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# TREMBLEY'S POLYP

## THE «ANIMAL-PLANT» THAT CHANGED 18th CENTURY BIOLOGY

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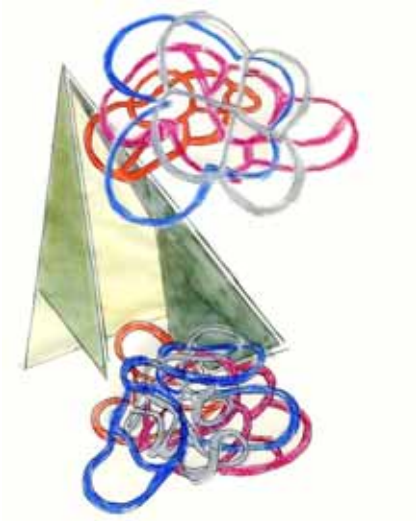
Abraham Trembley's experiments with freshwater hydra not only surprised his contemporaries, but his results also caused a huge stir among the scientific community of his time. Ideas such as «The Great Chain of Being», the mechanism whereby living things were created, or the nature of the soul were strongly shaken.

Keywords: biology, Great Chain of Being, performationism, regeneration, soul, zoology.

In 1740, while out on one of his usual strolls through the fields, Abraham Trembley –a young man from Geneva hired as a tutor in a noble Dutch house– noticed a tiny plant which caught his attention in the water of a pond near the mansion. Upon examining it more carefully, he observed that it was like a gelatinous tongue, with an opening in one end, surrounded by elongated protuberances. What had attracted the young tutor's attention was the fresh-water polyp (*Hydra vulgaris*), already described and classified by Anton van Leeuwenhoek (1632-1723) as a plant back in 1703, a description accepted by the scientific community of the time.

Trembley's curiosity was aroused and, wishing to observe the little creatures further, he collected a few samples in glass jars. It was then that he realized these tiny plants behaved more like animals than plants. He observed them moving with alternating rhythmic contractions and expansions, and they also responded to tactile stimuli, something quite unusual in living beings classified in the plant kingdom. Furthermore, these small polyps, with their tentacle-like protrusions surrounding the mouth-shaped opening at one end, were able to capture small prey and guide them to the mouth-like opening, and ingest them. To discover whether, like plants, the polyp could be reproduced by cuttings, he cut a specimen in half. To his surprise he saw that each piece regenerated a whole polyp. Afterwards he cut polyps transversely, longitudinally and in a different number of parts, each of which always produced a whole new polyp. Finally, in his most daring experiment he turned the polyp inside out by inserting a wire inside and pulling the skin back, just like turning a glove inside out. The polyp again adapted to this new situation and developed an outer surface on what had once been the inner surface (Baker, 1952).



**«TREMBLEY'S POLYP NOT ONLY GAVE RISE TO RIVERS OF INK AND BECOME THE FOCAL POINT OF SCIENTIFIC DISCUSSION, BUT IT ALSO TOOK CENTRE STAGE IN METAPHYSICAL AND THEOLOGICAL DEBATES»**

Trembley, aware of the importance of his experiments, reported what he had observed to René Antoine Ferchault de Réaumur (1683-1757), one of the leading authorities on natural history at that time, who on confirming the former's results did not hesitate to remove the small creature from its place in the plant domain and include it in the animal kingdom. Then in 1741, Trembley sent a sample of polyps to the President of the Royal Society

On the left, Julio Lopez Tornel. *Layers of paper*, 2012. Papier mache and pigments, 18 x 12 x 329 cm. Above, Julio Lopez Tornel. *Untitled* (triptych, fragment), 2012. 29.7 x 42 cm, mixed media on paper.

of London, Martin Folkes (1690-1754), and published six different communications in *Philosophical Transactions* between 1742 and 1747. In 1744, Henry Baker (1698-1774), the famous advocate of the microscope, also published an essay in French on the history of the polyp-insect, while in Germany Rösel Rosenhof von (1705-1759) and Jacob Christian Schäffer (1718-1790) wrote works on the same topic (Moscoso, 2000).

Then rumours about these new discoveries started to spread, and stirred up great interest worldwide. Not only did Trembley's amazing polyp give rise to rivers of ink and become the focus of scientific discussion, but it also took centre stage in metaphysical and theological debates, and went beyond strictly academic bounds to become a recurring theme of conversations, debates and tertulias in the salons where intellectuals met in the largest European cities (Ratcliff, 2004). This topic did not meet with indifference from the great thinkers of the time. Jean Jacques Rousseau (1712-1778), for example, listed polyp regeneration, in his *Discours sur les sciences et les arts*, as one of seven most important unsolved scientific and philosophical issues of the century. Voltaire, however, was unable to accept the polyp's animality and, after repeatedly observing some samples that his friend Du Fay kept in glass vials on the mantelpiece of his study, he wrote: «This production called a "polyp" is much more like a carrot or an asparagus than an animal» (Moscoso, 2000). Meanwhile Denis Diderot (1713-1784) made the protagonist of *Le rêve de D'Alembert* a dream of «human polyps» inhabiting Jupiter and Saturn. Thus this «animal-plant», whose morphology is closer to a plant's than an animal's, but which behaves just like an animal, sparked all kinds of philosophical-theological and botanical-zoological speculation. This was a speculative topic, which guaranteed debate and controversy at a time conducive to high quality discussions, like those marking the Age of Enlightenment (Vartanian, 1950).


