



Analogies of the Freshwater Polyp in Eighteenth-Century Humanist Philosophy & Literature

Citation

Chen, C. Elaine. 2026. Analogies of the Freshwater Polyp in Eighteenth-Century Humanist Philosophy & Literature. Doctoral Dissertation, Harvard University Graduate School of Arts and Sciences.

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Analogies of the Freshwater Polyp in Eighteenth-Century Humanist Philosophy & Literature

A dissertation presented

by

C. Elaine Chen

to

The Department of Germanic Languages and Literatures

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

Germanic Languages and Literatures

Harvard University

Cambridge, Massachusetts

May 2026

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Analogies of the Freshwater Polyp in Eighteenth-Century Humanist Philosophy & Literature

Abstract

This dissertation examines the analogy of the freshwater polyp in late-eighteenth century reflections on the forms and formation of life across the disciplines of science, philosophy, and literature. After discovering the creature in 1740, the Swiss naturalist Abraham Trembley (1710–1784) engaged in a years-long project to observe and describe this centimeter-long cnidarian. The polyp puzzled Trembley and eventually the broader European scientific community because it possessed the remarkable ability to reproduce both sexually and asexually and to regenerate any severed part of its body. Within a matter of years, Trembley’s discovery set off energetic debate not just in the emergent field of biology, but also in metaphysics, moral philosophy, anthropology, and aesthetics.

Vital materialists like Denis Diderot (1713–1784) viewed the animal’s seemingly infinite regenerative capacity as evidence that the organization of nature was not fixed—that a polyp, a goat, or an elephant could become human, or vice versa. The German response was ambivalent. Conservative theologians rejected this extreme materialism because it undermined their view that nature operated according to an internally coherent rational plan. Progressive philosophers and anthropologists, however, endorsed the idea that a capacity for change and transformation must be encoded within that plan. In the works of Johann Friedrich Blumenbach (1752–1840), Friedrich Schiller (1759–1805), and Carl Friedrich Kielmeyer (1765–1844), the polyp became a byword for *Bildung*—organismic change oriented toward the telos of nature—and the foundation

of what this dissertation terms polyp-humanism: the conviction that the human being's capacity for moral and cultural self-transformation is not a triumph over nature but an expression of it. The final part of the dissertation considers Johann Wolfgang von Goethe (1749–1832) as a literary inheritor of this tradition, tracing the diffusion of polyp-humanist ideas into his morphological writings and his novel *Wilhelm Meisters Lehrjahre* (1795/96). As the project demonstrates, over the course of a few decades, a seemingly modest creature came to bear the weight of the Enlightenment dream that the human being could become the architect of a future aesthetic-moral order—not just as an aspiration, but as a law encoded in the very material of life.

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Acknowledgments

Writing this dissertation has been one of the most significant experiences of my life, and it would not have been possible without the support of my mentors, colleagues, friends, and family. I am lucky to be surrounded by such kind, generous, and clever people. Some have donated their time and expertise, others have shared laughter and wisdom with me, all have made indispensable contributions to my development as a scholar and a human being.

Thank you, first, to my committee, who helped me transform this project from an idea into a book. Nicole Sütterlin, you have supported me since my first semester at Harvard; thank you for encouraging me to balance creative interpretation with genuine engagement with the scholarly canon. Daniel Carranza, your seminars on the Ecological Imagination and on Goethe were essential to the early development of these ideas. Your ability to look at an unwieldy mass of prose and find the coherent argument inside it has been a gift. John Hamilton, I am so grateful for your erudition and generosity: you read drafts within a day, sometimes within hours, and in your comments and our conversations I always felt that you were thinking with me rather than at me. You encouraged me to let this project to develop organically—very much in the spirit of polyp-thinking.

Several people have contributed to the genesis of this manuscript in other crucial ways. I am thankful to Seán Allan at the University of St. Andrews and Christian Moser at the University of Bonn for organizing the workshop “Reimagining the Modern Public Sphere, 1800–2000” (2022) where I first presented parts of the section on Schiller and the *Ästhetische Briefe*. Thank you, also, to the organizers of the conference “Republic of Letters: The Scholar and Scholarly Communities from Petrarch to the Present” (2025), where I was able to present a version of the interpretation of Mignon’s egg dance in Chapter 6. Finally, I would like to thank

Christoph Dupré in the Department of Molecular and Cell Biology at Harvard University, for sharing your expertise in the modern scientific landscape of polyp-research with me, as well as giving me a hydra of my own to take home.

I am so thankful to Professor Jeffrey L. High, my former advisor in the German Master's Program at California State University, Long Beach. You opened my eyes to the wonders of eighteenth-century literature and philosophy. Thank you for recognizing the academic potential in me and encouraging me to pursue this wonderful life.

I owe so much to my friends, who have helped me to stay motivated throughout my work on this project. Rebecca Stewart-Gray, you have been the Schiller to my Goethe for fourteen years. Glen Stewart-Gray and Luke Beller, I feel so lucky to have two such philosophers as friends. To Rebecca Balfour-McDonald and Jo Donovan, I will always cherish our friendship and the times we spent interpreting pop songs over coffee. And I owe so much to Peter Corti, Anna Hennigan, Natalie Martz, Siddharth Nizammudin, and Sarah-Jane Ripa, who not only have all been fantastic friends to me, but also contributed to the dissertation by helping me read through the final manuscript.

There are also so many people at Harvard who made my time as a graduate student special. Thank you to my friends and team-mates from the Graduate Student Resident Halls for giving me a home away from home—especially our fearless leaders Ashley Skipwith, Mari Lentz-Köker, and Becky Song-ngam. I'm also so thankful for my friends and colleagues in the Department of Germanic Languages and Literatures, Conor Bulkeley-Krane, Mercer Greenwald, Catherine Le, Philip Liston-Kraft, Rachael Petersen, Therese Shire, Riley Spieler, Max Street, and Siting Yang.

I owe so much to my parents Patricia and Kenny Chen, and to my sister and brother-in-law, Evelyn Chen and Radu Smarandoiu. You planted a love of literature in me that over time has bloomed into a vocation. Thank you for always believing in me and supporting me in getting the best education possible. I love you all.

And to my dear fiancé, Robert Huben: you are so positive and kind, whenever I doubt myself you cheer me back up, and when I feel confident, you celebrate with me. I will save the rest for our wedding vows.

*To my friends and family—
you mean everything to me.*

Wunder stehn mit naturgesetzlichen Wirkungen in
Wechsel: sie beschränken einander gegenseitig, und
machen zusammen ein Ganzes aus. Sie sind
vereinigt, indem sie sich gegenseitig aufheben. Kein
Wunder ohne Naturbegebenheit und umgekehrt.

Novalis,
Blüthenstaubfragmente (1797/1798)

Introduction

[...] In diesem holden Ort' und schönen Lust-Revier
Erblickt' ich einen Ameis-Haufen.
Ich sah Verwund'rungs-voll dies kleine Tier,
Mit unverdross'nem Fleiß und eifriger Begier,
Sich stets bewegen, rennen, laufen.
Es eilte sonder Ruh', und hatte keine Zeit,
Die ungemeine Pracht, die holde Zierlichkeit,
Veränd'rung, Farben, Glanz, Schmuck, Ordnung, Seltenheit
Des Gartens anzusehn. Ach! rief ich überlaut:
Du scheinst, wie sehr mir auch vor der Vergleichung graut
Uns zum belehrenden Exempel vorgestell't.
Die Ameis' ist der Mensch, der Garten ist die Welt.

Barthold Heinrich Brockes,
"Die Ameise" (1727)

1. An Ant in a Garden of Wonders

How often do we humans consider small things only as a result of, or with reference to, an encounter with something grand! In the baroque poem "Die Ameise" (The Ant) by Barthold Heinrich Brockes (1680–1747), the speaker enters a delightful pleasure garden filled with precious things: golden apples, ripe pomegranates, and every sort of tree. He marvels at all of the wonders of nature gathered together on this little plot. But then the speaker notices an anthill that does not seem to fit its surroundings. He remarks with dismay that the hardworking ants can spare no time to appreciate the wonderful things around them: "Die ungemeine Pracht, die holde Zierlichkeit, / Veränd'rung, Farben, Glanz, Schmuck, Ordnung, Seltenheit / Des Gartens [...]."¹ All of this is lost on the ants, who work and toil only to live without any pleasure in the beauty that surrounds them.

¹ Barthold Heinrich Brockes, "Die Ameise," in *Irdisches Vergnügen in Gott, bestehend in Physicalisch- und Moralischen Gedichten* (Hamburg: Joh. Christoph Kießner, 1727), 2:45.

Brockes employs the ants as a metaphor for human beings, likewise blind to the beauty of “die Welt.” Both the ant and the human are guilty of what Brockes terms in another poem an “Unverantwortliche Unempfindlichkeit,”—an “irresponsible insensitivity.”² One ought to be able to delight—“sich ergötzen”—in the presence of natural beauty. That is, after all, why the senses are the subject of many of the poems in the series *Irdisches Vergnügen in Gott* (Earthly Pleasure in God, 1721–1748), in which “Die Ameise” appears. The splendor of God’s creation is so great that it ought to overwhelm the senses. Yet humans, like ants, often neglect that beauty in favor of business and utility.

