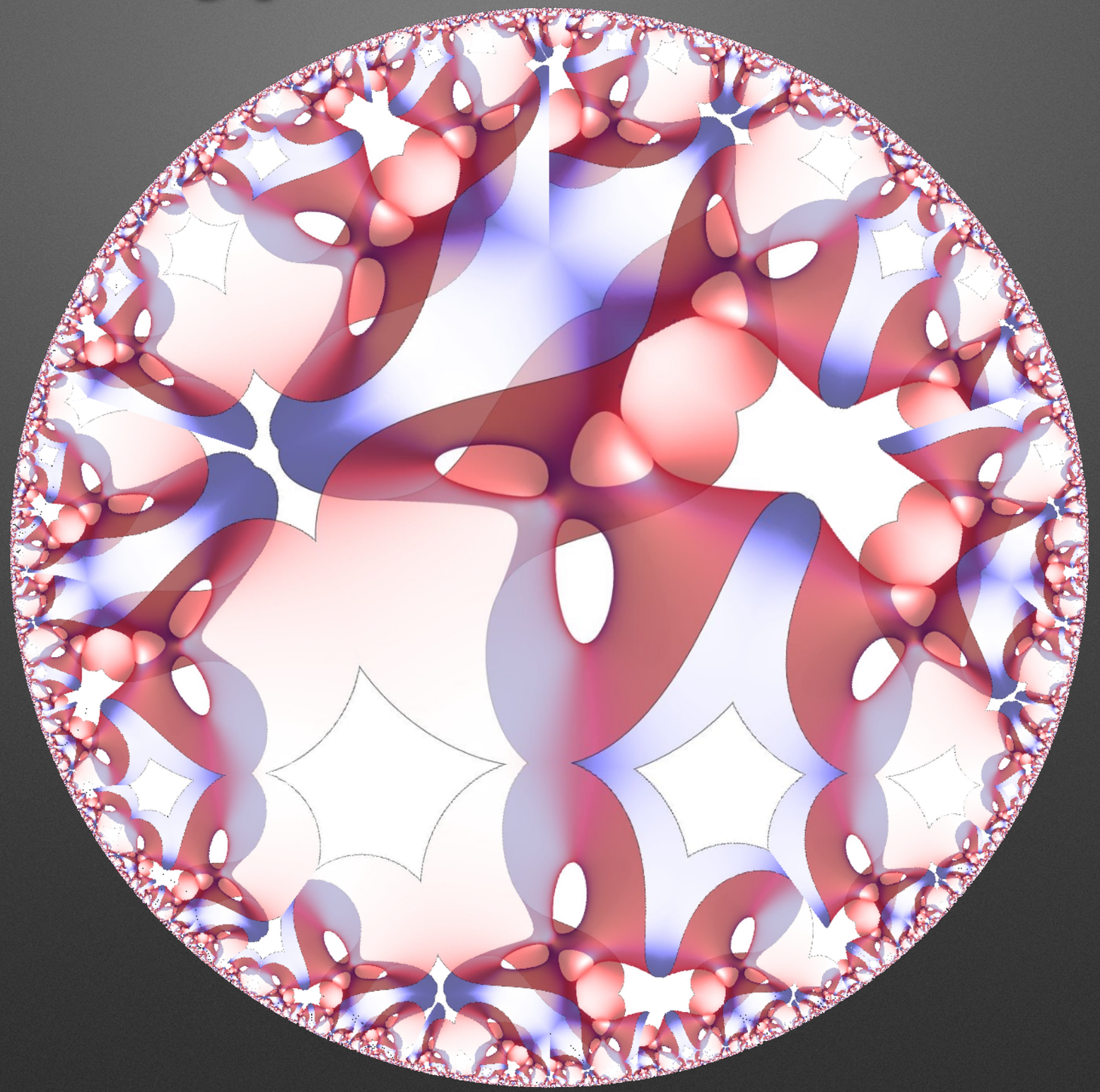