Portrait of Trembley in his work *Instructions* (1779), when 67 or 68 years old. The signature is from a letter he wrote to Count Bentinck in 1766.

**«THE POLYP WAS PRESENTED AS THE LONG-SOUGHT MISSING LINK BETWEEN PLANTS AND ANIMALS»**

## THE PERFECT LINK

One of the most immediate consequences of Trembley's discovery was its impact on the idea of the *scala naturae* known as «The Great Chain of Being». According to this idea, all living things can be arranged in a continuous chain or scale, starting with the simplest and continuing through all the animals up to man. This idea of a continuum of living beings played a very important part in the beliefs held by eighteenth century biologists. It provided a framework for their ideas about nature and became the basis of natural systems of classification, while facilitating the development of the idea of gradual evolution and strengthening beliefs in the unity of nature (Lovejoy, 1936; Bynum, 1975). The polyp, with its plant-like morphology but animal-like physiology, was presented as the long-sought missing link between plants and animals, replacing Aristotle's ambiguous zoophytes, which were no longer considered sufficient. The appearance of the polyp on the scientific scene also reinforced beliefs that principles of wholeness and continuity underlay the rational and immutable laws of nature. It also supported those who had already speculated on the existence of such a link, without actually having observed one. In this sense, Gottfried Leibnitz (1646-

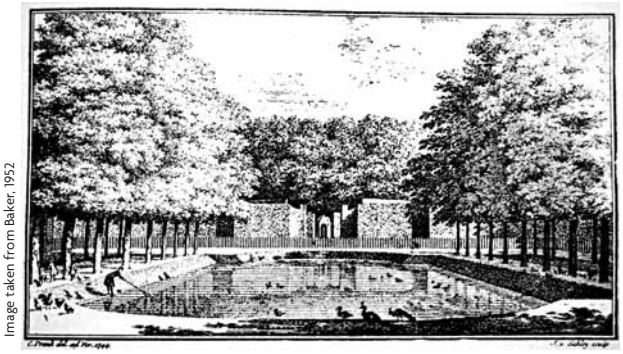


Image taken from Baker, 1952

Trembley fishing for *Daphnia* in a fishpond in Sorgvliet. The naturalist found the polyp in a pond and was highly intrigued.

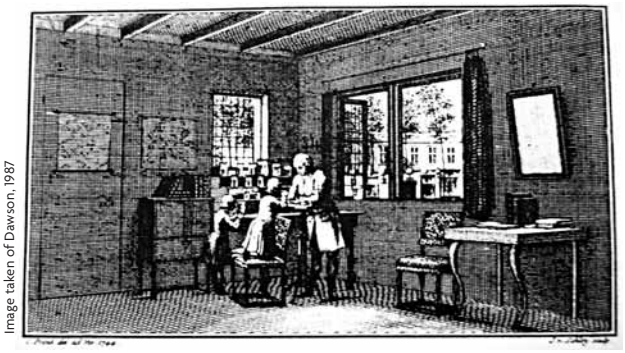


Image taken of Dawson, 1987

Abraham Trembley in his study in Sorgvliet, showing Count Bentinck's two sons the famous experiment in which he turned a polyp inside out. Trembley's glass jars filled with polyps can be seen on the windowsill.

**«TO DISCOVER WHETHER THE POLYP COULD BE REPRODUCED FROM CUTTINGS LIKE A PLANT, HE CHOPPED A SPECIMEN IN HALF. TO HIS ASTONISHMENT HE SAW THAT EACH PIECE REGENERATED A WHOLE POLYP »**

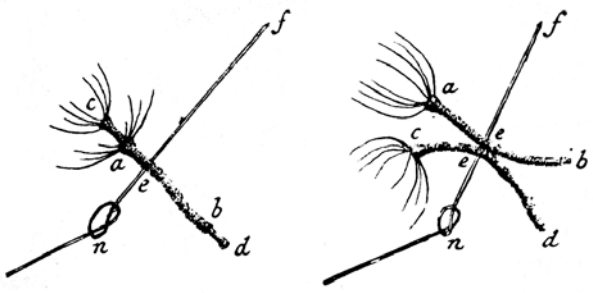



Image taken of Baker, 1952

An unsuccessful attempt to graft two *Hydra vulgaris*. On the left, one polyp is inserted inside another, so that both heads stick out. On the right, the two polyps have managed to separate from one another.

