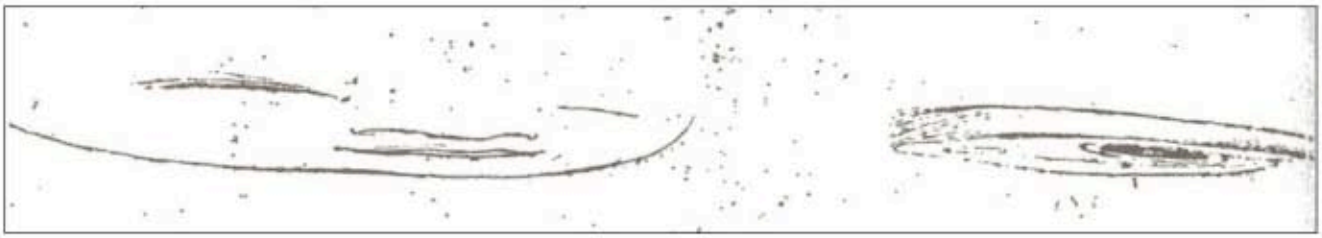
A view of Florence, about 1350 (from Bronowski, "The Ascent of Man")

"La Citta Ideale" (The Ideal City) by Piero della Francesca, about 1470

The German artist Dürer made some of the best illustrations of the idea of perspective. In the following, the artist observes his subject by putting his eye at a particular location (the viewpoint) and looking through a "window" (an evenly-spaced grid of black strings tied to a wooden frame). The image of the woman as seen through that window *is* the picture, which the artist is copying onto the grid in front of him. Although a skilful, trained artist does not need an actual window to look through, or a copying grid, the *idea* of the picture being a window is fundamental to perspective. Also fundamental is the existence of a single viewpoint, so that if we want to see exactly what the artist saw then we must position ourselves at a viewpoint in front of the drawing which is identical to *his* viewpoint in front of the "window".

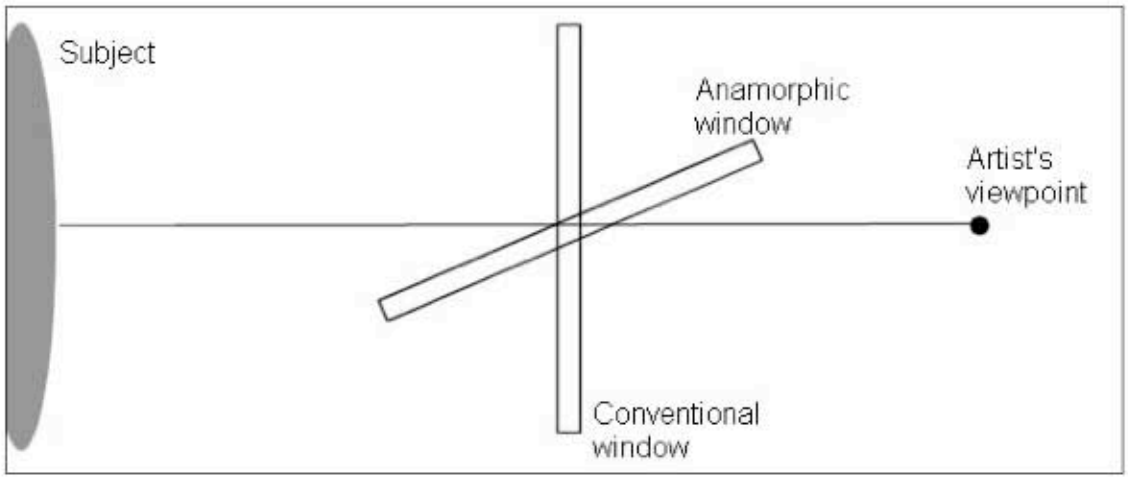
"An artist drawing a nude" by Albrecht Dürer, 1525

Against this background, anamorphosis was born. The notebooks of Leonardo da Vinci contain the earliest-known anamorphic drawings, dating from the 1480s:



Anamorphoses of a child's head, and an eye, by Leonardo

What Leonardo (and other artists too) had realised is that the orientation of the picture window at 90 degrees to the "central line" between the artist's eye and the centre of the window is just a convention—there is no reason why the window cannot be turned to a different angle:



The result of this turning is that if we try to view the resulting picture from the conventional position (window at right angles to the central line) it will look distorted, and possibly (if the turning is large enough) unrecognisable.

