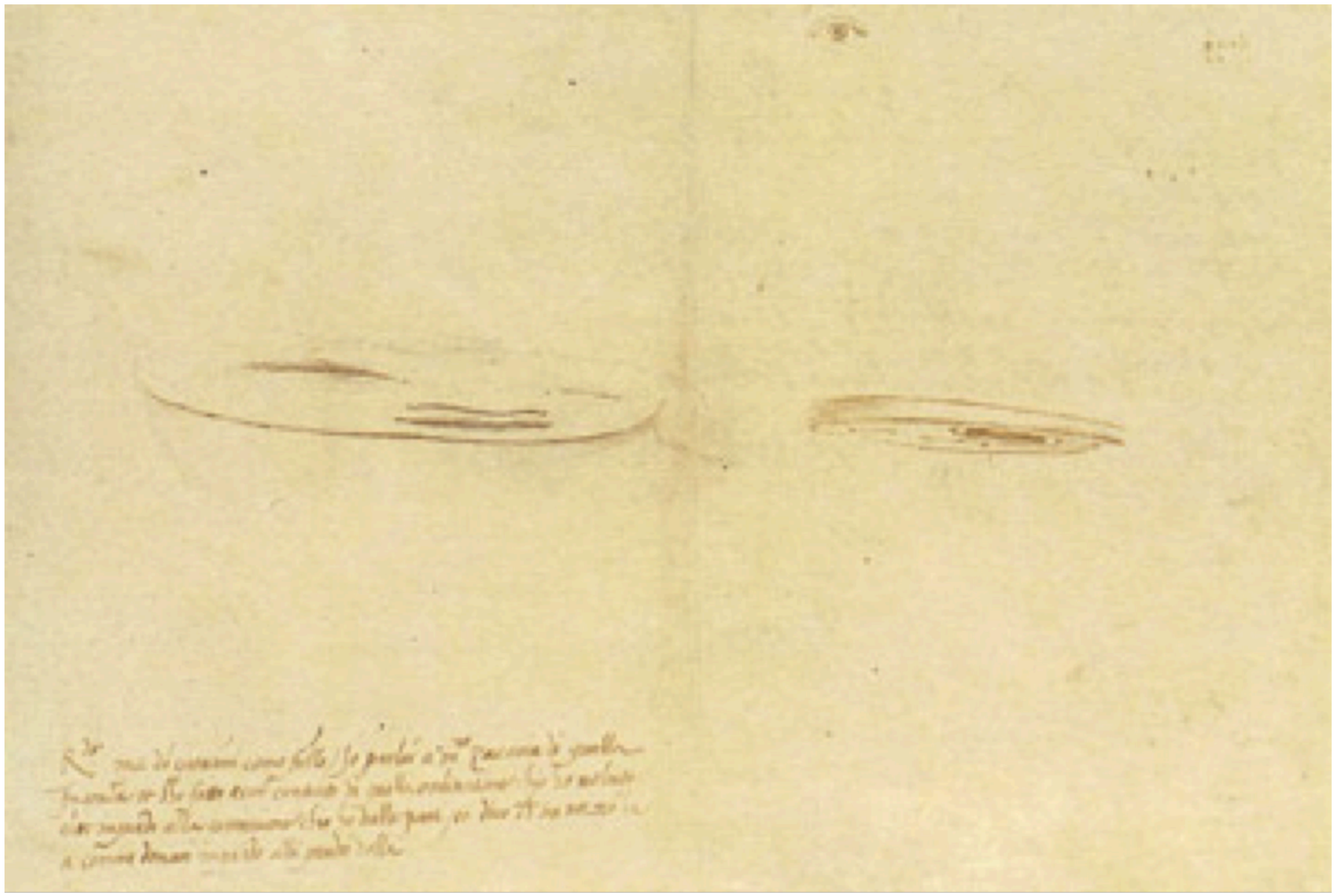
# Anamorphic Art

*Never argue with an angle - they're almost never right.*

# What is Anamorphic Art?

- A distorted image that can only be viewed correctly from a single point
- Popular during Victorian era, but appears in Renaissance art as well
- Leonardo da Vinci had a sketch in a notebook, considered the first known example of anamorphic art:



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- From almost any vantage point, the images are difficult to identify