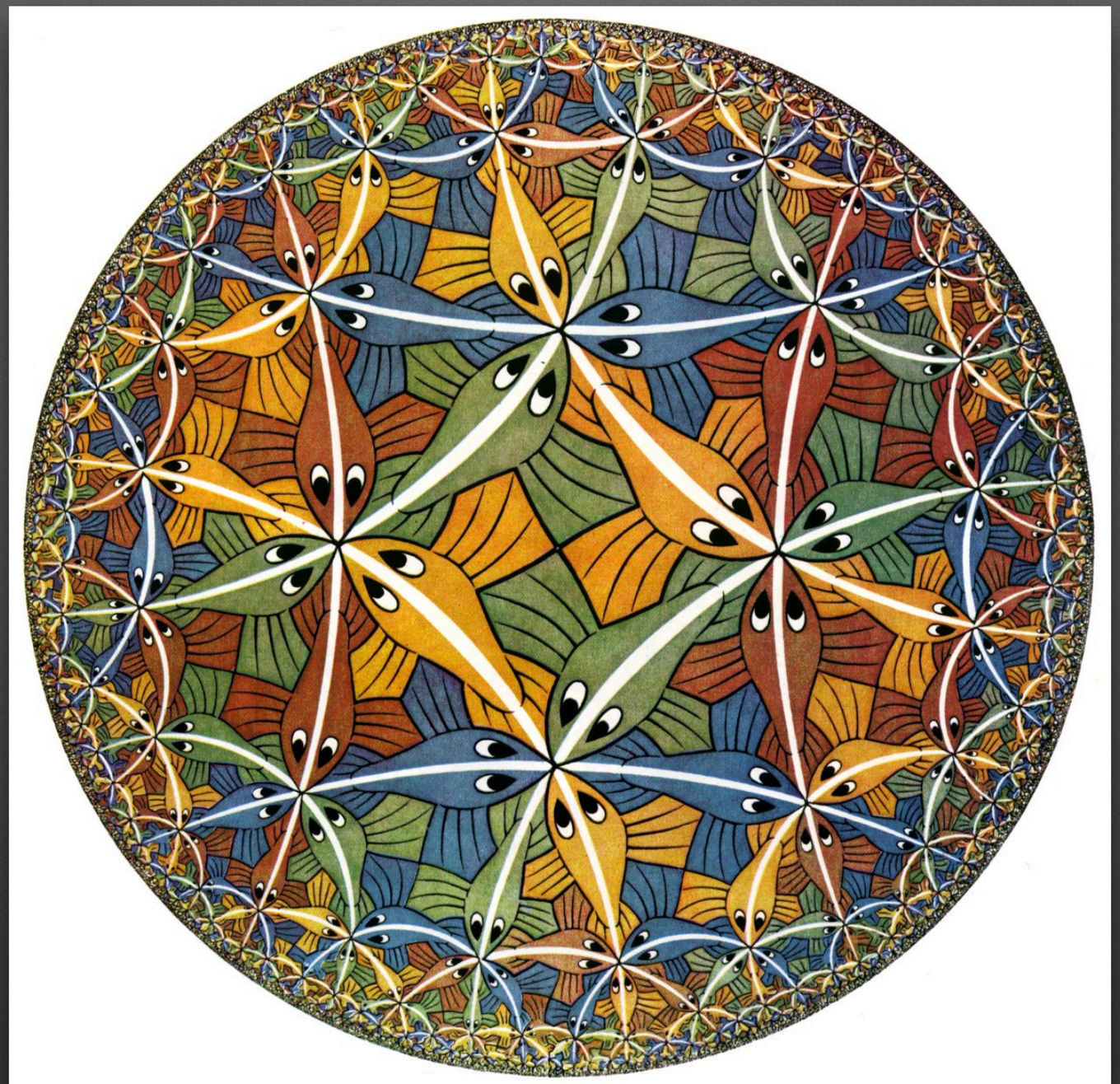
Hyperbolic Art