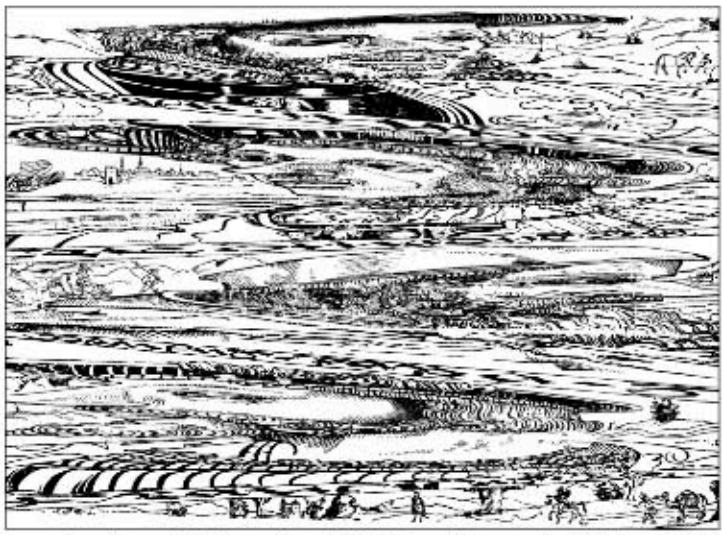
THE 16TH CENTURY

As knowledge of perspective spread northwards from Italy, artists in northern Europe began to adopt the technique, and to experiment with the "distorted perspective" of anamorphosis.

A celebrated example is contained in the portrait painting by Hans Holbein known as *The Ambassadors*. A skull is stretched anamorphically at the feet of the two men (pictured in the full of life, the skull is a traditional symbol and reminder of the inevitability of death).

"The Ambassadors" by Hans Holbein, 1533

In Germany, one type of anamorphosis that became popular has distorted forms which are made to appear like something else. In this example by Erhard Schön, a pupil of Dürer, the heads of four European leaders appear as geographical features of landscapes:



"Anamorphic portraits of Charles V, Ferdinand of Austria, Pope Paul III and Francis I" by Erhard Schön, about 1535

This is a nice development of the basic anamorphosis technique, because it is harder for the brain to make sense of the distorted forms. As you look around this exhibition, you will find after a while that some of the anamorphoses become easy to un-distort just by thinking about them.