- But from a particular angle, the images appear three dimensional

# What is Anamorphic Art?

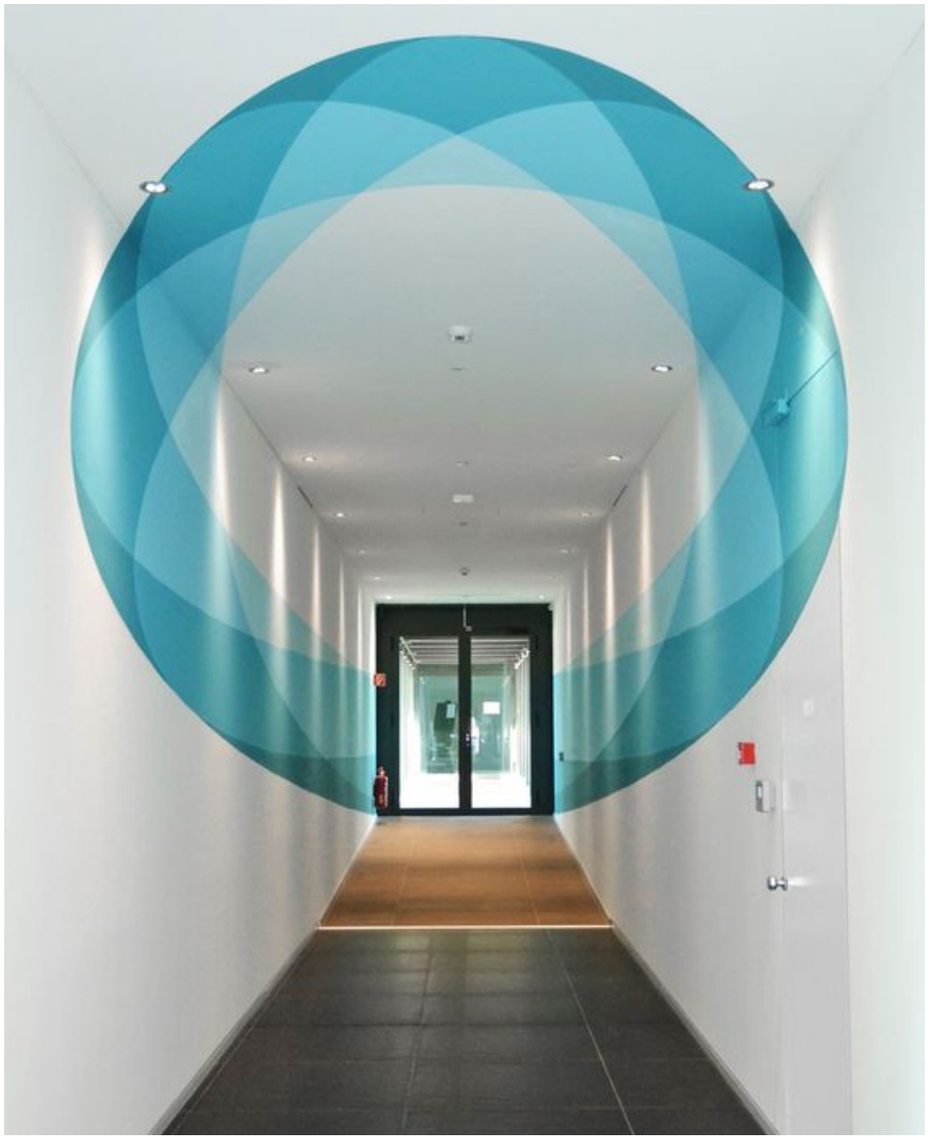
- This art requires a lot of planning, and are challenging because the artist themselves cannot view their work from the “correct” location as they progress

# What is Anamorphic Art?

- Incorporating real ‘actors’ into the scene can make the images more convincing

# What is Anamorphic Art?

- The same effects can be applied to other surfaces, including vertical walls and ceilings



# What is Anamorphic Art?

- Real wall, fake tunnel… Roadrunner?

# What is Anamorphic Art?

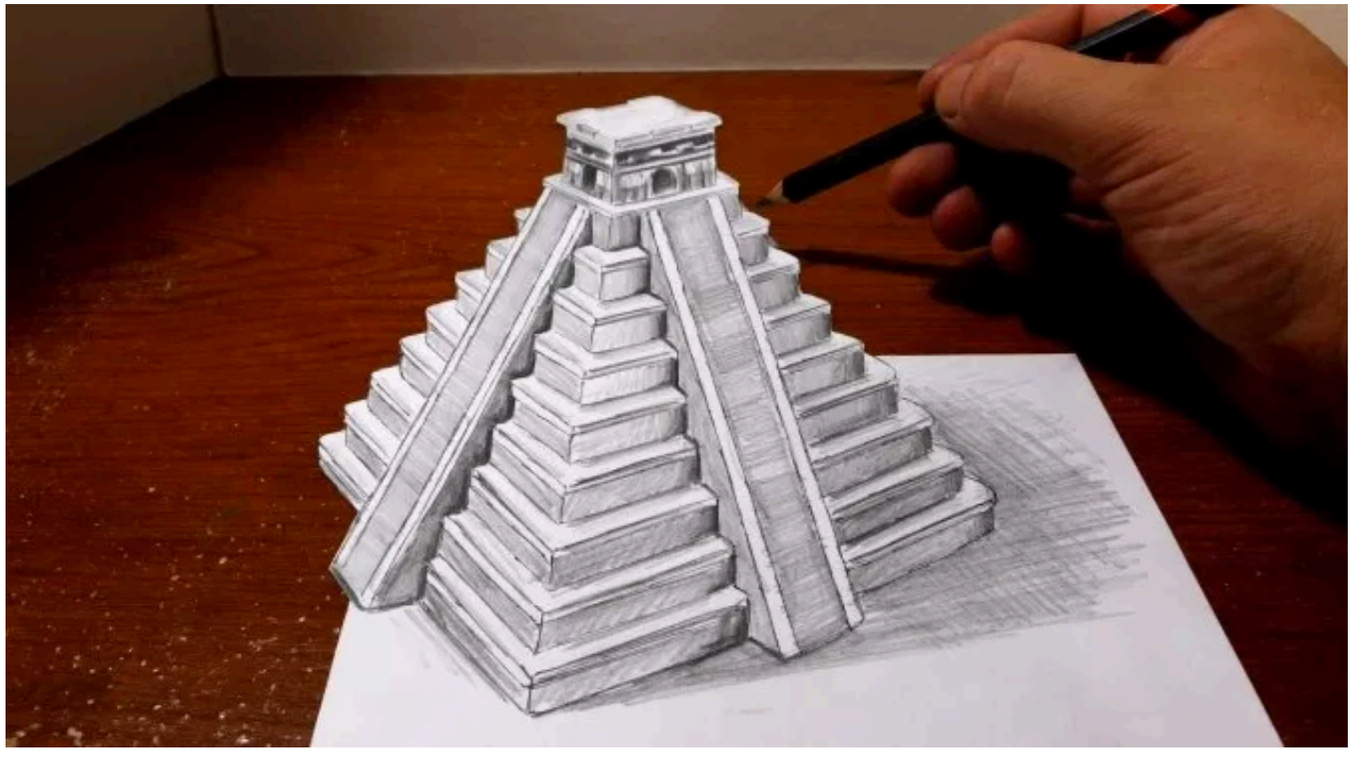
- To create anamorphic art, we just need an idea and a location… with a perfect spot to view it