On the other hand, is not the speaker in “Die Ameise” guilty, too, of an “unverantwortliche Unempfindlichkeit”? After all, he enters the garden in order to revel in the new growth of spring, the glorious works of his God, and only after admiring the lushness of the garden does his gaze settle on the anthill, the small and unfeeling creatures set apart from this larger world. In the ants, he does not find the same elegance that he sees reflected in the fruit trees that surround them, but only “Fleiß” and “Begier.” Compared with the marvelous products of springtime, these are but *mere ants*. And, ironically, just as nature in the world of the ant is reduced to a resource, to its bare utility, the ants themselves are viewed by the speaker not as curious and unique manifestations of God’s splendor in their own right but rather are put to work, doubly, as symbols of human hardness toward the beauty and richness of nature. Brockes views the ants as a means to a poetic-theological end.

The purpose of this reading of Brockes is not to criticize the author or his epoch for the oversight. It would be an act of postmodern arrogance to suggest that, in the age of the

² Barthold Heinrich Brockes, “Unverantwortliche Unempfindlichkeit der Menschen, über entferntes Unglück,” in *Irdisches Vergnügen in Gott, bestehend in Physicalisch- und Moralischen Gedichten*, 2nd ed. (Hamburg: König und Richter, 1735), 4:291.

Anthropocene, the humans of the twenty-first century know any better than those of the eighteenth about the value of life, great or small. Rather, the purpose is to play a friendly trick on Brockes—or his speaker at least—and to transform him, the human being, into the ant in the garden, not of wonder, but of wondering about small things. For this dissertation is not, after all, an analysis of Brockes and his poetry but focuses instead on the contribution that small things make to the development of human culture.

In the reading above, then, Brockes’ “Die Ameise” is invoked as a *negative analogy*³ for the thought structures that occupy the subsequent pages of this dissertation. Whereas the speaker simultaneously engages in and critiques human oversight, the following pages are dedicated to a period of great attention and attentiveness to one small creature in particular, the freshwater polyp. Specifically, this dissertation is about the *positive analogies* between the polyp and the human being that eighteenth-century scientists, philosophers, and artists invoked in their writings about the natural inclination toward progressive change and flourishing inherent to all creation. For, by the end of the century, the polyp-human analogy would come to represent not the shortcomings of the human animal—as is the case in Brockes’ poem—but rather its ability to transform the very conditions of its existence in service of a progressive goal.

2. Scholarship on Trembley and Polyp-Science

The freshwater polyp, today known as the hydra, was first described by Antonie van Leeuwenhoek (1632–1723) in a letter to the Royal Society: the Dutch naturalist shared his observations of an “animalcule” that lived in slow-moving freshwater rivers, creeks, and ditches

³ In the philosophy of analogy, a negative analogy describes attributes that the objects being compared do not share.

and was able to reproduce by sprouting from its side an apparently identical copy of itself.⁴ These initial observations went largely unnoticed, so that for forty years, much of the European scientific community knew nothing of the existence of this odd little animal. Then, in the summer of 1740, the Genevan naturalist Abraham Trembley (1710–1784) discovered the animal for a second time. Trembley was amazed by the animal’s ability to reproduce asexually—that very same year, Charles Bonnet (1720–1793) had proven that aphids could reproduce without sexual intercourse.⁵ Even more incredible was the fact that the polyps could be cut into pieces, turned inside out, grafted onto each other—in short, they could survive all manner of outlandish operations and would not only recover but regenerate whatever body-part had been severed. The news of this discovery quickly spread throughout Europe, inspiring heated debate and a spate of new discoveries and theories regarding the material conditions of nature. As news spread, talk of the polyp disseminated into other spheres—into theological, philosophical, and literary discourse—so that by the end of the eighteenth century, the polyp had become not just a novel creature, but a fixture of common knowledge, featured in magazines, encyclopedias, and educational literature alike.

In the two centuries since Trembley published his 1744 monograph *Mémoires pour servir à l’histoire d’un genre de polypes d’eau douce, à bras en forme de cornes* (*Memoirs Concerning the Natural History of a Type of Freshwater Polyp with Arms Shaped Like Horns*), the hydra’s

⁴ These “daughter” polyps are indeed genetically identical to the parent. Antonie van Leeuwenhoek, “Part of a Letter from Mr. Antony van Leeuwenhoek, F.R.S. Concerning Green Weeds Growing in Water, and Some Animalcula Found about Them,” *Philosophical Transactions of the Royal Society* 23 (1702/1703): 1304–1311. Subsequent citations as “Part of a Letter from Mr. Antony van Leeuwenhoek” with page number(s).

⁵ See Virginia P. Dawson, *Nature’s Enigma: The Problem of the Polyp in the Letters of Bonnet, Trembley, and Réaumur* (Philadelphia: American Philosophical Society, 1987). Subsequent citations as “*Nature’s Enigma*” with page number(s).

marvelous regenerative abilities have continued to attract the attention of researchers in the life sciences, especially in evolutionary biology and medicine, where they have functioned as a kind of model animal. However, until the middle of the twentieth century, Trembley and his polyps' importance for modern European intellectual history remained relatively hidden. Then, in 1950, Aram Vartanian published a study on Trembley and the polyp, which reintroduced the scientist, the scientific object, and their mutual significance for Enlightenment thought to contemporary scholars.⁶ In 1986, two hydra researchers at the University of California, Irvine, Sylvia and Howard Lenhoff, published a modern translation of Trembley's *Mémoires*, including an extensive introduction outlining Trembley's contributions to biology and methods of scientific experimentation broadly.⁷ In 1987, Virginia P. Dawson published her influential monograph on the correspondence between Trembley and Bonnet during their year of discovery. These scholarly contributions helped to revive interest in polyps beyond STEM fields, particularly in philosophy and the history of science. Thus, by the early twenty-first century, much of the early phase of this history—from 1740 to approximately 1760—has received substantial scholarly attention.

This extensive body of work has focused, for the most part, on the influence of Trembley's discoveries and methodologies on Francophone materialism in the mid-eighteenth

⁶ Aram Vartanian, "Trembley's Polyp, La Mettrie, and Eighteenth-Century French Materialism," *Journal of the History of Ideas* 11, no. 3 (1950): 259–286.

⁷ See Howard M. Lenhoff et al., *Hydra and the Birth of Experimental Biology, 1744; Abraham Trembley's Mémoires Concerning the Polyps* (Pacific Grove, CA: Boxwood Press, 1986). Subsequent citations of *Hydra and the Birth of Experimental Biology* as "Hydra" with part and page number(s). See also: Howard M. Lenhoff and Sylvia G. Lenhoff, "Trembley's Polyps," *Scientific American* 258, no. 4 (1988): 108–113; Howard M. Lenhoff and Sylvia G. Lenhoff, "Challenge to the Specialist: Abraham Trembley's Approach to Research on the Organism—1744 and Today," *American Zoologist* 29, no. 3 (1989): 1105–1117.

century. For example, May Spangler has discussed the function of the polyp in Denis Diderot's (1713–1784) conception of the relationship between consciousness and matter.⁸ Similarly, Erita Hill considers the image of the polyp in Diderot's "Le Rêve de d'Alembert" ("D'Alembert's Dream," 1769/1782) in light of early-modern ideas about monsters and monstrosity.⁹ In addition to focusing mainly on Francophone authors, these works tend to cleave closely to the conceptual framework of the history of science or intellectual history. Discussions of how images of and ideas about the freshwater polyp influenced culture in general remain somewhat underrepresented.

Some more recent scholarship broadens the scope of consideration beyond the world of Francophone science and metaphysics circa 1760. One chapter in Janelle A. Schwartz's monograph *Worm Work* of 2012, for example, reads Trembley's experiments with polyps in light of the development of Romantic science at the end of the eighteenth century. The 2013 dissertation by Nick Treuherz, "The Reception of French Materialism in Enlightenment Germany, 1739–1789," briefly discusses the animal's importance for the development of French materialism, though it does not delve into German responses to Trembley's discovery.¹⁰ Similarly, shorter essays on Christian Wolff (1679–1754), Immanuel Kant (1724 – 1804),

⁸ May Spangler, "Science, philosophie et littérature: le polype de Diderot," *Recherches sur Diderot et sur l'Encyclopédie* 23, no. 1 (1997): 89–107.

⁹ Erita Hill, "Materialism and Monsters in 'Le Rêve de d'Alembert,'" *Diderot Studies* 10 (1968): 67–93. See also Marx W. Wartofsky, "Diderot and the Development of Materialist Monism," in *Models*, ed. Robert S. Cohen and Marx W. Wartofsky, vol. 48, by Marx W. Wartofsky, Boston Studies in the Philosophy of Science (Dordrecht: Springer Netherlands, 1979), 297–337; and Matteo Marcheschi, "Diderot e il polype d'eau douce: l'immaginazione tra natura e metafora," *Aisthesis* VII, no. 2 (2014): 109–25.