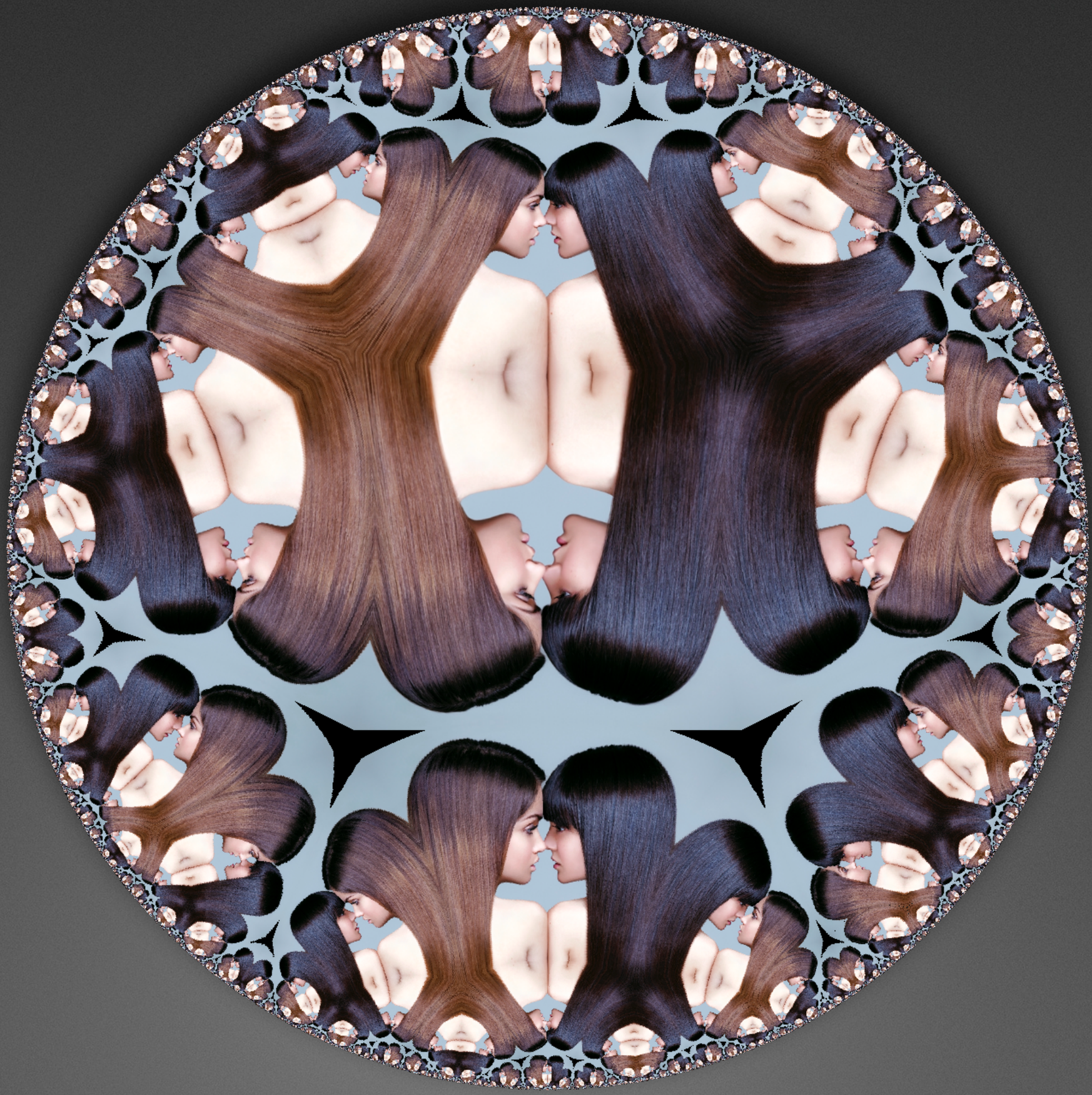
This is “Circle Limit III”