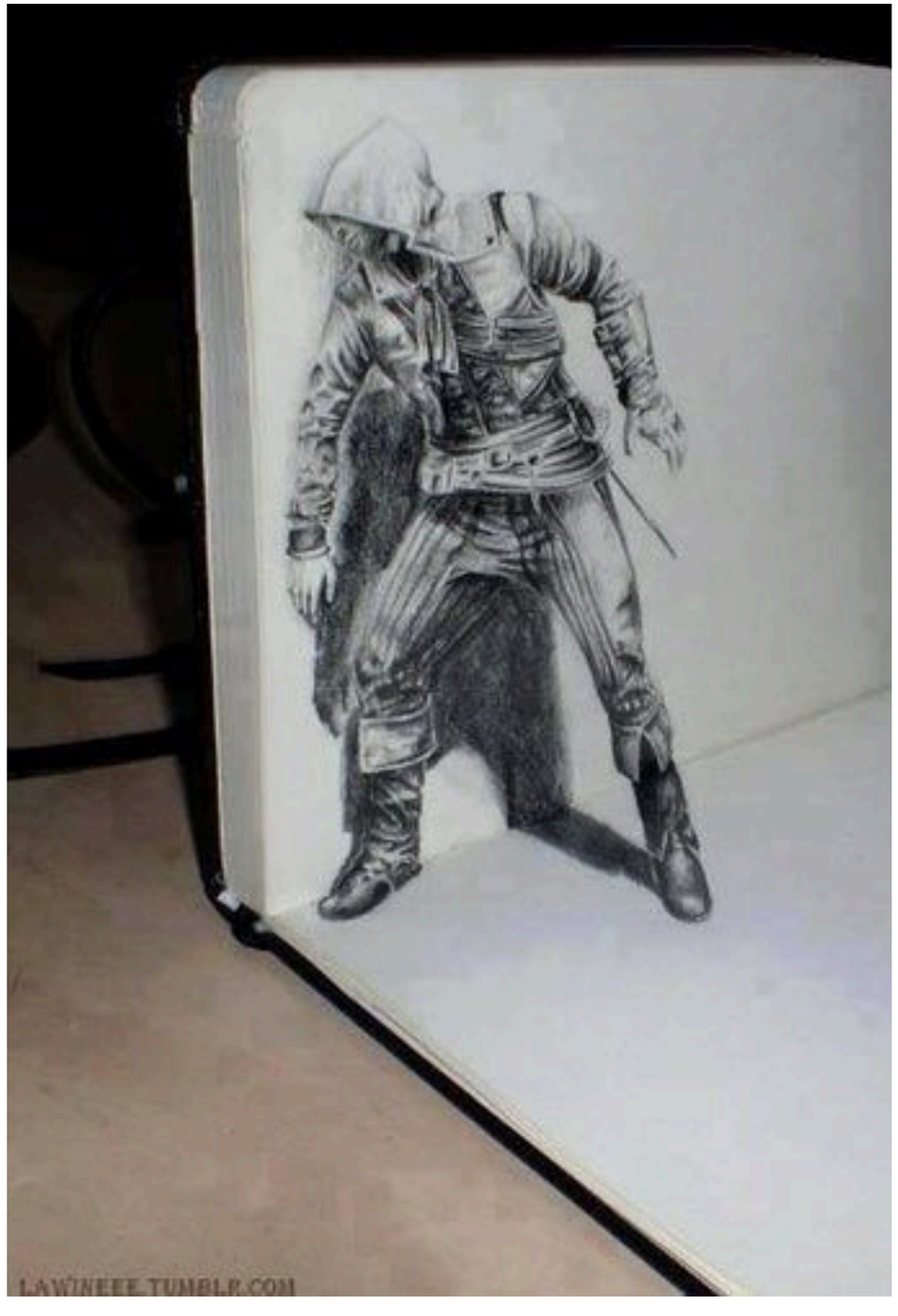
- Sidewalks are a popular canvas, but you can create convincing anamorphic art on paper as well

# What is Anamorphic Art?

- Trimming around the image can add to the effect

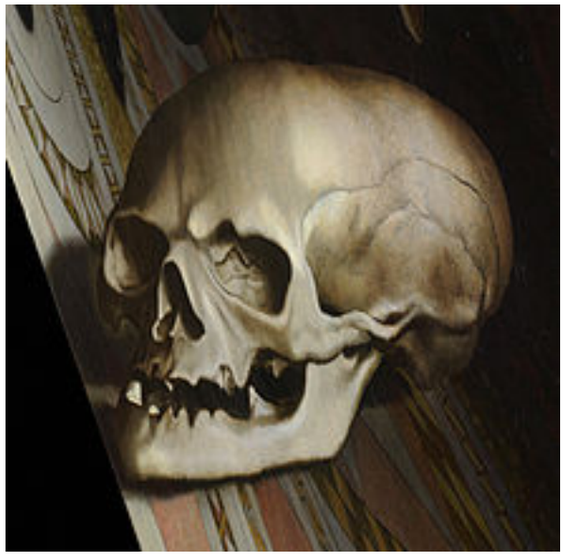
- Another style involves using paper with a single crease, such as adjoining pages in a book