¹⁰ Nick Treuherz, "The Reception of French Materialism in Enlightenment Germany, 1739–1789" (PhD diss., University of Manchester, 2013).

Johann Gottfried Herder (1744–1803), and Johann Friedrich Blumenbach (1752 – 1840) show that the animal continued to be an important touchstone in debates about epigenesis and preformationism into the latter half of the eighteenth century.¹¹ Numerous monographs focused on these and the related issues of the development of vitalist thought and biology in Germany likewise allude to the discovery of the polyp as an important piece of historical context, but do not consider the figure of the polyp itself in more detail.¹² Like much of the scholarship on Francophone polyp-science, these studies focus more on the intersections of science and philosophy than on issues relating to language and literature.

The existing body of research invites further investigation into the images and ideas of the polyp that emerged throughout this period of intense scientific investigation, especially since the scientific corpus in question relied so heavily on the craft of writing—of documenting impressions and observations in prose. Furthermore, contributions by figures like Diderot and Herder, in particular, raise important questions about how the image of the polyp moved from the world of scientific research, through the disciplines of metaphysics and philosophy, into the

¹¹ See, for example: Stefan Borchers, “Christian Wolff und der Süßwasserpolyp. Zum wissenschaftsgeschichtlichen Quellenwert des Briefwechsels des Philosophen,” *Studia Leibnitiana* 37, no. 2 (2005): 224–237; Robert J. Richards, “Kant and Blumenbach on the Bildungstrieb: A Historical Misunderstanding,” *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 31, no. 1 (2000): 11–32; John H. Zammito, “Between Reimarus and Kant: Blumenbach’s Concept of Trieb,” in *The Concept of Drive in Classical German Philosophy*, ed. Manja Kisner and Jörg Noller (Cham: Springer International Publishing, 2022), 46; Peter McLaughlin, “Blumenbach und Der Bildungstrieb: Zum Verhältnis von epigenetischer Embryologie und typologischem Artbegriff,” *Medizinhistorisches Journal* 17, no. 4 (1982): 357–372.

¹² See, for example: John H. Zammito, *The Gestation of German Biology: Philosophy and Physiology from Stahl to Schelling* (Chicago: University of Chicago Press, 2017). Subsequent citations as “*The Gestation of German Biology*” with page number(s). See also Andrea Gambarotto, *Vital Forces, Teleology and Organization: Philosophy of Nature and the Rise of Biology in Germany*, History, Philosophy and Theory of the Life Sciences (Cham: Springer International Publishing, 2018).

realm of literature. For example, if the freshwater polyp occupies the intersection of literature and philosophy in the works of Diderot, then to what extent did Diderot's German readers—most prominently Herder, Johann Wolfgang von Goethe (1749–1832), and Friedrich Schiller (1759–1805)—adopt or reject his polypoid sensibilities? And if images of the polyp circulated in Kant, Herder, and Blumenbach's debates about concepts like the *Kern* (seed) or the *Bildungstrieb* (formative drive), to what extent did these polypoid images also populate the creative works that this generation of philosopher-anthropologists inspired? To what extent does the image of the polyp meaningfully shape the cultural project of *Bildung* (formation) in Germany at the end of the eighteenth century?

In response to these questions, the present dissertation argues that the freshwater polyp attained cultural significance beyond the field of natural history because of the way the animal frustrated the very analogies which philosophers and scientists relied upon to make sense of it. From the start, Trembley and his contemporaries employed analogies between polyps and various wondrous beasts in order to communicate to the learned public the extent to which the newly discovered animal violated classical notions of natural law. In Germany, the epistemic rupture triggered by the polyp spawned numerous debates about how and under what circumstance a Nature organized according to a rational plan could permit the kinds of transformations of which the polyp was capable. German natural historians, metaphysicians, theologians, and philosophers began to consider positive and negative analogies between the polyp and other kinds of organisms—worms, elephants, and human beings—as a way of achieving clarity about this creature's significance. This constant attempt to grasp the polyp by means of analogy led ultimately to the reconceptualization of Nature in the image of the polyp,

as something that could be molded according to a reasoned plan. By comparing the polyp with everything, philosophers began to recognize all that was or might be polypoid in their world.

3. Patterns and Analogies

Analogies serve an important function in the study of organized life. The discovery of analogies between two organisms may generate new scientific paradigms. For example, modern research in the field of medicine is partially determined by similarities between the rat and the human being. The researcher supposes that these similarities may ultimately lead to revolutionary insights into human health and illness. Yet the relationship between analogical objects is complicated to say the least: not all knowledge derived in one domain is automatically transferable to the other. That is why modern researchers know a great deal about curing cancer in rats and substantially less about curing cancer in human beings. Simultaneously, the images, associations, and meanings that arise around such an analogy may be just as impactful on a cultural level as the experimental results they may produce. In the twenty-first century, the metaphor of the lab-rat or the cartoon *Pinky and the Brain* are broadly familiar. Thus, since analogy plays such an important role in conceptualizing the polyp's position within German intellectual history, it is worthwhile to spend some time considering analogy itself from the perspectives of the history of science, philosophy, and rhetoric.

As Douglas Hofstadter and Emmanuel Sander argue, children learn about the world by constructing rudimentary, then ever more complex, analogies about objects, processes, and concepts.¹³ They use their unique abilities to make analogies in order to organize sensory

¹³ Douglas R. Hofstadter and Emmanuel Sander, *Surfaces and Essences: Analogy as the Fuel and Fire of Thinking* (New York: Basic Books, 2013).

information into a complex, nuanced picture of the world. This self-same process of analogy-making, a fundamental feature of all human cognition, structures the human being's loftier endeavors, including scientific research. As Joseph Priestley (1733–1804) puts it in his history of the study of electricity, “analogy is our best guide in all philosophical investigations; and all discoveries, which were not made by mere accident, have been made by the help of it.”¹⁴ The observant scientist reflects back on the many familiar analogies that she has constructed over a lifetime of curiosity and learning. She begins to wonder about the laws of nature that might have produced those analogous appearances.

The above account of analogy-making focuses on two distinct epistemological functions. In the first case, analogies form the cognitive structure that sifts through the thinking being's manifold experiences, making meaning from the more and less familiar things that they encounter. Much of what is experienced—that is, much of what is unfamiliar—is eventually subsumed to one or another category. The mind produces a catalogue of familiar things that share attributes with the unfamiliar thing, and through this generation of analogies, it comes to *know* something new. There is, then, a whole complex of analogies that must interact with each other for the human being to assimilate *novel* information in the form of an additional analogy, a new link in the chain.

Yet just as often nature presents the mind with analogies that, according to experience, should be or very clearly are impossible—what Thomas S. Kuhn deems an anomaly in his seminal work, *The Structure of Scientific Revolutions*.¹⁵ In these situations, the epistemological

¹⁴ Joseph Priestley, *The History and Present State of Electricity, with Original Experiments*, with Robert E. Schofield (New York: Johnson Reprint Corp., 1966), 14.

¹⁵ Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Fourth edition (Chicago: The University of Chicago Press, 2012).

function of the analogy is different: it is a sign of an absence in the cognitive structure that orders the world. The mind senses that some series of familiar analogies ought to exist into which this particular phenomenon would fit, and yet recourse to existing knowledge is insufficient. In this case, knowledge of the phenomenon is blocked by the necessity of discovery. The pursuit of an explanation of an unaccountable analogy leads to the generation of a system of ideas and images that plausibly accounts for the phenomenon witnessed.

In this mode, that of discovery, one makes a transition from the simpler cognitive act of making sense of the world to the more complex, creative act of advancing new interpretations of the world. Thus, one enters into the mode of argument and rhetoric. In his theory of analogical arguments, Paul Bartha defines the form of the analogical argument as follows: “It is plausible that Q^* holds in the target because of certain known (or accepted) similarities with the source domain, despite certain known (or accepted) differences.”¹⁶ For Bartha, the purpose of making an analogical argument is, first and foremost, to assert the plausibility that the quality “ Q^* ” is represented in both the source and target domains. From the perspective of the scientist, this means at least establishing sufficient evidence that the apparent analogy merits further exploration.

As Nancy Leys Stepan and Paul Bartha have each argued, citing Kuhn, argument by analogy has the power to define scientific paradigms.¹⁷ That is, a strong analogy can generate a program of research, inform the kinds of questions that scientists ask about the natural world, and shape the sorts of experiments that are or are not undertaken. A plant? An animal? Or a

¹⁶ Paul F. Bartha, “Analogical Arguments,” in *By Parallel Reasoning: The Construction and Evaluation of Analogical Arguments* (New York & Oxford: Oxford University Press, 2010), 15.