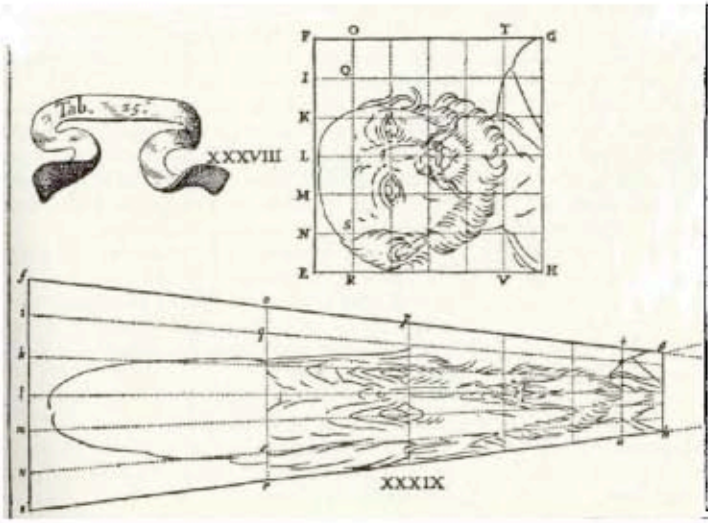
THE 17TH AND 18TH CENTURIES

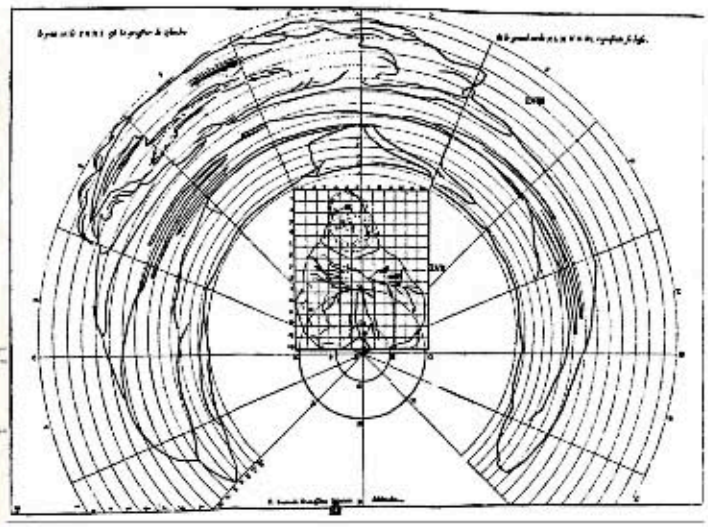
During this period, the art of anamorphosis evolved both theoretically and practically, especially in France and Italy. It is interesting to note that most of the leading investigators were Jesuits, that is, priests of an order within the Roman Catholic church that has had a tradition for many centuries of scientific and mathematical scholarship. One anamorphosis showing a saint has been described thus: "Through God's natural laws, man is able to create visions. With his normal earthly powers of observation, he can detect nothing but chaos; but from a point determined by natural law, the vision of a saint emerges" (Leeman, *Hidden Images*).

The geometrical rules for anamorphosis became better understood, making techniques more precise and efficient, and making it easier to construct large anamorphic designs for the walls and ceilings of buildings.

New types of anamorphosis were developed. Perspective ones where the picture is no longer a flat plane, but a more complex surface such as a cone or pyramid (as in Du Breuil's "Cabinet" in Panel 1). Also, anamorphoses using reflections from curved mirrors shaped into cylinders, cones and pyramids (an idea that originated in China).

The first textbooks describing the techniques of anamorphosis were published in the 1600s. Jean-Francoise Niceron's book *Thaumaturgus Opticus* (or, "Performer of optical miracles") which appeared in 1646 was the most important of these; here are his diagrams for the construction of perspective and cylindrical mirror anamorphoses:





In all these constructions, one starts by making the anamorphic transformation of an empty square grid, according to certain choices about the position of the viewpoint, the sizes and angles of the mirrors, etc. Then, the square grid is put on top of the original picture, and the contents of each small grid element are copied across to the corresponding element of the distorted grid.

THE 19TH AND 20TH CENTURIES

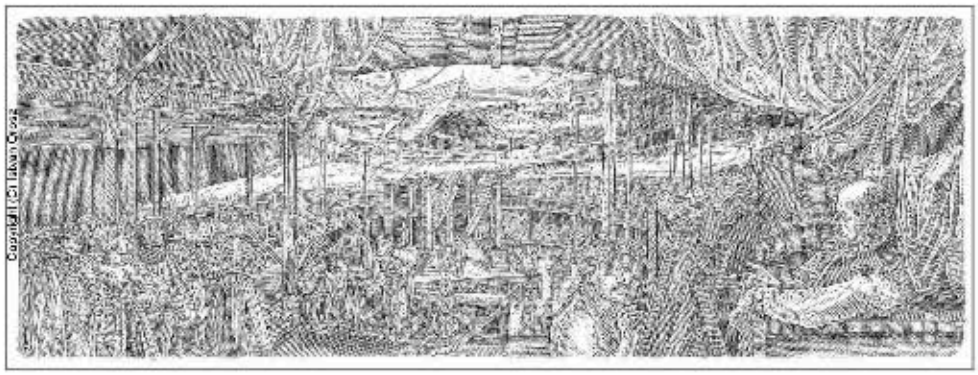
In the 19th century, the development of inexpensive colour printing made anamorphic images more widely available, and it became a popular "parlour game", alongside other "visual games" like stereoscopic photographs.

But in the past century, anamorphosis, like many other gentle pastimes of the 19th century, has disappeared from popular knowledge, though usually earning a small mention in books about perspective, and appearing occasionally in special exhibitions or books.