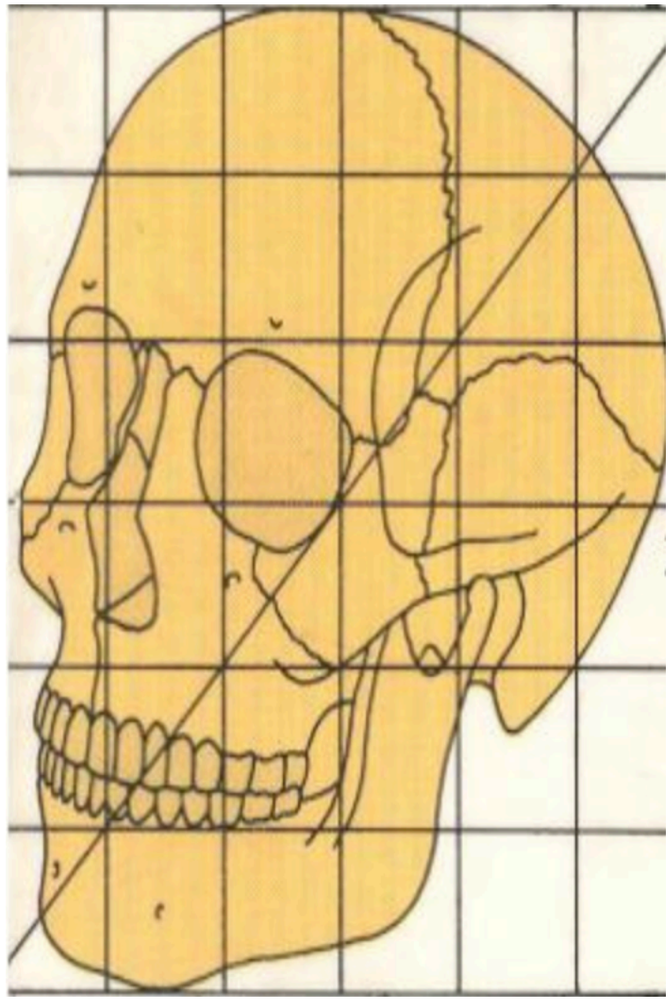
# How to do it: Method 1

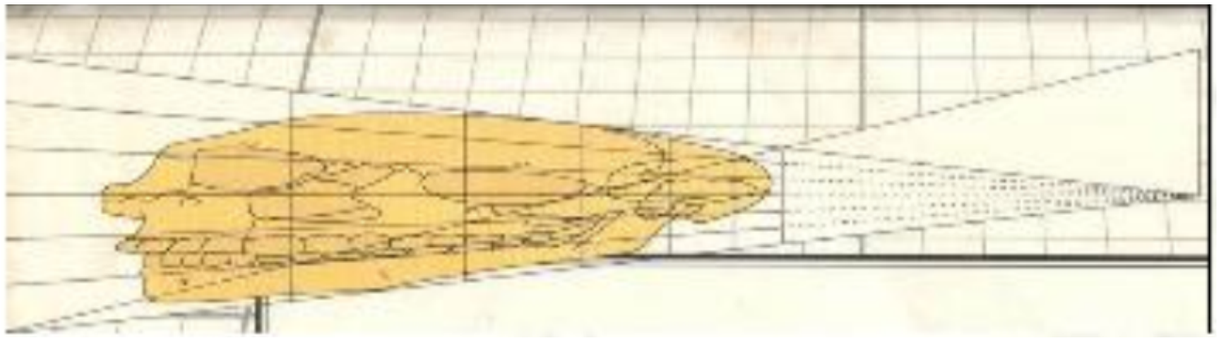
- How did Hans Holbein the Younger create this anamorphic skull in *The French Ambassadors*?



# How to do it: Perspective Grid

- Begin with an image drawn on a traditional squared grid.
- Map the image, point by point, to a distorted grid, where one set of parallel lines intersect off canvas.
- The distorted version can be viewed properly from the “vanishing point” where the grid lines intersect.

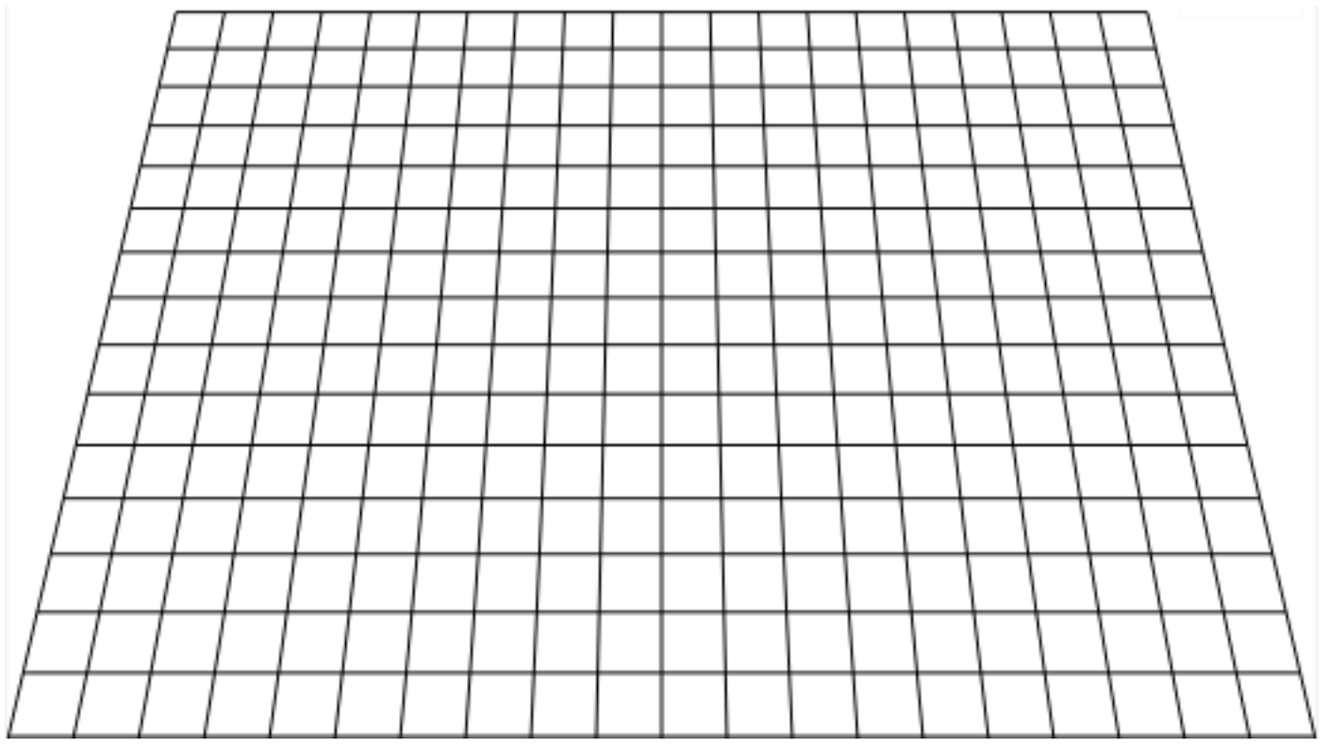




# How to do it: Perspective Grid

- To make the perspective grid, we need mathematics
- Begin with a regular square grid
- The lines of the grid intersect at points (a,b)
- We apply a 3D rotation matrix to the grid by multiplying the matrix and each point (a,b)

$$R(\theta)(a,b) = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ 1 \end{bmatrix}$$