¹⁷ Nancy Leys Stepan, “Race and Gender: The Role of Analogy in Science,” *Isis* 77, no. 2 (1986): 261–77; Bartha, “Analogical Arguments,” 12.

plant-animal? The answers to such fundamental questions can have paradigmatic significance for scientific research. In the case of the polyp, classification of the being as an animal and not a plant allowed scientists to treat it as a model organism for more than two centuries.¹⁸

In fact, the view that the flexible biology of the polyp provided insights into the fundamental laws of nature persisted through the twentieth and even into the twenty-first century. In a 1985 news article on the highly active community of hydra researchers at the University of California Irvine, biologist Richard Campbell is quoted stating: “The hydra is in a constant, steady state, and from it you can learn the basic biological principles of higher animals.”¹⁹ And as recently as 11 May 2026, an article in the New York Times cites the “tiny freshwater invertebrates” in the recent discovery of the human interstitium—the complex fluid network that spans the entire human body. Because the body of the hydra and the interstitium both contain collagen and “gel-like substance[s]”—hyaluronic acid in the human and a similar glycosaminoglycan in the case of the hydra—researchers surmise that the “fluid moving through interstitial spaces” in the human body “might have represented the first circulatory systems to develop in the earliest forms of complex multicellular plant and animal life, hundreds of millions of years ago.”²⁰ Still in 2026, the notion of biological analogies between the polyp and the human being is opening up new avenues of scientific research.

¹⁸ Brigitte Galliot, “Hydra, a Fruitful Model System for 270 Years,” *The International Journal of Developmental Biology* 56, nos. 6–8 (2012): 411–423.

¹⁹ “UNIVERSITY OF CALIFORNIA AT IRVINE HISTORICAL HOTBED OF HYDRA RESEARCH,” *US Fed News Service, Including US State News* (Washington, D.C), 2010.

²⁰ Avraham Z. Cooper, “The Astounding Discovery That Could Link Eastern and Western Medicine,” *The New York Times*, May 11, 2026.

Arguably, the focus of this dissertation is not, or at least not primarily, valid analogical arguments, since so many of the hypotheses discussed in the following pages have long been discredited. In some cases—for example, Diderot’s comparisons of sentient clavichords with other sentient beings and worms with elephants—the analogies asserted are intentionally implausible, that is, they are comparisons that exploit negative analogies for rhetorical effect. Thus, what is most interesting in the history of the polyp as an image is frequently the analogical surplus—the elements of the analogical argument that exceed or even undermine the validity of the argument from a logical perspective.

For example, it is common throughout the scientific literature of the mid-eighteenth century to refer to the polyp’s “head.”²¹ The polyp’s “head” can be severed from its body without killing the organism: the head, once removed, will regrow its body, and the body will be able to regrow a head. This statement sounds shocking, since as is readily apparent, human heads must remain attached to human bodies for the organism to live on. But the statement can only have that effect because of the implicit assertion of an analogy between the “head” of the polyp and the head of the human being. In reality, the anterior end of the small invertebrate bears almost no functional resemblance to the anterior end of a human being. And yet, as is discussed in more detail in Chapter 2, the comparison of the polyp and the many-headed Hydra of Lerna would occupy the scientific imaginary for many decades.

As this example demonstrates, the analogies that scientists employ serve the purpose of straightforward description, but there is also a surplus of meaning that reaches into other

²¹ “Je ne pensois pas qu’elle pût vivre longtems séparée du reste du corps. Qui se seroit figuré qu’il lui fût revenu une tête!” Abraham Trembley, *Mémoires pour servir à l’histoire d’un genre de polypes d’eau douce, à bras en forme de cornes* (Leiden: Chez Jean & Herman Verbeek, 1744), 1:15. Subsequent citations as “*Mémoires*” with volume and page number(s).

domains of intellectual life. Those associations become a part of what the object of study then means for future students of nature. According to Amanda Jo Goldstein, “tropes, figures, images, and metaphors” do not merely “adorn or obscure the simple evidence of sense”; rather, they “constitute the best possible linguistic register for aspects of objective activity sidelined by the philosophical pursuit of ‘clear and distinct ideas.’”²² In essence, elements of the analogical argument that may seem secondary or extraneous actually constitute knowledge of the object. That is, analogies that assert too much of the objects being compared still contribute connections that may be useful or meaningful in a variety of intellectual contexts.

Scientific analogies and metaphors function as a two-way valve between the knowledge orders being compared. Although difference between the source and target objects is ultimately maintained, there is a residue of meaning left by the analogy. Thus, the names by which we call animals, should they make reference to other natural objects, will create a kind of semiotic conduit between the things being compared. In the case of the polyp-human analogy, eighteenth-century scientists, philosophers, and literary artists viewed both tiny cnidarian and human beings differently as a result of comparing the two vastly different organisms with each other.

4. An Analogical Approach

The focus of the present dissertation is an investigation of the meanings generated by the analogies of polyps and many different kinds of organisms. The polyp came to represent many things. The malleability of its physical form, being a creature composed of a gelatinous substance, generated many transformations and metamorphoses of culture. Thus, this dissertation

²² Amanda Jo Goldstein, “Introduction,” in *Sweet Science: Romantic Materialism and the New Logics of Life* (Chicago & London: University of Chicago Press, 2017), 1–34, here 9. Subsequent citations as “*Sweet Science*” with page number(s).

considers “polyps” from a variety of semiotic and material perspectives. It is interested in: the specific biological organism to which that name was given, its anatomy, and its behaviors; the situations in which human beings interacted with polyps, directly, in nature, in the laboratory, in public demonstration spaces, and in smaller social gatherings; the kinds of images, ideas, and narratives that came to be attached to the animal and the contexts in which it was encountered; textual and visual representations of the polyp in both scientific and creative contexts; and the broader milieu of the polyp, that is, the cultural ecosystems that it would have impacted, both concrete and ideal. Thus, ultimately, the purpose of the following investigation is to track the ways in which the animal shaped the intellectual world of the late eighteenth century in a variety of domains, from the then-emergent field of microscopy, for example, to the parallel developments of anthropology and humanist literature at the end of the century.

This broad-based approach to the polyp’s cultural reach is inspired, in part, by the concept of “polyp-thinking,” as defined by Lydia Azadpour and Daniel Whistler. They employ the term to describe the mode of scientific inquiry developed for the purpose of “*naturalizing the thinking process*” through the polyp research and philosophy of the late eighteenth century.²³

Polyp-thinking—even if it is only momentarily invoked—specifies the capacity of the human species to adapt and develop in diverse directions. Thus, Kiehmeyer—like Diderot and Bonnet—applies the figure of the polyp analogically to the ideal realm, and, in so doing, he embeds human capacities into his overall picture of ‘the great machine of the organic world.’²⁴

“Polyp-thinking” itself is radically analogical, concerned with similarities that seem, at times, quite remote and even implausible. Hence, Azadpour and Whistler argue that for Diderot,

²³ Lydia Azadpour and Daniel Whistler, “Polyp-Thinking in the Eighteenth Century,” in *Thought: A Philosophical History*, 1st ed., ed. Daniel Whistler and Panayiota Vassilopoulou (Routledge, 2021), 148–161. Subsequent citations as “Polyp-Thinking” with page number(s).

²⁴ Azadpour and Whistler, “Polyp-Thinking,” 157.

“polyp-thinking” meant “the proliferation of ever-new images, skepticism about the permanence of the present state of affairs, speculative conjectures on radically different forms of life.”²⁵ Yet while “polyp-thinking” represents more speculative than strictly empirical analogies, it also implies the generation of strong connections. Hence, according to the authors, “polyp-thinking” for Bonnet meant the development of “a chain-like mode of reasoning that imitates the palingenetic dynamics of the natural world.”²⁶ At bottom, “polyp-thinking” is part of a generative harmonization of seemingly disparate facts and artifacts in pursuit of transformational truths.

Based on this definition, formally, this dissertation is an attempt to think about, with, around, and like polyps. It strives to mimic in its very form the biological features of the polyp that fascinated the scientists, philosophers, and writers of the late eighteenth century. Specifically, the following argument experiments with the idea of “polyp-thinking,” as both “the proliferation of ever-new images” and a “chain-like” mode of reasoning. That is, it seeks to both describe and demonstrate ideas about the polyp-human analogy that developed during the late eighteenth century.

The chapters are composed of short vignettes that pick up and elaborate on concepts described in the foregoing pages. Initially, the argument proceeds mostly chronologically. Yet it also features some longer, analeptic passages that discuss relevant cultural traditions—such as the history of the paradigm of elephants and dragons as zoological opposites in the medieval bestiary tradition in Chapter 3. From Chapter 3 onward, the perspective is largely synchronic and considers multiple parallel developments in “polyp-thinking” around the end of the century. In

²⁵ Azadpour and Whistler, “Polyp-Thinking,” 154.