by M.C.Escher

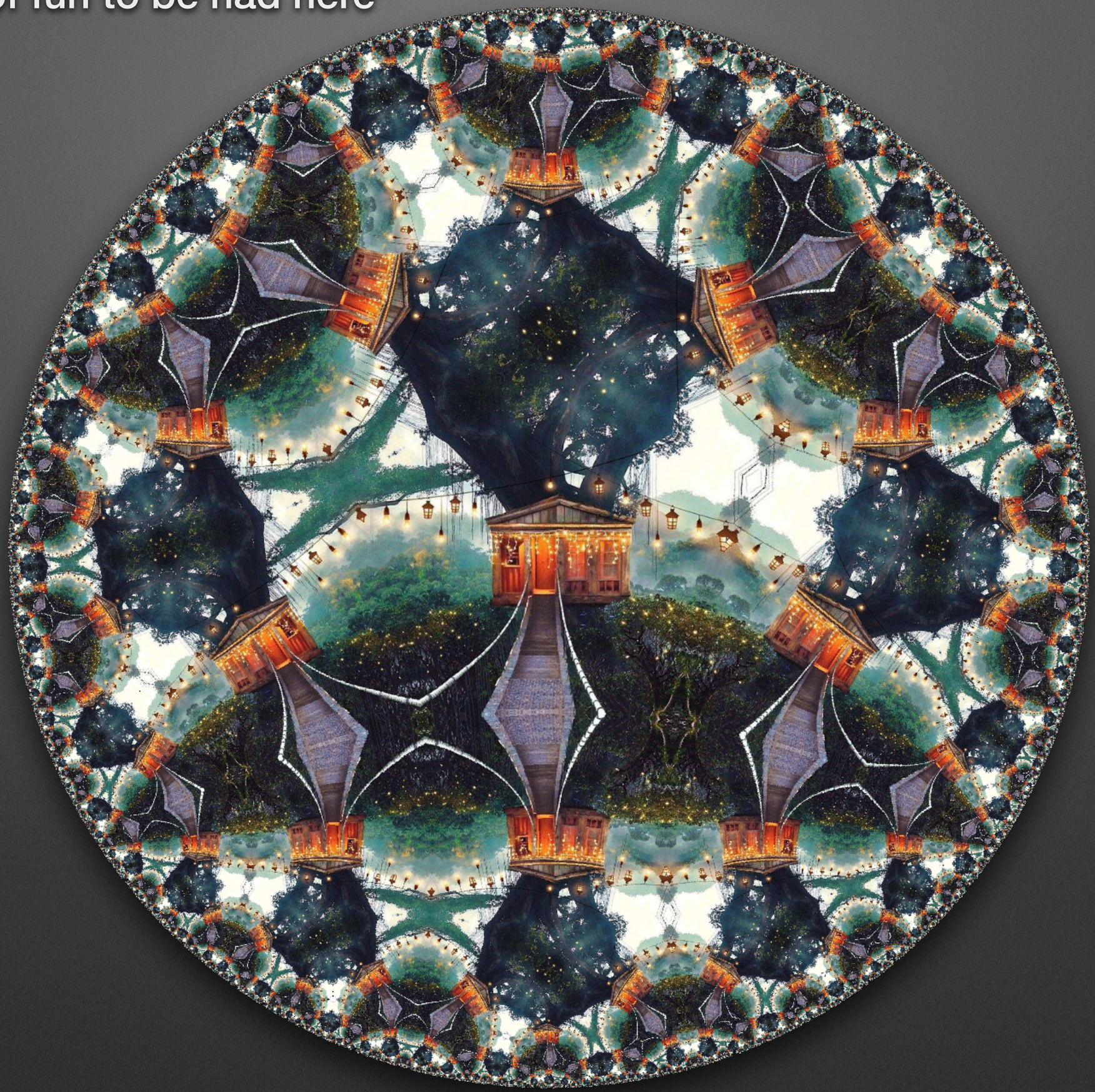
By repurposing other people's images and software…

I created my own pictures along similar lines

This one uses a "snailstag" from a mediaeval manuscript.