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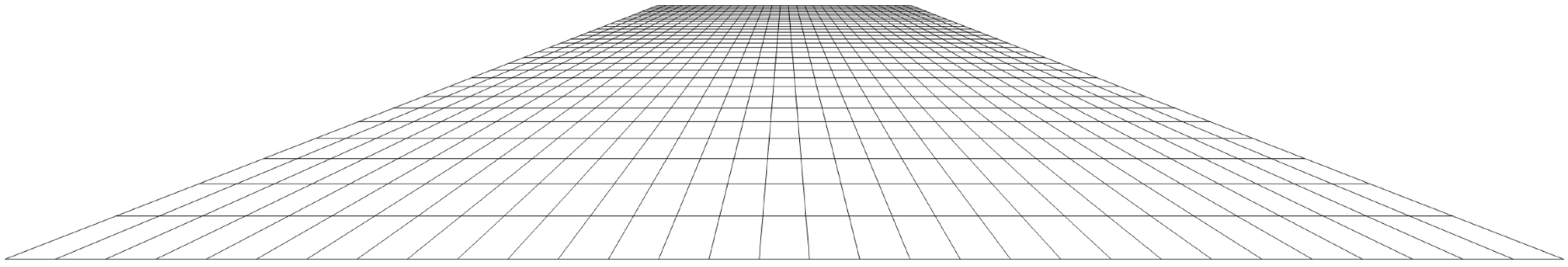
- To make the perspective grid, we need mathematics
- Begin with a regular square grid
- The lines of the grid intersect at points (a,b)
- We apply a 3D rotation matrix to the grid by multiplying the matrix and each point (a,b)
- Adjusting the angle of rotation gives us a different perspective



# How to do it: Perspective Grid

- Rotating around a different axis can also give us a different perspective, but all of them turn out to be the same (just turned)

Counterclockwise rotation around x-axis

$$R_x(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & -\sin\alpha \\ 0 & \sin\alpha & \cos\alpha \end{bmatrix}$$

Counterclockwise rotation around y-axis

$$R_y(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{bmatrix}$$

Counterclockwise rotation around z-axis

$$R_z(\gamma) = \begin{bmatrix} \cos\gamma & -\sin\gamma & 0 \\ \sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

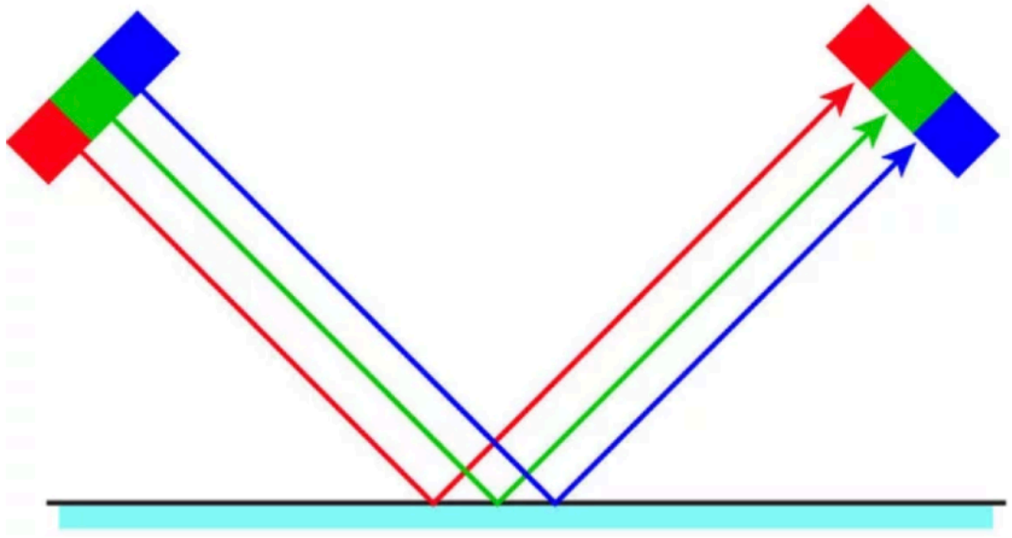
# Cylindrical Anamorphs

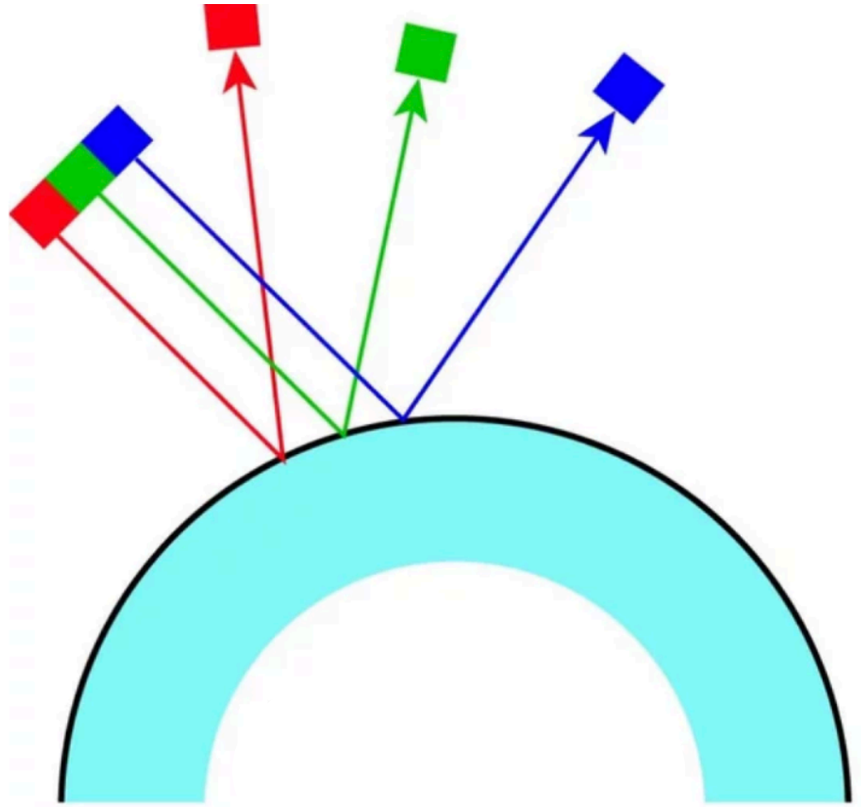
- Another form of anamorphic art involves making an image that only appears “correct” when viewed as a reflection