²⁶ Azadpour and Whistler, “Polyp-Thinking,” 156.

this way, through the transition from a diachronic to synchronic lens, with moments of productive digression, the form of the dissertation unfolds in the form and manner of a polyp sprouting daughters from its side. Thus, through its very form, the present study is also a participant in the intellectual history of the polyp.

According to the conventions of modern scholarship, some digressions may appear to strike out too far from the intended path of the “main argument.” However, the purpose of employing a polypoid form is precisely to demonstrate the emergence of analogies across different domains of consideration. Hence, there is a degree of iterativity to the structure of the argument, whereby certain key concepts and images—such as the notions of analogy and the miracle—return in different contexts. This iterative or motivistic approach allows images to resonate across temporal, geographical, and disciplinary contexts, even as they are transformed and rearticulated by the contextual move. Ultimately, as the dissertation demonstrates, this is precisely the process that the image of the polyp itself underwent during the second half of the eighteenth century.

5. The Hydra’s Heads

Part I of the dissertation considers the literary and linguistic question of the metaphorical content of animal names, and how a culture with a particular shape and particular meanings and associations coalesces around that metaphor. Chapter 1 of this dissertation looks at the idea of the polyp-human analogy from the perspective of language. The process of describing the as-yet-undescribed places the scientist in the position of having to resort to analogy as a way of sorting through his observations. Yet analogy does not function in the scientific process only as a means of generating precise descriptions, it also mediates between culture and scientific discovery and

contributes to the generation of narratives around a scientific object that drive public interest via the imagination. In the case of the polyp, the generation of analogies with mythic creatures in particular stimulated public discourse regarding its unique abilities.

Chapter 2 demonstrates that the representation of the polyp as a ‘miracle of nature’ facilitated the articulation of a meaningful analogical relationship between polyps and human beings. During the mid- and late-eighteenth centuries, the ascent of the empirical sciences cast doubt on the legitimacy of stories of the supernatural, driving scientists and other intellectuals to find other, sublunary explanations for seemingly supernatural occurrences. In the process, miracles were recoded as natural events demonstrating the existence of a pattern for which science could not *yet* provide an appropriate explanation. The secular age did not cause the narrative of the miracle to disappear but rather left a palpable residue on the investigations of creatures, like the polyp, that behaved in ways previously thought to be impossible. It is shown how the foundation of the reputation of the polyp as a symbol of new potentialities exceeding what was previously thought to be possible emerged from the early work that Trembley and his contemporaries did to promote polyp science.

Part II of the dissertation considers the dialectical process that occurred between 1740 and 1790 that led to the dissemination of polyp analogies in German thought. These changes transformed the animal from a symbol of a metaphysical problem—the potential destruction of teleology—into a metaphor for the telos itself. The animal therein became a representative of the human prerogative for progressive change that is built into the very structure of nature.

Chapter 3 considers Francophone and German responses to the notion that the creature defied the regular laws of nature. Treatises, essays, and articles of the period show, too, that the version of the polyp promoted by Trembley also left a residue in German descriptions of the

polyp, which likewise built on Trembley's imagery with a Herculean rhetoric of its own. Nevertheless, the mythological qualities with which this animal was endowed created problems for German Neoplatonists. As is shown through a discussion of responses to Diderot's particularly outlandish representation of polyps in his "Le Rêve de d'Alembert," the solution to the problem was a dual movement: to accept the animal's exceptional qualities *and* reify its position in a specific, unchanging part in the hierarchy of nature. By virtue of this process, the polyp could illustrate the principle of intelligent design, whether or not the human observer had yet come to grasp the particular rules of that design. This chapter therefore builds on the discussion of analogies from Part I but turns away from the question of mythological and miraculous analogies, toward the more concretely natural-scientific analogies of comparative zoology.

Chapter 4 considers the emergence of analogies between the polyp and the human being in canonical texts of late-eighteenth century humanism—the works of Blumenbach, Schiller, and Friedrich Kiehmeyer (1765–1844). These texts represent neither the destruction nor the rigidity of the natural laws that produce all natural organizations. Rather, they are concerned with the possibility of progressive change according to an eudaemonistic ideal in all domains of experience. Blumenbach makes the polyp-human analogy part of the origin story of his concept of the *Bildungstrieb*, or formative drive, which embeds a principle of flexibility in the very laws of nature. Then, in his influential lecture of 1793, *Ueber die Verhältnisse der organischen Kräfte* (On the Relations between Organic Forces), Kiehmeyer builds on Blumenbach's science of comparative morphology, analogizing the polyp with the blossoming of the human spirit. Finally, in his *Briefe über die ästhetische Erziehung des Menschen* (Letters on the Aesthetic Education of the Human Being, 1795), Schiller compares Ancient Greek society with the nature

of the polyp, thereby establishing a polypoid-principle as an essential part of his theory of aesthetic education. As this progression shows, by the end of the eighteenth century, German anthropologists had developed in the analogy of the polyp-human a synthesis of French nominalism and German Neoplatonism in the form of a concept of nature defined by a telos of progressive transformation toward the ultimate goal of happiness.

Part III considers the world of letters once the polyp-paradigm has been established, first showing that the analogical function of the animal has come full circle—the world and culture gave the polyp meaning; now the polyp gives meaning to the world and culture; and Chapter 6 reflects on a literature informed by a post-polyp-analogy world and demonstrates not affirmation or rejection, but deep ambivalence.

Chapter 5 focuses on the polypoid images that appear in Goethe's letters, lectures, translations, as well as the author's exposure to and engagement with polypoid science and anthropology of the period, in order to demonstrate the extent to which German cultural consciousness had, by the end of the century, absorbed polyp imagery and its attendant meanings. In this sense, Chapter 5 builds on the questions raised in Chapters 1 and 2 regarding the ways in which culture informs science by means of analogical reasoning. Its focus is the mechanisms by which those meanings, once invested in the concept of the organism, reenter the collective imaginary through allusions to the organism. At the same time, Chapter 5 also draws on the discussions in Chapters 3 and 4 regarding the transformation of the polyp into a symbol of humanistic ambition. For it is precisely these discourses that shaped Goethe's maturation as a natural scientist and artist.

Chapter 6 constructs a conceptual ouroboros, returning to and devouring the themes of mythology presented in Chapter 1, insofar as it considers, through the lens of the polyp, the

creation of a modern mythology in the form of the *Bildungsroman*. It is argued that the novel *Wilhelm Meisters Lehrjahre* (Wilhelm Meister's Apprenticeship, 1795/1796) portrays divergent paths of polypoid *Bildung* in Wilhelm's two children, to both tragic and happy effect. The chapter is structured around three moments in the novel in which Goethe, it is argued, develops a polyp-humanist conception of the generation and formation of life: Philine's wish in Book 4 that babies could grow on trees; descriptions of Mignon and Felix as "worms" throughout Book 8; and Mignon's egg dance in Book 2. Through these close readings, it is argued that *Wilhelm Meisters Lehrjahre* can be read as a thought experiment concerned with testing in narrative form the polyp-humanist concepts of *Bildung* discussed in Chapter 4. Specifically, the tragedy of Mignon and the comedy of Felix is that attempts at compensation in the novel aim to subject the children heteronomously to social modes of being that are incongruous with their own inner character. Ultimately, *Bildung*, in the polyp-humanist sense, must mean the formation of the individual through the reciprocal forces of character and compensation toward a telos of pure potentiality.

Part I

I: The Habits of the Polyp

1. Introduction

The term “freshwater polyp” is not the most familiar, not even the most accurate name, for the microscopic animal at the center of this dissertation. Readers familiar with the biological sciences likely know the animal by its genus and now common name, *Hydra*, which Trembley coined in his 1744 study of the creature. They may also know that the term “polyp” refers, in the twenty-first century, not to a specific kind of animal, but to a phase in the life cycles of many different animals in the phylum Cnidaria, for example jellyfish and corals. Likewise, the philologist will recognize in “polyp” the Greek for “octopus,” πολύπους (*polypous*), or “many-footed” creature. The list of organisms clustered around the concept of the “polyp” and its “many-footed” form seems to reach out into all parts of creation.

This history of semiotic displacement, which began well before the mid-eighteenth century, resulted from the fact that the term “polyp” is, in fact, an analogy—one that has, over the course of centuries, served to compare a host of different organic forms with the shape of the “many-footed” octopus. Many times over, naturalists reached for the image of the *polypus* when, evidently, a more concrete description of the scientific object eluded them. It is in the nature of many of these Cnidarians—shifty, wiggly, intractable creatures that they are—to elude categorization, even when categorization itself represents one of the naturalist’s most important occupations. As this cluster of associations grew, the resulting network of “many-footed” organisms began, as it were, to interact with itself. The ideas and meanings that surrounded the concept of the “polyp” were pulled into the polypoid semantic network, and then dispersed again along its many tentacles, enriching and complicating the meaning of the word and the world it

occupied. Consequently, the use of the term “polyp” in this analogical mode has consistently triggered shifts and displacements in the way that language works.