A few artists have worked with the technique, most famously Salvador Dali. He produced several examples where the image is a clever "double":

"Insect and Clown" by Salvador Dali

A contemporary artist in Hungary, István Orosz, has also explored these "double image" designs. Can you work out the theatrical subject of the following picture?



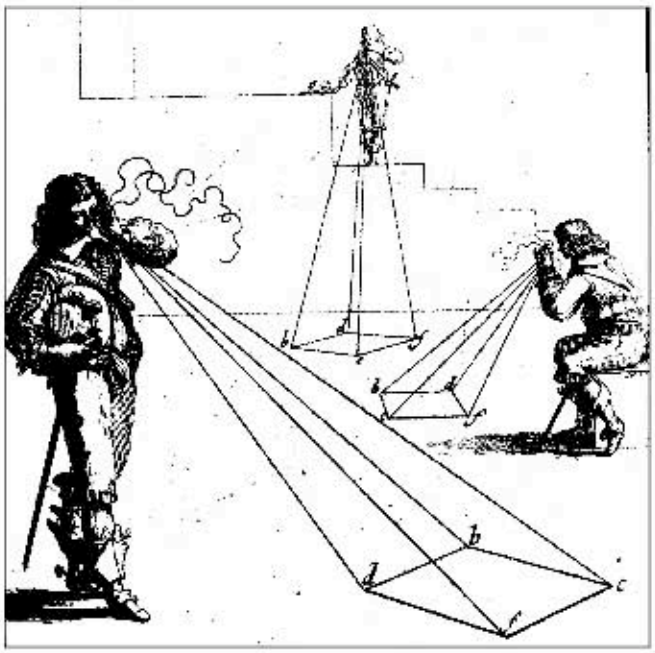
Perhaps popular interest in anamorphosis may revive, especially now that computers allow the kind of artistic experimentation with images that was once the privilege of professional artists.

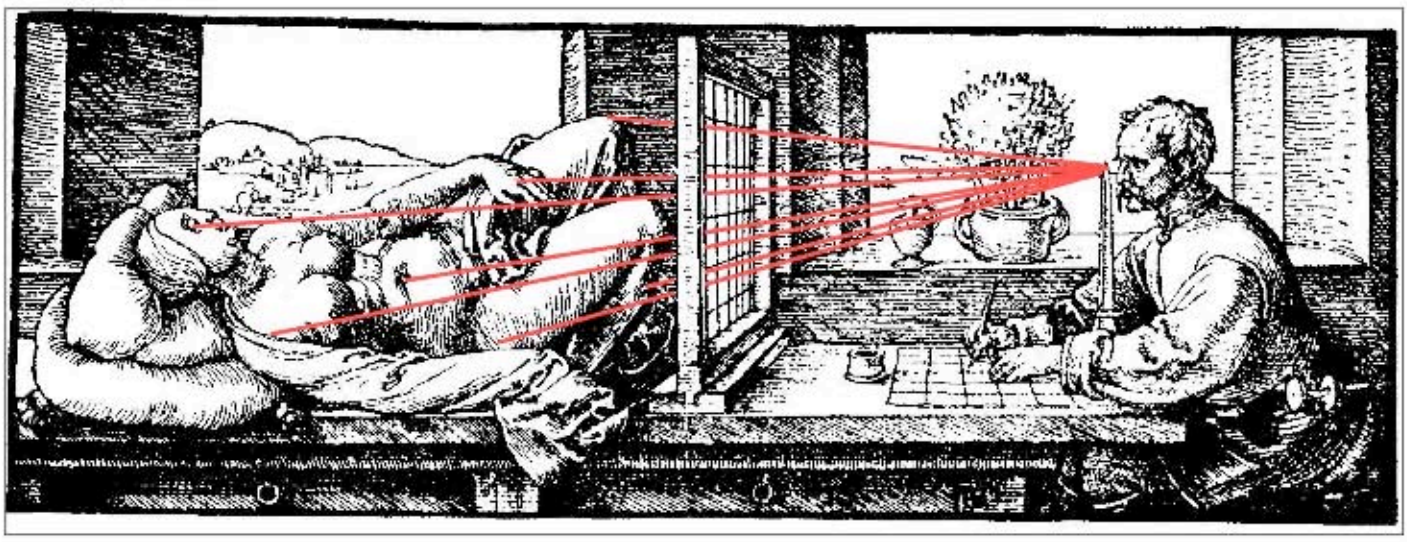
HOW ANAMORPHOSIS WORKS

There are two key physical ideas that explain the mechanism of perspective, and hence the construction of anamorphoses using perspective.

