

# Proteus

Proteus, thus large thy privilege was found,  
Thou inmate of the seas, which Earth surround.  
Sometimes a blooming youth you grac'd the shore;  
Oft a fierce lion, or a furious boar:  
With glist'ning spires now seem'd an hissing snake,  
The bold would tremble in his hands to take:  
With horns assum'd a bull; sometimes you prov'd  
A tree by roots, a stone by weight unmov'd:  
Sometimes two wav'ring contraries became,  
Flow'd down in water, or aspir'd in flame.

*Metamorphoses*, Ovid, Book the Eighth, 'The Changes of Proteus'.

Translated by Sir Samuel Garth, John Dryden, et al.

**P**roteus in Greek mythology is a god of water, which is understood as the part of nature that constantly changes. He possesses the knowledge of all things—past, present and future—but he is also very reluctant to use his prophetic gift. When asked to foretell the future, he will try to avoid the answer and escape by changing his form from human to an animal, to an object, plant, to an element, fire or water. Only those who manage to capture him long enough during the shape-shifting process will be given the answer.

Both liquid and solid are the states of a ferrofluid<sup>1</sup> that presents itself in a colloidal form with suspended nanoparticles of metal. Its behaviour depends on many factors such as its own density or the viscosity of a carrier liquid, but it truly comes to life through the invisible force of a magnetic field. Then, it constantly changes its shape, from aggregated dots to meandering stripes, coagulated regions, just like the Greek god Proteus, capable of assuming many forms. Next to the quantifiable factors mentioned above, the dimension of time plays a large role in affecting ferrofluid behaviour. The patterns are not absolute and very much depend on its former states, which introduces the process of movement, evolution and becoming. The impossibility of precise material behaviour control is treated here as an added value in the process of ephemeral and non-repeatable pattern generation. Visual exposure to such a strong graphical pattern is used as an apparatus to understand human intelligence, that of making meaning in a constantly changing flow of images of unpredictable symbolic relations.

*Proteus* explores its varied formal representations, but always stays visible, like a display asking to be looked at. It plays with its own resolution and the format

of a pixel. It started as a discretised screen table consisting of 96 pixels of small Petri dishes filled with ferrofluid, each carrying much richer information than a typical RGB colour or its intensity. Over time it evolved into a continuous display allowing for free liquid flows in a larger vessel. At the same time, the grid-based structure was shifted to ‘magnetic instrument’ stacked in layers underneath, partly hidden. From such a system that mechanically displaces 38 individual static magnets, it moved once again into a densely packed grid of 163 electromagnets carrying electric current through kilometres of copper wire in order to create a magnetic field. The display, with a little light coming from underneath, leaves no shadow, delineating black matter with perfectly sharp edges, almost like a digital image. As such Proteus stands for the hybrid analogue and digital, both low resolution, with a no-end resolution ferrofluid image.

Proteus doesn’t need a crowd or immediate, entertaining friendships, but is also incomplete without human attention. Positioned horizontally with little scenography around, it catches the eye of a few, but very curious ones. For those, it unfolds its full capacity, inviting to a personal visual game with its ferrofluid charm.

The first steps towards understanding the physical behaviour of the ferrofluid phenomenon were aligned with a simple and friendly interaction categorised as ‘pets’ in the *Atlas of the Species of Media Architecture*<sup>2</sup> by Mihye An. Proteus explores a basic form of human intelligence, namely intuition, that allows it to quickly understand the logic driving the interaction. It constantly scans its surroundings and when capturing a person, instantly reflects their image in its display, like a mirror. Its system operates with real-time data



Fig. 1-2 *Proteus 2* exhibited at Ars Electronica Festival "ERROR" (Linz, 2018)

feedback<sup>3</sup> between two spaces—from face tracking camera to electromagnetic instrument. This direct geometrical translation determines the amount of possible configuration, and as such visitors can enjoy their abstract representation travelling on the display as long as they stay around or until they notice rich artefacts of ferro-pixel hidden behind their self-reflection.