- A popular choice of reflective surface is a cylinder, but any shape will work (if you can figure out the corresponding grid)

- When we view a reflection in a flat mirror, the image is not distorted

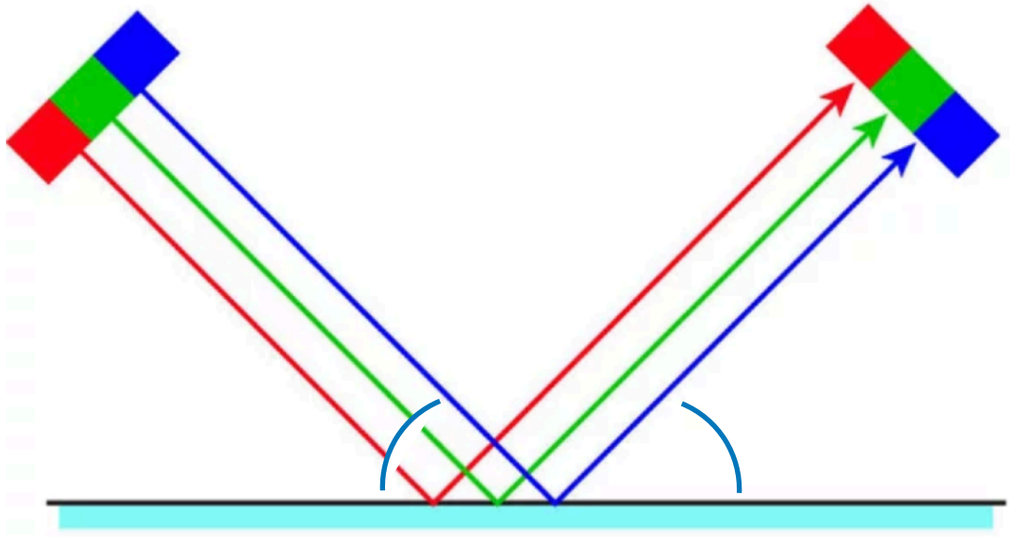
- In a curved mirror, the angle of reflection is a little different for each point



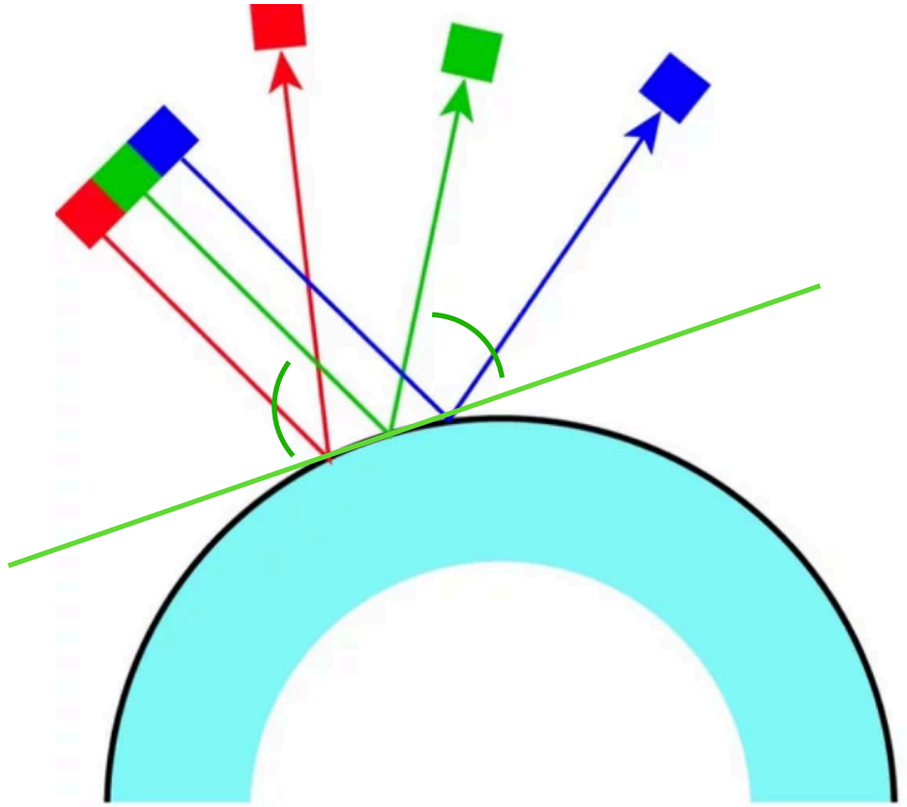


# Cylindrical Anamorphs

- Notice the rays reflecting off the flat mirror - the angle of “entry” is the same as the “exit” angle. If a ray hits the mirror at 20 degrees, it will reflect off the mirror at 20 degrees



- The same property holds on a curved mirror, but the angles are measured against the tangent line to the curve where the ray hits. This means the rays are “scattered”.