First, the idea that light travels in straight lines. Second, that we see an object because a ray of light travels from each point on the object into our eye. (Perspective is a “one-eyed” phenomenon—each eye is seeing a different picture of the world—hence my advice right at the beginning to close one eye when looking at anamorphoses.)

Put together, these ideas lead to the concept of a “cone of vision”: the millions and millions of light rays form a conical shape whose tip (where all the rays meet) is the eye. The idea is illustrated in this charming diagram by Abraham Bosse (1648), where three “perspectors” are looking at squares drawn on the ground:





How does this connect with anamorphosis? Let's look again at Dürer's artist drawing a woman. I've added just a few of the light rays that make up the cone of vision. Looked at this way, we can see that the picture "window" is a plane slicing through the cone of vision.

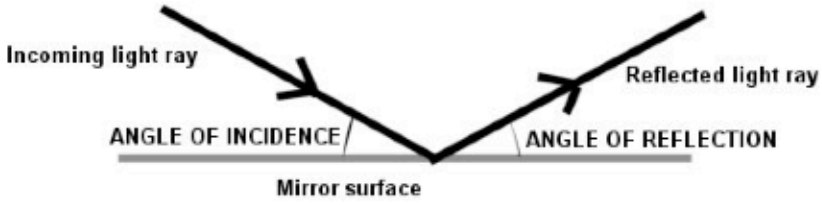
Now the fundamental fact is that *any* slicing plane will produce the same impression for the eye as the original object, and, as Leonardo discovered, this slice does not have to be perpendicular to the "central line" between the artist's viewpoint and the window.

But there is more: the slice does not have to be a plane. Indeed, *any* shape can produce the same impression. In this exhibition you will find examples of slices in the form of cones and pyramids, which are fairly easy shapes to do the mathematical calculations for.

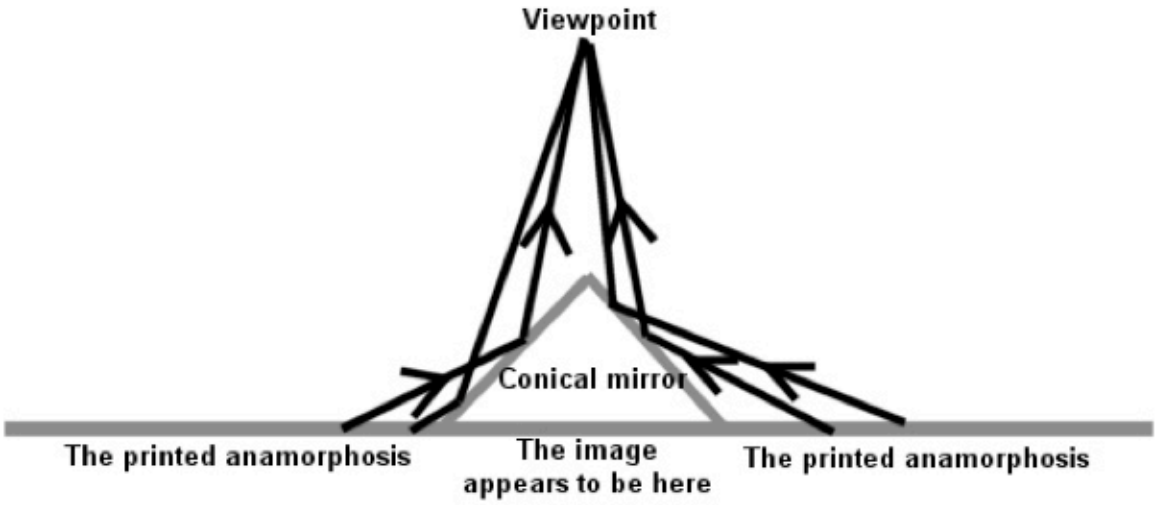
ANAMORPHOSIS USING MIRRORS

This works according to the same principles as for perspective anamorphoses. But there is an additional factor, the *bending* of light rays by the mirror, which has the effect of making the anamorphosis more scrambled and more difficult to decipher.