Proteus 2.0, for a change, intensifies the interaction. Through an individual and prolonged visual experience, it immerses the visitor into an implicit and intimate journey with the material through a custom, gaze-based, brain-computer interface. A pre-trained dedicated machine learning model is informed by real-time neural signals, produced by the participant's gaze while being exposed to the rapid, and initially random, serial change of patterns. Over a period of about 15 minutes of gazing experience, visitors might witness a certain stabilisation of their own flow of the material compositions. This stabilisation is an event of Proteus' capture, a moment when he speaks out the prophecy and when a lively metal liquid scratching the glass becomes an understandable image. Such communication differs from the former version of the project, where the behaviour was governed by predefined rules. Proteus now is creating his own rules from scratch during the time of each individual viewing experiment. This "chain of metamorphoses"<sup>4</sup> is an iterative process of capturing, creating and negotiating one's own grammar in order to establish this intimate relationship with the matter. The electromagnetic instrument becomes not only a device to transmit conditional information, but rather an information acquisition device that has learnt how we visually differentiate the images, and aligns its generation and

sequencing accordingly. This allows both human and machine intelligences to capture personal meanings and symbols in the endless stream of material information. Change and then stabilisation, hiding and then revealing, chaos and any order that follows are the ultimate goals of Proteus.

Christiane Paul states that for traditional art, the interaction of an audience with the art piece remains strictly a "mental event,"<sup>5</sup> while for many of the interaction artworks, the observer takes an active voice as a "participant." Her view is supported by Ernest Edmonds who confirms that, "the audience's behavioural response to the artwork's activity [is what] matters most,"<sup>6</sup> be that direct manipulation, physical action or bodily gesture. Proteus though, in order to be complete (but not closed), more than a human presence or clearly understood physical response, needs the act of interpretation in the cloud of images that is traced in the neural signal of the participant. Does it open a new means of human participation and new measures of aesthetics in the field of interactive arts? That which goes beyond purely behavioural action and is combined with human perception into one experience?

Or perhaps Proteus enters the world of performance by pulling the 'participant' fully towards the actor side, which recalls the traditional boundaries between performers and an audience in a theatrical sense? What are the entry points for the audience to understand the nature of this intimate and unified system? Or perhaps Proteus is a "work in movement"<sup>7</sup> following the idea of openness introduced by Umberto Eco. He proposes a piece without a fixed conclusion but with the completion coming from the audience's individual interpretation of the piece.





Fig. 3 *Proteus 2.5* during Meta.Morf X-Digital Wild exhibition, Trondheim Biennale for arts and technology 2020, curated by Espen Gangvik

While the question of new, blurred or overlapping definitions and categories of art creations is not uncommon since the development of information and communication technologies, Proteus would rather ask: How do we communicate with the cloud of images that constantly changes? Or what does it mean to build a meaningful interaction conditioned by change in the first place?

\* Proteus is an ongoing project carried out since 2018 by Maria Smigielska and Pierre Cutellic with institutional help from the chair of CAAD, ETH Zürich and Creative Robotics UfG Linz. Additional support has come from Johannes Braumann, Robots in Architecture, KUKA Robotics, Ars Electronica SMC CEE, supermagnete (Proteus 1.0 and 2.0), Trondheim Electronic Arts Center TEKS and Daniel Nikles for fabrication development (Proteus 2.5).

- 1 Ferrofluid was developed in the 1970s as a rocket fuel to operate in non-gravity space.
- 2 Mihye An, 'Coexistence as species' in *Media Architecture and Categories of Spatialization*, PhD Diss ETH 23479, ETHZ, 2016, p. 72
- 3 Bi-directional exchange is essential for the concept of interactivity that includes an action and response from all elements in the system. In the case of an interactive installation, these are artificial physical artwork and human audience as two equal actors in this unified system ("all things that process art data are components of the work of art," Burnham 1969). The concept of feedback comes from cybernetics as part of a loop of outputs and inputs in the system. In version 1.0 of the Proteus project, we are dealing with a large, yet finite amount of possible configurations and choices made in the system.
- 4 Michel Serres, *Genesis*, University of Michigan Press, 1995
- 5 Christine Paul, *Digital Art*, p. 67
- 6 Ernest A. Edmonds, "11 Diversities of Interaction," in *From Fingers to Digits: An Artificial Aesthetic*, MITP, 2019, pp. 223
- 7 Umberto Eco, *The Open Work*, Cambridge, Mass: Harvard University press, 1989