1716), known as the «German Plato», was the one to receive the greatest glory, as a staunch believer in the idea of a continuous and united system, which the polyp now confirmed in a way that was difficult to refute (Carlin, 2000; Dawson, 1987).

This confirmation encouraged the search for new intermediate forms to fill the gaps that remained in the design of such a chain, revealing a line with some unresolved discontinuities. Bold Charles Bonnet (1720-1793) dared to predict a future finding that would unite minerals, apparently dead matter, with the living. He claimed that:

> Nature seems to make a great leap in passing from the vegetable to the fossil [i.e., rock]; there are no bonds, no links known to us, which unite the vegetable with the mineral kingdom. But shall we judge of the chain of beings by our current knowledge? Because we discover some interruptions, some gaps in it here and there, shall we conclude that these gaps are real? [...] The gap that we find between the vegetable and the mineral, will apparently someday be filled up. There was a similar gap between the animal and the vegetable; the polyp has come to fill it and to demonstrate the admirable gradation there is between all beings.
>
> LOVEJOY, 1936: 245

## GENERATION AND REGENERATION

The fact that the polyp could regenerate not only missing parts, but a whole animal, led naturalists to consider regeneration as another form of generation. In this sense, the polyp further transgressed Aristotelian law whereby generation occurred only as a result of the two sexes mating. It was another case of asexual reproduction, adding to Charles Bonnet's discovery, in 1740, of parthenogenesis in aphids, and thus it reinforced the idea that the «double seed» was unnecessary for reproduction. The reproduction of the polyp was presented, therefore, as a counterexample to any generation theory that claimed embryo formation depended upon sex. This indirectly justified the idea of pre-existence, a theory holding that miniature individuals were pre-formed in the germ seed, an idea defended by Bonnet himself, who thought the polyp's body was composed «by the endless repetition of small polyps that were just waiting for favourable circumstances to develop» (Moscoso, 1995).

Nonetheless, the most surprising thing about the polyp was that reproduction took place by bipartition. That made it a remarkable animal, which did not follow the established pattern of natural processes, thus threatening not only the *status quo* in which God was creator, but also calling into question naturalists'

consensus on the principles defining a biological unit. This threat, however, came to nothing, as naturalists convinced of the immutability of natural laws began a frantic race to find any worm-like «bug» that responded similarly to the polyp on being subjected to the same experiments. Even before the publication of the sixth volume of Réaumur's *Memoirs to Serve the Natural History of the Insects* in1743, where Trembley's discovery was officially inaugurated, any animal suspected of some similarity with the polyp was subjected to vivisection. Lizards, frogs, worms, snakes, butterflies, grasshoppers and crayfish were the main victims to succumb to the knives of a legion of naturalists, stubbornly set to end the polyp's uniqueness by finding new cases of similar reproductive behaviour (Moscoso, 2000).

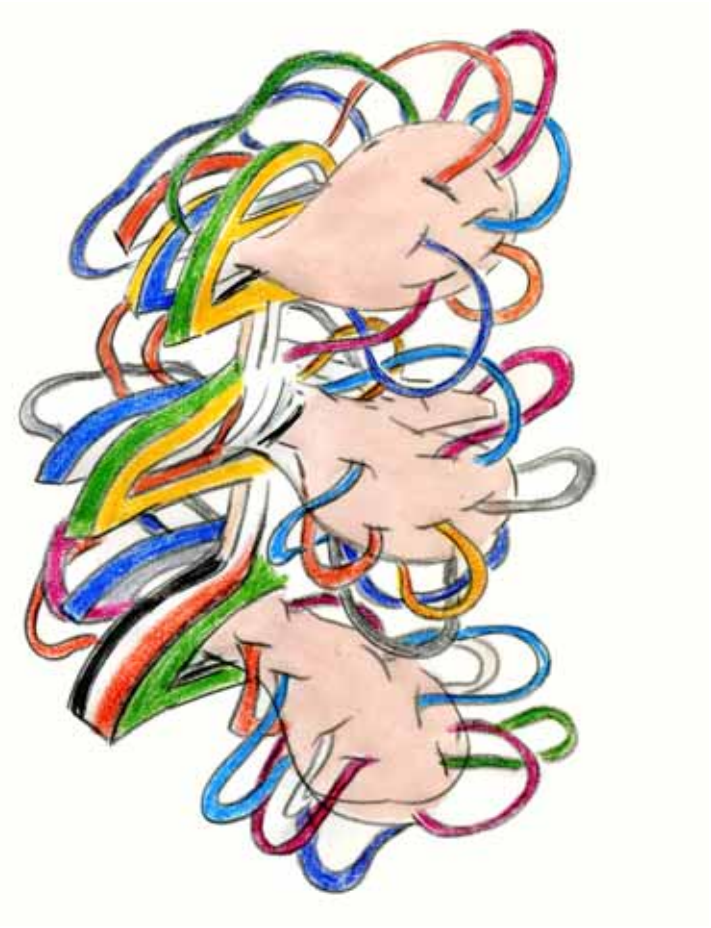
This resolve not to allow any natural phenomenon to remain unique, but to reduce everything to universal principles, led to the improper –or at least daring– use of analogical reasoning. In this sense, Voltaire mockingly stated that he hoped men would someday master the regeneration process to the point of being able to replace their own heads, a change that for many people «could hardly be for the worse». And in the same vein, John T. Needham attempted to explain the creation of Eve from Adam's rib by the «*manière du polype*»:

> The body of the first woman was not formed from the earth, like the body of her husband, but she was rather generated from him through an accelerated vegetative process, nourishing on his substance during his sleep until she separated in a state of perfection, like what is observed among the young polyps and organized bodies of the same kind.
>
> Moscoso, 1995: 368

In a way, it was understood that the way the polyp regenerated proved that matter was dynamic and not just passive. Its plasticity, which had been demonstrated by the deliberate production of monsters –indeed Trembley had managed to generate seven-headed polyps–, showed that life depended not only on the organization and distribution of parts. This concept together with the idea that the regenerated structure seemed to recognize the moment at which it should regenerate, led to the belief that matter either possessed some kind of consciousness, or acted intelligently albeit unknowingly. These ideas fired up the debate about the existence and attributes of the animal soul.

## THE POLYP'S SOUL

Thus, an important philosophical dilemma arose. If every part of an animal could regenerate the whole animal, then where was its «soul» or its organizing principle? Naturalists had long been aware of the ability of crayfish and salamanders to regenerate lost parts, but in these cases the severed parts died. It had been assumed that the organizing principle was not in the severed claw or tail, but in the animal from which it came. In the case of the polyp, however, each part regenerated and therefore must hold the power and way necessary to reproduce the whole. For Julien Offray de La Mettrie (1709-1751) and Denis Diderot, the polyp experiments demonstrated there was no soul, and that the properties of life were widespread throughout matter. It was a useful argument for a philosopher advocating materialism and atheism, but it did not



Julio López Tornel. *Untitled* (triptych, fragment), 2012. 29.7 x 42 cm, mixed media on paper.

**«THE POLYP FURTHER TRANSGRESSED ARISTOTELIAN LAW WHEREBY GENERATION OCCURRED ONLY AS A RESULT OF THE TWO SEXES MATING»**

Julio López Tornel. *Untitled* (triptych, fragment), 2012. 29.7 x 42 cm, mixed media on paper.

**«THE WAY THE POLYP REGENERATED WAS THOUGHT TO PROVE THAT MATTER WAS DYNAMIC AND NOT JUST PASSIVE»**

help physiologists because it did not shed light on how this life was distributed (Vartanian, 1950). The most plausible answer was that entertaining the idea of the soul's divisibility, an explanation that totally conflicted with ecclesiastical assumptions, forcing naturalists to tiptoe around issue.

Science dodged providing an official response: the question, when formulated, was considered simply as an intractable problem. Réaumur, for example, considered it without taking sides. The same attitude is to be found in the works of Henry Baker, Pierre Lyonnet (1708-1789) or Louis Moreau de Maupertuis (1698-1759). Indeed, Trembley himself made no allusion to the subject.

Not only did divisibility of the soul pose a theological problem, but it also put to the test the physical or physiological difficulty to explain the regenerative movement of a body part that was no longer connected to its alleged immaterial principle of movement. Naturalists speculated long and hard to find an explanation that would fit with the current paradigm and not transgress the preconceived bounds that authority called for. In 1741, Charles Bonnet, for example, driven by his uniformitarian preconception, began to study other animals that might share the same regenerative capacity as the «insect discovered by Trembley». The conclusions reached were framed within the idea that regenerative movement was not governed by an inviolable principle, but rather was due to the processes of animal automatism advocated by Cartesianism-like mechanisms (whereby the mind is wholly separate from the corporeal body). This conclusion got around the theological problem of the soul's divisibility, but did not quite explain the phenomenon with respect to the interaction between matter and motion (Moscoso, 2000).

In short, although the uniqueness of the polyp confirmed the predictions of the *scala naturae*, and was welcomed as the missing link, it was also distorted by pre-existence theory, skilfully avoided by speculative arguments, like those of Charles Bonnet. An explanatory «achievement» that did not share the same scenario for nature and the properties of the animal soul. A question that was left without a conclusive answer, ratifying the saying that what cannot be spoken about, is better left alone.

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