There’s a lot of fun to be had here



Beyond showing you pretty pictures…

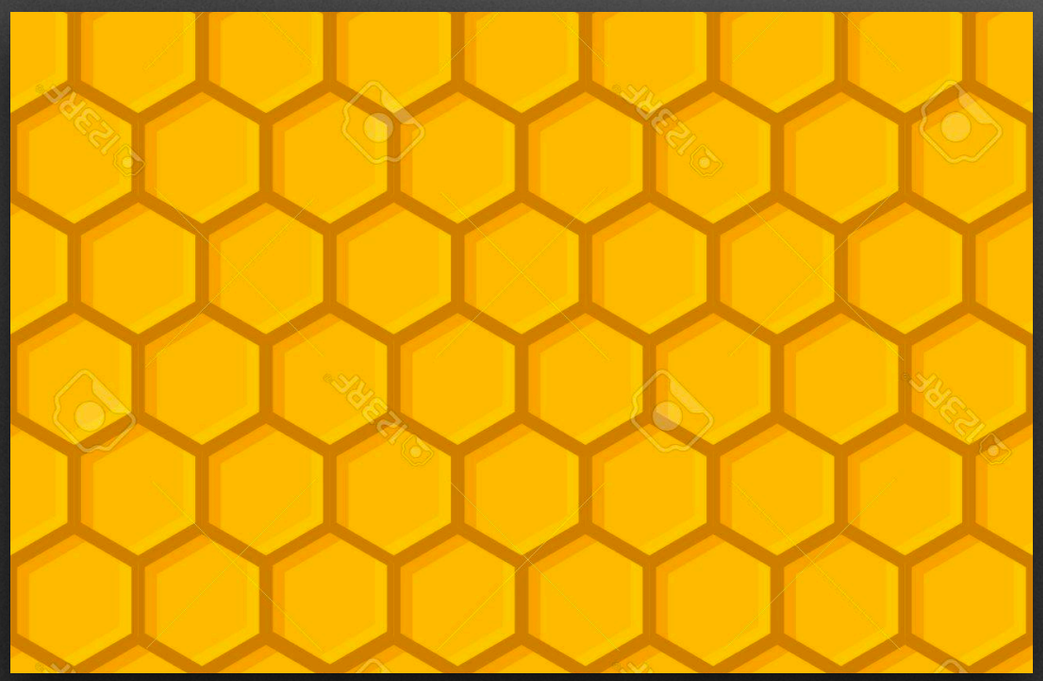
I wanted to talk about the geometry behind these

The images are actually *tilings* on a geometric structure called the *hyperbolic plane*

Much as you might tile your bathroom using ordinary (Euclidean) plane geometry

…and we will come back to Euclid, because substantial violence has been done to him here