The purpose of this chapter is to explain how, from a literary-philosophical point of view, organismic analogies function and what they signify about the organisms being compared; that is, to explain the component parts of the analogy, how they are wielded, and what scientific narratives about nature they imply. This work is doubly important since Trembley, as well as the scientists discussed in subsequent chapters, lived at a time when *narrative* was one of the biologist’s most reliable tools. This chapter therefore reads eighteenth-century texts on polyps and the language of scientific research in conversation with the classical myths that, in an era of revived interest in antiquity, fundamentally shaped interpretations of nature. These readings demonstrate that, by evoking images of monsters and prodigies in their descriptions of polyps and polypoid beings—worms, corals, and other invertebrates—eighteenth-century scientists made the strange behavior of these animals the focus of their science.

Thus, in the following, it is argued that the images of monstrosity embedded in the polyp-discourses of the mid-eighteenth century should be taken seriously as a part of Trembley’s scientific contribution. The polyp’s name enacts in the world of ideas the wily, intractable nature attributed to the tiny animal. Analysis of the analogies that Trembley employs shows how animal names can function as catalogs of knowledge, encoding the results of a process of biological hermeneutics that extends from the moment of discovery to the public presentation of the scientific object. The relationship between analogies and naming here articulated is in keeping with the scientific ethos of the era, captured in the Linnaean taxonomic paradigm, wherein matters of culture and semiotics inform the epistemological priorities of scientific naming. Consequently, the analogy of the polyp—the comparison of the small animal with the fearsome

polypus—requires further analysis. A brief review of references to the marine polyp from antiquity shows that such associations embed in the concept of the freshwater polyp ideas of power, craftiness, and cleverness. At the same time, because marine and freshwater polyps fundamentally signify plurality, the story of that name is one of constant change, wherein the knowledge and meaning are constantly displaced. Ultimately, the polyp's name codifies the cultural-epistemological struggle to subdue the beast of uncertainty and gain mastery over nature by means of understanding.

2. Linnaean Taxonomy

The act of classifying and naming a species requires the naturalist to do more than provide that species with a unique identifier. Were it so simple, then it would be sufficient to refer to plants and animals in the way that astronomers sometimes refer to distant cosmic bodies, or geneticists to specific combinations of amino acids, with a string of letters and numbers that serve only as indices of specific bodies in space. Many who interface with the natural world, however—that is, biologists, artists, philosophers, and laypersons—would not be satisfied with a signifier and signified, but no sign. For the semantic field that the plant, the animal, or the fungus occupies bears immeasurably upon the work one does, what one knows about, or the pleasure one takes, in nature.

The semiotic epistemological functions of nomenclature receive thorough explication in the *Philosophia Botanica*, written by the Swedish naturalist Carl Linnaeus (1707–1778) in 1751 to expand on the ideas presented in his *Fundamenta Botanica* (Foundations of Botany) of 1736 and *Critica Botanica* (Critique of Botany) of 1737. In this treatise, Linnaeus prescribes conventions and practices for the modern botanist. Aphorisms 210 to 255 of the treatise provide

an exhaustive list of considerations when naming new plant species.²⁷ For Linnaeus, the goal is the rigorous standardization and simplification of botanic nomenclature, for, as stated in aphorism 210, “If you do not know the names of things, the knowledge of them is lost too.”²⁸ It is through language that botanists interface with the plants that they study, and it is language first and foremost that preserves knowledge of natural things.

Names that are easy to remember are well suited to preserve knowledge. Hence, many of the conventions in the *Philosophia Botanica* serve the purpose of making the taxonomic system easier to understand and ultimately memorize. For example, “Generic names ½ feet long, those that are difficult to pronounce, or are disgusting, should be avoided.”²⁹ The primarily mnemonic function of the Linnaean taxonomic system also explains, at least partially, some of its more dubious features. The banishment of “barbaric” common names in favor of Greek and Latin, as well as of diminutive suffixes, do simplify the task of communicating about species that may be known by dozens of common names.³⁰ A simplified form of a designated scientific lingua franca creates a standard reference easily applicable to all organisms regardless of their origin.

Linnaeus not only sets forth formal principles but also attends to the mnemonic function of meaning as well. In aphorism 232, he rejects as “unsatisfactory” all “Generic names that are

²⁷ Botanists of the twenty-first century abide by the *International Code of Nomenclature for algae, fungi, and plants*, for which the Linnaeus’s *Fundamenta Botanica* and *Critica Botanica* can also be seen as predecessors.

²⁸ Carl von Linné, *Philosophia Botanica*, trans. Stephen Freer (Oxford: Oxford University Press, 2007), §210. Subsequent citations as “*Philosophia Botanica*” with aphorism number(s).

²⁹ *Philosophia Botanica*, §249.

³⁰ Other aspects are dubious and indeed still the subject of critique today, as is the case with the following. “No sane person introduces primitive generic names. All barbarous names are regarded by us as primitive, since they are from languages not understood by the learned” (*Philosophia Botanica*, §220).

inconsistent with any species of their genus [...].”³¹ He therefore rejects, for example, the names *Chrysanthemum flore albo* meaning “golden flower with a white flower” and *Cyanus luteus* “yellow blue flower.” Instead, per aphorism 240 “Generic names that show the essential character or habit of the plant are the best.” In other words, the “best” plant names are easy to remember because they refer to the essential attributes of the particular genus or species. Both precepts imply that formal consistency is in fact not enough—or else it would suffice to refer to every species, genus, or class by a unique string of mute symbols. No, names preserve knowledge by serving as an index of existing objects in the world, but they do this also by representing these objects meaningfully. Hence, names that are rich in meaning are well suited to preserve knowledge in that they also contain knowledge.

Arguably, the requirement that a name be meaningful pulls it even farther away from its function as a unique identifier; for there is no meaning without analogies, without references, implicit or explicit, to all of the ways in which one thing may be similar to another. In explaining aphorism 240, Linnaeus states that “The habit [*Habitus*] indicates a likeness from which an image [*idea*] is produced, and from the image a name.” In other words, well-formed genus names conjure images of objects that resemble the plant in question.

If the name of an organism should represent its “habit” by conjuring its likeness in the image of a different object, then, when the scientist encounters a new organism, his first task is to grasp its “habit.” This term, in Linnaeus’s original Latin “habitus,” refers to the growth patterns and general appearances of a given plant. More broadly, “habitus” can refer variously to a condition or state of being, to clerical vestments or, in a sociological sense, to a particular lifestyle or social disposition. The semiotic landscape here suggests an important linkage

³¹ *Philosophia Botanica*, §232.

between form and behavior, the characteristic appearance of an organism in action.

It is worth emphasizing, further, that in the best circumstances, names refer to objects specifically, and not to attributes, since Linnaeus privileges substantives over adjectives in aphorism 235. Hence, per aphorism 230, Linnaeus permits the employment of names that designate organisms in other kingdoms—so long as the botanist notifies the zoologist or mineralogist who first employed that name. Permitting, indeed encouraging, the employment of substantives means that, very often, the taxonomic name of an organism is like a spell that conjures a fully formed image of something else entirely. For example, the term *rhododendron* conjures the image of a rose-bearing-tree—*ῥόδον* (*rhodon*), meaning rose, and *δένδρον* (*dendron*), meaning tree.

Linnaeus certainly places many functional limits on the sorts of substantives that botanists may employ—“terms used by anatomists, pathologists, healers and artisans [...] should be dropped”—but he likewise makes many allowances for the analogical, indeed metaphorical, richness of the taxa to bloom: “I retain generic names derived from poetry, imagined names of gods, names dedicated to kings, and names earned by those who have promoted botany.”³² Each of these rules would seem to complicate the formal requirements of the system, yet they are permissible—precisely because they embed the plant and its name more deeply into the world of known things, thereby making that world more knowable in the process.

Linnaeus’s system is helpful framing for the story of the freshwater polyp. His *Systema Naturae* and *Fundamenta Botanica* prescribed a formal relationship between the language, methodology, and objects of scientific research that revolutionized the field of natural science. They also appeared in 1735 and 1736, respectively, only a few years before Trembley began his

³² *Philosophia Botanica*, §237.

work on polyps. The above characterization of Linnaeus's approach to taxonomy therefore provides a snapshot of the discursive landscape in the early 1740s, when Trembley undertook his polyp research, regarding the scientific description of nature. In that sense, Linnaeus's system provides useful language for describing Trembley's work in a manner indigenous to his period.

At the same time, as is illustrated in the subsequent sections, there is no trace of Linnaeus's systematic rigidity in the story of the polyp. The highly abstract and organized Linnaeus functions, then, as a foil for the rigorously empirical Trembley, who, as a materialist, preferred to avoid systematization to the extent that he could, in favor of offering a complete and accurate representation of nature in its multiplicity.³³ The following story of the polyp's habits—the attempt to find the right language for describing them—is thus, at times, as “intractable” as the creature itself. It therein casts into relief the struggle of knowing through language an animal that resists human categories.