There is a simple rule for the bending: when a light ray is reflected by a mirror surface, the *angle of incidence* is equal to the *angle of reflection*:



So, let's look at how the light rays travel in an anamorphosis that uses a conical mirror; here is the view from the side:



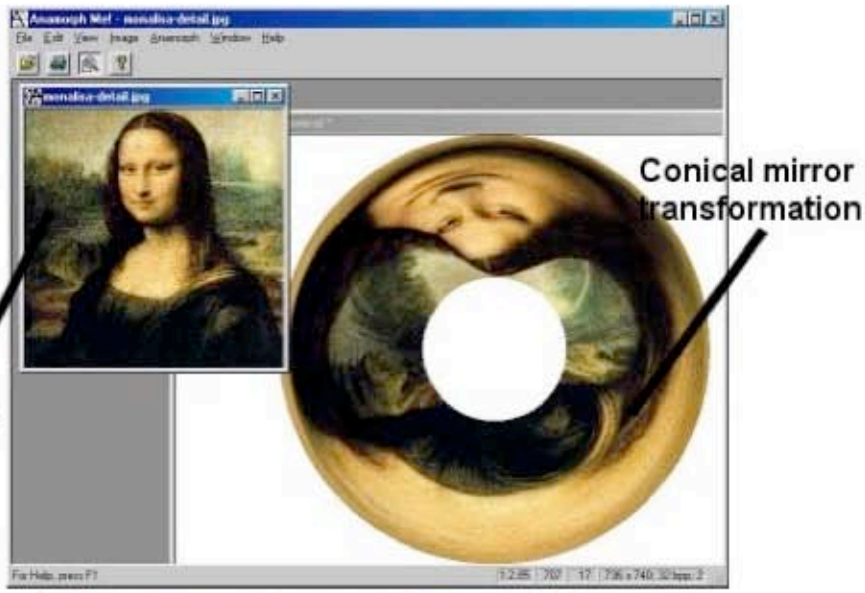
Conical anamorphoses look especially scrambled, because the conical mirror has the effect of "inverting" the original image — the centre of the original becomes the outside edge of the anamorphosis, and vice versa.

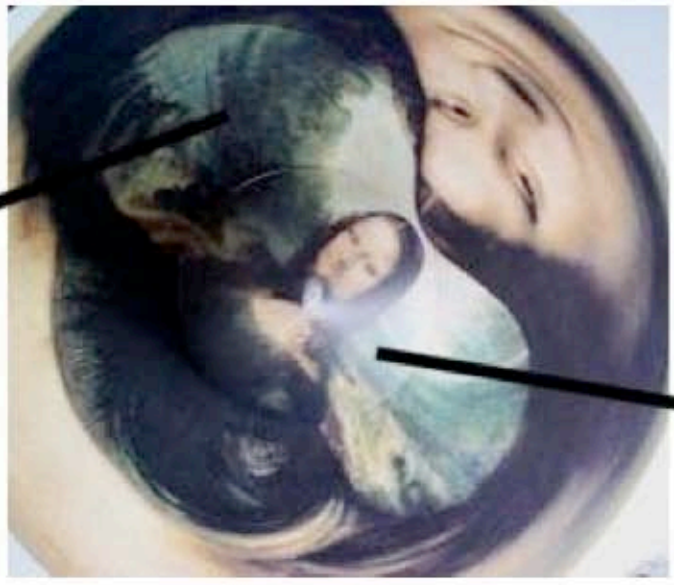
ANAMORPH ME!
COMPUTER ANAMORPHOSIS

Traditionally, anamorphoses have been created using grid templates: an original image is covered by a regular grid, and then the contents of each grid-square are copied over into the anamorphic grid. This is hard work, and requires a fair amount of artistic skill.