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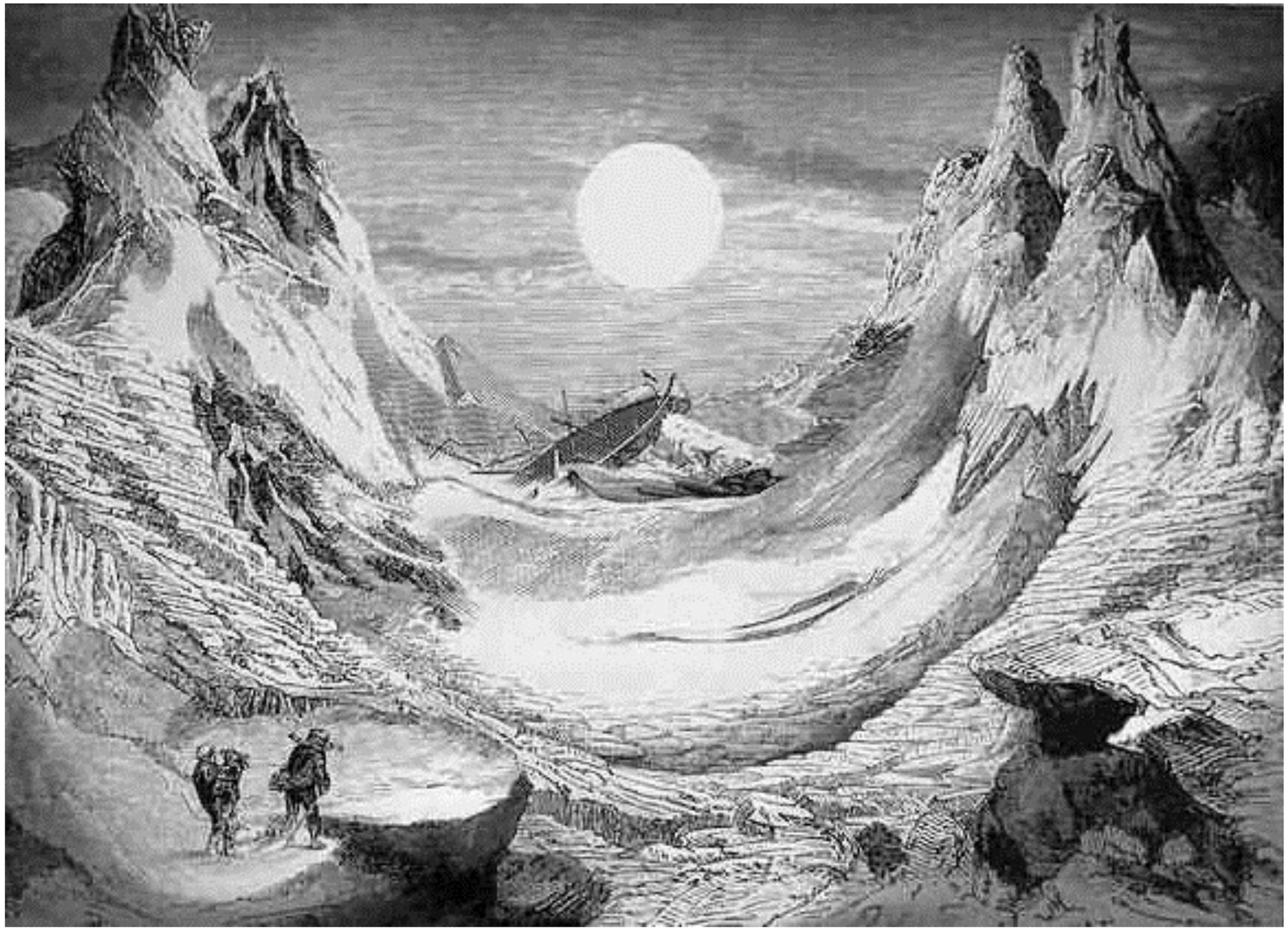

Istvan Orosz, *Mysterious Island*

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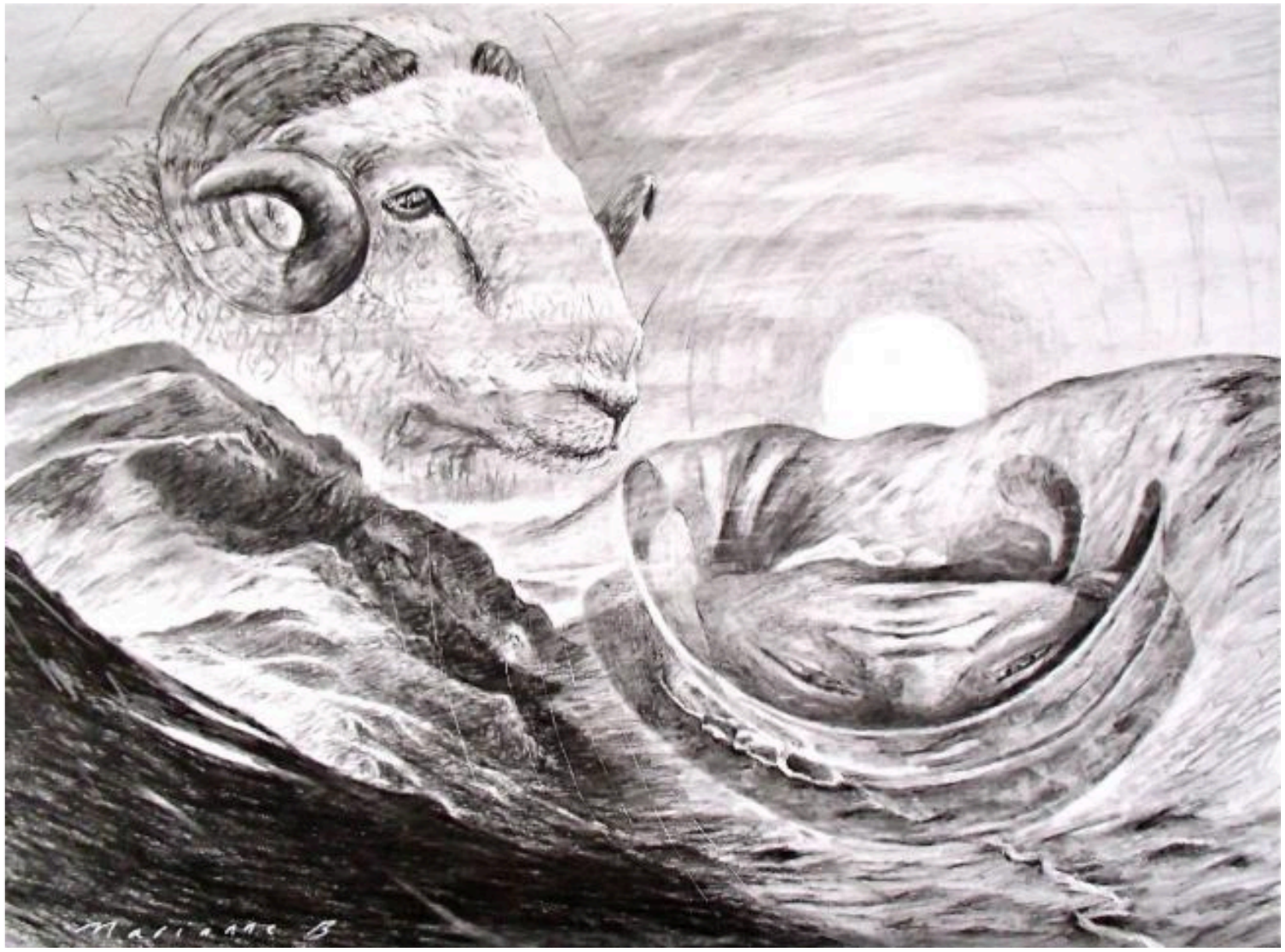