3.1. Discovery

In 1740, Trembley stumbled upon a biological marvel: strange aquatic beings with slender, gelatinous green bodies, translucent arms like threads (“fils”) growing from one end, and a little foot on the other.³⁴ These animals used the foot to anchor themselves to the glass, and their arms

³³ In this regard, Linnaeus, who preferred a navigable if arbitrary system to an accurate if messy catalog of things, might also be regarded as a foil to Trembley, who in contrast rejected not only systematization, but even theorization as well. Trembley's approach resembled much more the figure of Buffon, whose intellectual disputes with Linnaeus have recently been detailed in Jason Roberts, *Every Living Thing: The Great and Deadly Race to Know All Life* (New York: Random House, 2024).

³⁴ Trembley, *Mémoires*, 1:9.

to move across the surface of the glass by performing “somersaults” (“culbute”).³⁵ They also had a peculiar way of reproducing. Small protrusions would emerge on the sides of their bodies. Within a few days, these protrusions took on the same shape as their parents, like branches on a tree. Quite unlike trees, a few days later, these branches detached, forming new creatures, identical to the organisms from which they had sprouted. Just as marvelously, the creatures possessed the ability to regenerate any part of their bodies. No matter what sort of incision the scientist made, even severing them entirely, the creatures would usually recover in a matter of days.³⁶

This creature presented Trembley with an analogical conundrum. Taxonomically speaking, he ought to be able to reason from exhibited traits whether the thing was a *plant* or an *animal*.³⁷ If an organism moves, eats, and even hunts like an animal, then a scientist may predict that it shares other traits with animals and therefore is an animal. But if that being is also green and can reproduce asexually, through splicing and grafting, then might the scientist conclude that its “arms” are instead “branches,” its “head” is instead a “crown,” and its “foot” is instead a “root”? In that case, plant analogies rather than animal analogies are more useful in making sense of the organism.

On the other hand, if the scientist is able to discern the features of *both* plants and animals in this one being, may he then dub it some sort of hybrid creature—a plant-animal? Trembley

³⁵ “Voilà un pas, ou plutôt une culbute [...]” (Trembley, *Mémoires*, 1:35).

³⁶ Survival depends on the health of the polyp prior to incision and other environmental factors.

³⁷ “Il y en avait sur des tiges de renoncule et de lentille aquatique, sur le fond et sur les côtés du verre. Cela est vert, et paraît au premier coup d’œil une plante. L’on découvre ensuite plusieurs caractères d’un animal.” Abraham Trembley, “Letter of 15 December 1740,” in *Correspondance Inédite Entre Réaumur et Abraham Trembley*, by Abraham Trembley and René-Antoine Ferchault de Réaumur (Genève: Georg, 1943).

cannot avoid employing analogies when describing the polyp, precisely because its anatomy appears to be entirely unprecedented in nature. He is faced with the challenge of describing something for which the existing categories are not quite appropriate. And yet, the analogies themselves create further problems. For does the idea of a “plant-animal” not presuppose that such beings have neither “branches” nor “arms,” but rather “branch-arms”? Or would the phrase “branch-tentacles” be more appropriate, and what would *that* imply about such a creature?

What the scientist does in the moment of engaging with the organism, is engaging in creative, metaphorical thinking. In that moment, he creates metaphor upon metaphor in order to compare the scientific object with all of the patterns that have hitherto presented themselves to his intuition. It would be a mistake to take it for granted that the “arms” of the polyp are literally “arms,” since that is a term that describes a set of very different anatomies—from the ape to the octopus. Sometimes, these metaphors regard a limited sphere of knowledge, but in a general sense, they provide deep insights into what it meant for the scientist to be looking at this particular organism at this time.

The scientist is therefore forced to make a choice: to accept the disorderly notion of the plant-animal in an attempt to better capture the peculiar nature of his discovery; or, opting for the tidier solution, to decide that the creature *must* belong to one or the other category, that it *must* be either a plant or an animal. The choice makes it clear that the analogies that the scientist *must* employ in constructing models of the world before his eyes are not neutral; that to employ the analogy of the plant will lead his thoughts in one direction, the analogy of the animal in another, and the plant-animal in a third.

The choice that Trembley made was to view the polyp as an *animal*. Consequently, the analogies that Trembley employs emphasize the polyp’s mobility—a creature with “arms,”

“legs,” and a “head.” The scientist accepts and is aware of the many differences between a polyp’s “head” and a human “head,” but deploys the analogy in the context of an implicit argument: namely, that both organisms use their heads to actively find and consume nutrients, such that the smaller head-bearing being must also be an animal.³⁸ It is not only Trembley who employs the highly misleading term “head,” but many scientists after him as well.³⁹ In doing so, each of these scientists attributes to the polyp animality by invoking the analogy of a higher animal.

This point is most obviously illustrated by the fact that Trembley’s decision to interpret the polyp as an animal spelled the superannuation of the category “plant-animal” altogether, which had lived comfortably alongside the other kingdoms since the Middle Ages. Hence, for example, Trembley’s colleague and interlocutor René Antoine Ferchault de Réaumur (1683–1757) had initially rejected the determination that the coral was an animal, made shortly before Trembley’s discovery. The coral was and would remain a “plant-animal” or “coral-insect.” Yet the path of the animal analogy led Réaumur and others ultimately to accept the idea not only that the coral was an *animal*, but indeed, an animal *like the polyp*: a “coral-polyp.”

Trembley sent his questions and observations to Réaumur hoping to find answers about this odd specimen. Réaumur was an expert naturalist and had recently demonstrated that echinoderms, such as starfish, were indeed capable of regenerating lost limbs. Réaumur shared

³⁸ “Plus j’avois observé des Polypes entiers, & même ces deux parties dans lesquelles s’étoit faite la reproduction dont je viens de parler, plus leur mouvement avoit réveillé dans mon esprit l’idée d’un Animal” (Trembley, *Mémoires*, 1:16).

³⁹ For example, Pallas describes how a “nach der Länge halb zerschnittene Hyder zu einer Mißgebur, die zwen oder mehrere Köpfe hat, gemacht werden kann.” Peter Simon Pallas, *Charakteristik der Thierpflanzen*, ed. Johann Friedrich Wilhelm Herbst, trans. Christian Friedrich Wilkens (Nürnberg: die Raspische Buchhandlung, 1787), 51.

Trembley's surprise that existent organisms could be split in half or quartered to produce many individual and viable animals. Over the course of several months, the two naturalists exchanged correspondences and specimens. Trembley collected more evidence, while Réaumur worked to reproduce his results.⁴⁰

While they debated whether the as-yet-unnamed organism was a plant, animal, or something in between, Trembley and Réaumur employed terms like “plant-animal” and “little machine,”⁴¹ which drew attention to broader issues then circulating in regard to the conceptualization of nature.⁴² And once they felt certain that this lifeform *was* an animal, Réaumur suggested the name “polype,” because the creature's tentacles reminded him of the octopus's anatomy—both are multi-limbed animals.⁴³

L'OCCASION se présente ici naturellement, de comparer nos Polypes d'eau douce avec les Polypes de mer, & de justifier, par le rapport que leur structure extérieure a avec celle de ces Animaux marins, le nom qui leur a été donné. Les pieds ou bras des Polypes marins sont placés à leur tête & autour de leur bouche, & l'on est à présent en état de juger, que telle est aussi la situation des pieds ou bras des Polypes d'eau douce. Les uns & les autres se servent de ces parties pour marcher, & je ferai bientôt voir que, de même que les Polypes marins, ceux d'eau douce s'en servent aussi pour arrêter leur proie, & pour la porter à leur bouche.⁴⁴

Eventually, the two concluded that Trembley had indeed discovered a new kind of animal. It was Réaumur who suggested the name, *le polype d'eau douce*, the freshwater polyp, based on the

⁴⁰ Regarding their correspondence, see Dawson, *Nature's Enigma*.

⁴¹ See Janelle A. Schwartz, *Worm Work: Recasting Romanticism* (Minneapolis: University of Minnesota Press, 2012), 77. Subsequent citations as “*Worm Work*” with page number(s).

⁴² See, for example, *L'homme machine* (*Machine Man*, 1748) and “L'homme plante” (Man as Plant, 1748) by Julien Offray de La Mettrie (1709–1751).

⁴³ Abraham Trembley and René-Antoine Ferchault de Réaumur, *Correspondance inédite entre Réaumur et Abraham Trembley* (Genève: Georg, 1943), 51.

⁴⁴ Trembley, *Mémoires*, 1:49.

analogy that he observed between the tentacles of the *polype* and those of the octopus, the *polype marin*.