With computers, anamorphoses are much easier to make because the rules (algorithms) for anamorphic distortions can be written as computer programs, which can then be applied directly to the many thousands of individual pixels of a digital image. (For the computer, any image is literally a grid of coloured squares, known as "picture elements", pixels for short.)

Anamorph Me! is a free computer program (available on the exhibition web site) which allows you to carry out almost all the traditional anamorphic transformations that use perspective and mirrors. For example:

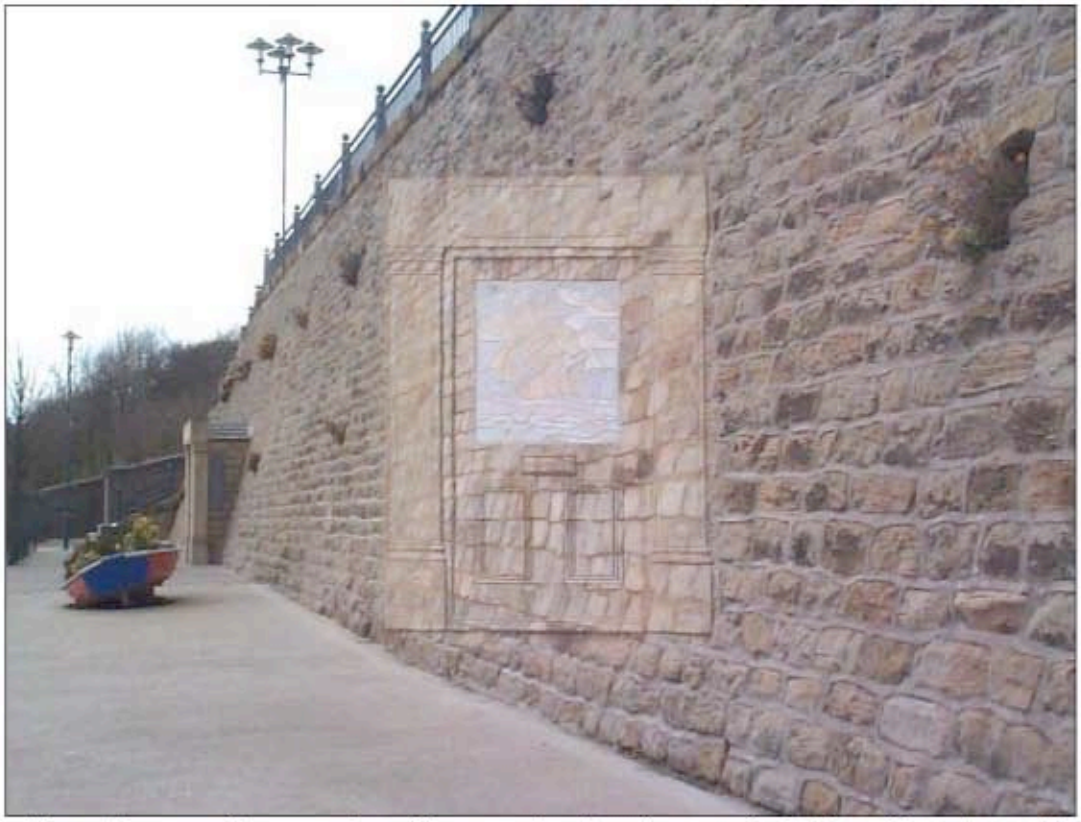




ANAMORPHOSIS IN SUNDERLAND

On the banks of the River Wear in Sunderland, the St Peter's Riverside Sculpture Project, led by Colin Wilbourne, created in 1997 a wonderful perspective anamorphosis called *Passing Through*:

Left: The anamorphosis (on the stone wall) and the observation seat
Right: Viewing from a conventional viewpoint