You can tile squares and hexagons …



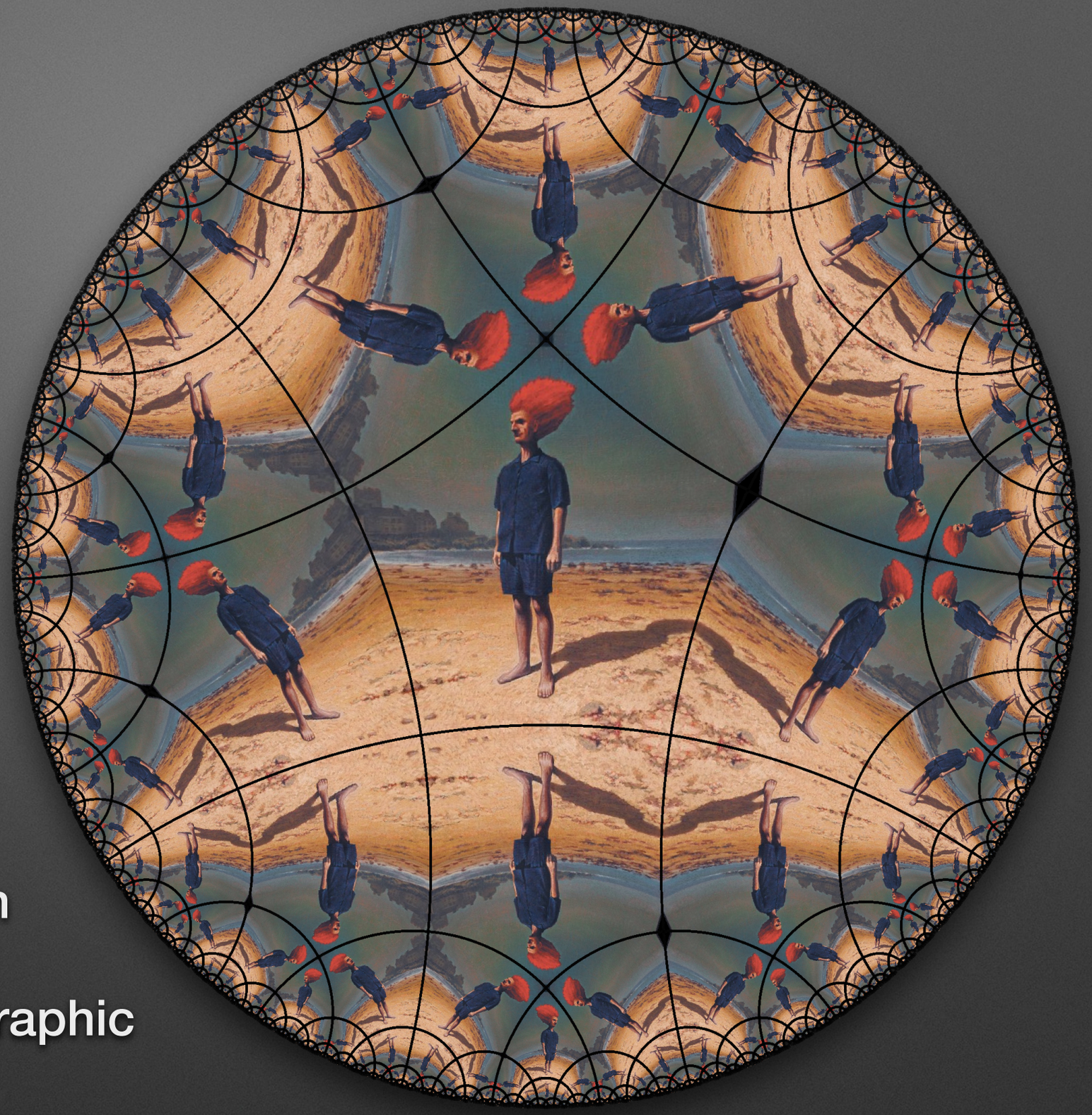
You can’t tile pentagons

But…

What if you did anyway?

In the context of (say) a computer game, we can easily model 5-sided cells (pentagons) and fit them together four at a time, like squares.

Visualising it on the screen is then a small matter of graphic design. And there will be distortion!



What is the hyperbolic plane?

- What “surface” are we modelling here?
- Is it a real place?
- Can I go there on holiday?

Yes. You can play HyperRogue

Geometry, but not as we know it:

- tiling pentagons and heptagons

- the angle sum of a triangle is not 180^{o}

- the circumference of a circle now depends *exponentially* on its radius: a few steps and you're lost

Where is Euclid in all of this?

On the hyperbolic plane, basic laws of geometry have been repealed

The first half of Euclid’s Elements (foundational description of geometry, circa 300BC) is left intact

After that, it’s like we took the Bible and rewrote the New Testament.

More another time. Thank you for attending my TED talk!

THANK YOU