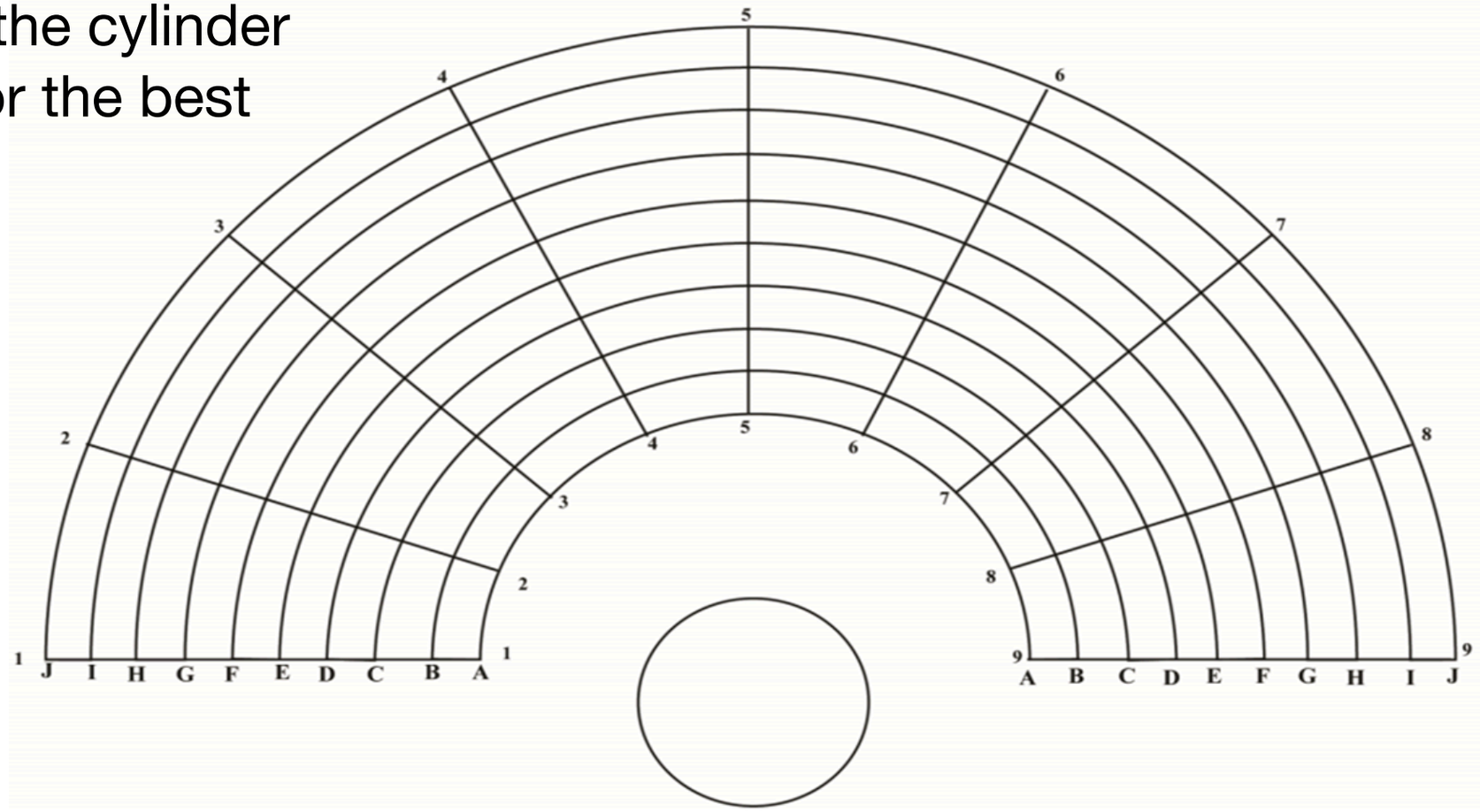
Marianne Birkby, *Potter's Ennerdale*

# How to do it: Cylindrical Anamorphs

- The grid we map to is shaped according to the object we're using as our reflective surface

- For a cylinder, the grid would look something like this

- The circle is where the cylinder should be placed for the best effect



# How to do it: Cylindrical Anamorphs

- However, complicated cylindrical anamorphic art is usually created in a less mathematical way: simply draw while looking at the reflection, rather than the drawing