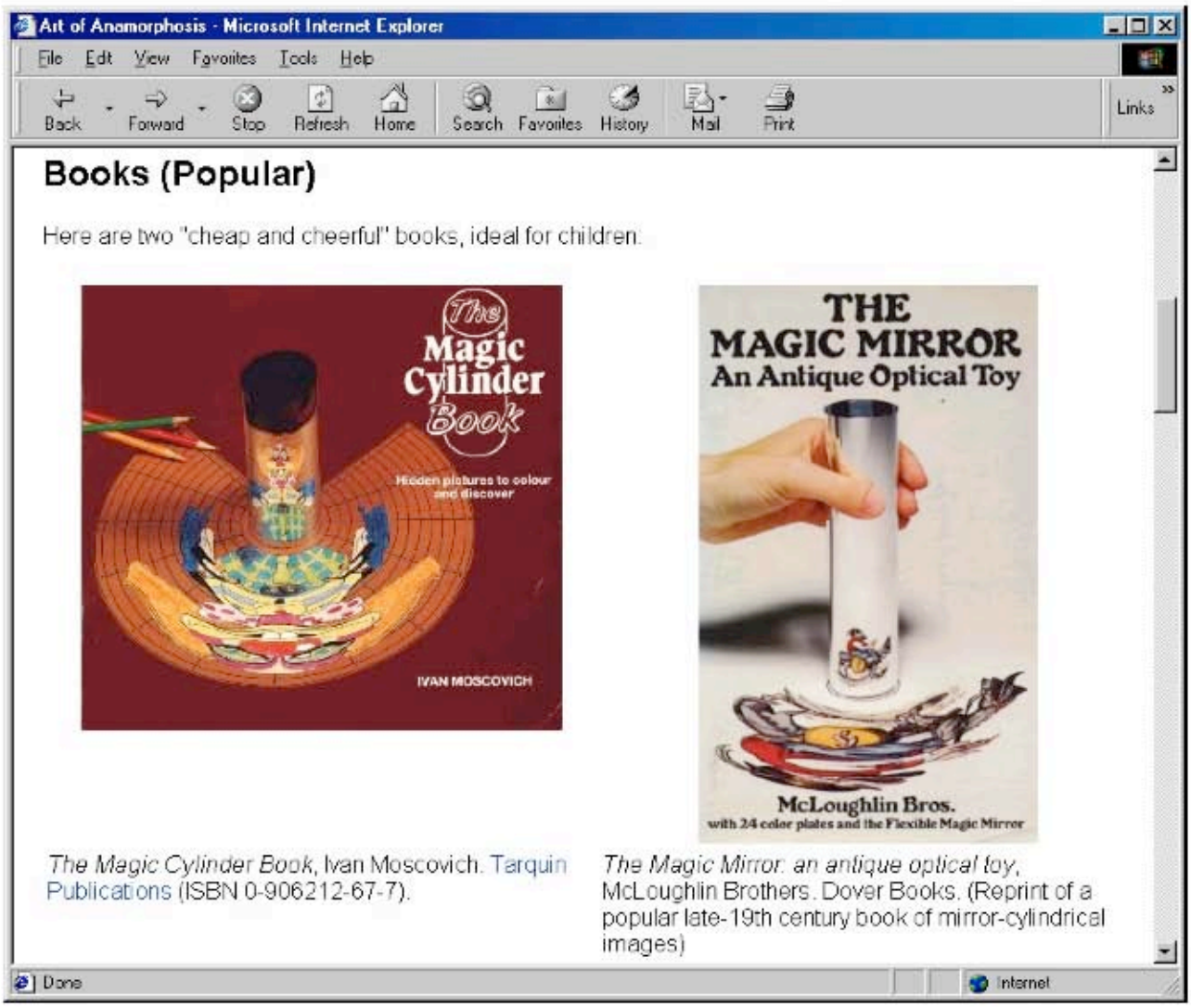


View from the observation seat, with eye to the "peep hole"; notice how the doorway seems to lean out from the wall

TO FIND OUT MORE

The exhibition web site is intended to be a major reference point for finding out about anamorphosis:

www.anamorphosis.com



Your comments and questions about the exhibition are welcome by email to:

feedback@anamorphosis.com

EXHIBITION CREDITS

This exhibition was designed by Phillip Kent, with the assistance of John Sharp (UK), Kelly Houle (USA), István Orosz (Hungary) and Stefan Machedon (Romania). I am grateful to the Watford Recycling Arts Project (WRAP) for providing some of the construction materials. The presentation of the exhibition at Arts Centre Washington was organised by Helen Stearman, with the support of Ele Carpenter at the Northern Gallery for Contemporary Art in Sunderland.