3.2. The Polyp

Trembley was not the first European scientist to describe the freshwater polyp, nor even the first to assert that it was an *animal*. The Dutch microscopist van Leeuwenhoek had already published his initial impressions of the animal forty years earlier in the *Philosophical Transactions of the Royal Society*.⁴⁵ In a letter dated 25 December 1702 “concerning green Weeds growing in Water, and some *Animalcula* found about them,” van Leeuwenhoek voices his surprise at the “sight of a great many and different kinds of *Animalcula*” attached to his samples of duckweed.⁴⁶ This collection of “animalcules”—a now outdated term for microorganisms—included the very creatures Trembley would describe almost a half a century later in his *Mémoires*.

Given van Leeuwenhoek’s stature in the history of science, one might expect that his work on polyps would have had a more meaningful impact on the animal’s public reception.⁴⁷ After all, in this account, he provides the first description of the animal’s remarkable ability to reproduce by budding. However, in opting to employ the term “animalcula,” van Leeuwenhoek declines to actually *name* the thing that he has discovered. Rather, he asserts with his choice of analogy *only* that he has discovered a *small animal*. And while, by mid-century, the very notion of the polyp’s animality would become a major point of contention, without any analogical

⁴⁵ Leeuwenhoek was the first scientist to describe the polyp’s ability to reproduce asexually. He was not aware of the animal’s regenerative abilities and did not perform the same sorts of extensive experiments that Trembley did.

⁴⁶ Leeuwenhoek, “Part of a Letter from Mr. Antony van Leeuwenhoek,” 1305.

⁴⁷ Trembley recognizes Leeuwenhoek’s work in the *Mémoires*. See Trembley, *Mémoires*, 1:6.

surplus to recommend it to the attention of learned society, van Leeuwenhoek's "animalcula" would remain a relatively unknown entity.

By contrast, it was precisely Trembley's decision to name the animal a "polyp" that created an opportunity for the public to engage with his discovery more meaningfully. Unlike the more general term "animalcule," the word "polype" conjures an image suitable to the "essential character" of the aquatic invertebrate. Moreover, the word "polype," by referring to a particularly active animal, aptly communicates the animal's agency, which so surprised Trembley. By choosing the term "polype," Trembley and Réaumur not only asserted the significance of their discovery but did so with the force of imaginative associations to support them. Thus, to fully appreciate what the polyp meant in the eighteenth century, it is necessary to consider some of the traditions that the two scientists invoked.

4. The Poulpe

In the 1740s, in French, the term "polype" could refer broadly to many kinds of cephalopods, but it was also used interchangeably with "poulpe" to refer specifically to the octopus. Both of these forms derived from the Ancient Greek word for the octopus, *polypus*—hence, the necessity of providing an extended taxonomic justification. To make matters worse, "octopus" was not the only common meaning of "polyp" during the eighteenth century. In the treatise *Affections*, Hippocrates (c. 460–375/370 BCE) had called tumors of the nose "polyps" because of the way these growths dangle from the nostril like an octopus's tentacles.⁴⁸ In the following, to avoid confusion, *poulpe*—a modern French metathesis of *polupe*—is used to denote the large octopus,

⁴⁸ "If a polyp forms in the nose, it is like a swollen uvula and protrudes out of the nostril towards the side." Hippocrates of Cos, *Affections*, trans. Paul Potter, Loeb Classical Library 472 (Cambridge, MA: Harvard University Press, 1988), 13.

while *polyp* is reserved for the small, freshwater creature. Where quoted texts refer to the octopus as a “polyp,” the text is amended for the sake of consistency.

The image of the *poulpe* has long been associated with ideals of adaptability, as attested across classical antiquity. In a fragment from his lost *Iphigeneia*, Sophocles has Clytemnestra advise her daughter:

νόει πρὸς ἀνδρὶ χρῶμα πουλύπους ὅπως
πέτρα τραπέσθαι γνησίου φρονήματος.

Just as an octopus [*polypous*] matches its color to the rock,
be sure to match yourself to a husband with an honest mind.⁴⁹

Social adaptability, in turn, could imply cunningness, as in a fragment from Theognis, also cited by Athenaeus:

πουλύπου ὀργὴν ἴσχε πολυπλόκου.
Have the temperament of a wily octopus!⁵⁰

Here, multi-footedness is associated with a nature that is “crafty” (*polyplokos*)—literally referring an innate gift for weaving (< *plekō*). The *poulpe* symbolizes the ability to intertwine

⁴⁹ Quoted in Athenaeus, “Deipnosophistai 12, 513d.,” in *The Learned Banqueters*, Books 12–13.594b, vol. 6, ed. and trans. S. Douglas Olson, Loeb Classical Library 327 (Cambridge, MA: Harvard University Press, 2010), 18–19.

⁵⁰ Athenaeus, “Deipnosophistai 12, 513d.,” 18–19.

multiple strands of *perplexity*.

The other side of tentacular adaptability is strength, the notion of the formidable grasp that can trap and strangle unwitting victims. In the *Metamorphoses* (c. 8 CE), as Salmacis attempts to rape Hermaphroditus, Ovid (43 BCE–17 CE) describes how the naiad “wraps him round with her embrace, as a serpent when the king of birds has caught her and is bearing her on high [...]; or as the ivy oft-times embraces great trunks of trees, or as the octopus [*polypus*] holds its enemy caught beneath the sea, its tentacles embracing him on every side.”⁵¹ The *poulpe*’s many tentacles make it an indomitable force that easily overwhelms its prey. In sum, the classical-literary *poulpe* is both adaptable and devious, intractable and aggressive.

The nimble *poulpe* of poetry also tantalized classical natural historians. In his *Natural History* (completed 77 CE), Pliny the Elder (23 or 24–79 CE) writes in regard to the *poulpe*: “[Trebius] Niger asserts that no animal is more savage in causing the death of a man in the water. For it struggles with him by coiling round him and swallows him with its sucker-cups and drags him asunder by its multiple suction, when it attacks men that have been shipwrecked or are diving.”⁵² The second-century poet Oppian tells the story of the innate enmity between three squirming creatures—crayfish, eels, and *poulpes*—in Book 2 of his *Halieutica* (176–180 CE). “Above all others the dashing Crayfish and the Muraena and the *Poulpes* have a bitter feud with each other and destroy one another with mutual slaughter. Always there is fishy war and strife

⁵¹ Ovid, *Metamorphoses*, 4, 360–367, G. P. Goold, ed., Frank Justus Miller, trans. Loeb Classical Library 42 (Cambridge, MA: Harvard University Press, 1916), 204–205.

⁵² Pliny the Elder, “Book IX,” in *Natural History*, trans. Harris Rackham, Loeb Classical Library 353 (Cambridge, MA: Harvard University Press, 1938), 223.

between them, and one fills his maw with the other.”⁵³ Although the octopus’s intelligence and physical pliability help it to survive the attacks of the eel (*Muraena*) for a time, it is the weakest of the three and ultimately succumbs; the *Muraena*, in turn, is the natural prey of the crayfish. This is the sort of creature that can only be bested by a foe as “slippery” as it.

In the classical conception, the *poulpe* is a predator that represents nature’s sublimity, a violent and powerful force. It is a battle-ready beast, capable of awesome destruction. Yet, somewhat counterintuitively, the animals’ armor is its *lack* of solidity. The *poulpe* is not a “ladder of muscle,”⁵⁴ but something more like a fleshy ghost through which the assailant passes to no effect. Its adversaries come up against a master of evasion, a skill that inheres in its physical composition. That would seem to contradict one basic assumption behind the idea of a struggle, that the individual in struggle comes in contact with or struggles against some force or entity. How can a fighter struggle against a force against which every blow is ineffectual?

In naming the freshwater polyp after the *poulpe*, Trembley called forth a body of images and associations well-established in the Western imaginary. The metaphorical history perfectly described all of the contradictions, the problematic materiality, and the elusiveness of the creature he had discovered. Foreshadowing the discussions in Part II and III of this dissertation, the image of the *poulpe* also placed human attributes—cleverness, craftiness, monstrous ability—alongside abject features of another, fishy world. Most concretely, it gave the animal a name with weight, and therefore human scientists a way of connecting meaningfully with the creature’s mystifying world. And finally, perhaps self-evidently, the decision to name the polyp

⁵³ Oppian, “Halieutica 2, 253–257,” in *Oppian, Colluthus, Tryphiodorus*, trans. Alexander William Mair, Loeb Classical Library 219 (Cambridge, MA: Harvard University Press, 1987), 306–307.

⁵⁴ From Mary Oliver, “Rain in Ohio,” *The Atlantic*, April 1981.

after *another animal* created communicative difficulties for the scientific community of the eighteenth century.

5. Polypoid Polysemes

If one considers Linnaeus's taxonomic precepts, foremost the importance of endowing each species with a unique identifier, then the name that Trembley and Réaumur selected for the remarkably active "plant-animal" seems rather problematic. In the 1740s, the word "polyp" still referred to various unpleasant growths on the body.⁵⁵ Numerous medical and surgical journals of the period provide instructions for the removal of polyps from the nose, throat, heart, or uterus, and deaths from "heart polyps" appear in a number of literary texts. Thus, French readers of Trembley's *Mémoires*, the majority of whom would have been naturalists trained in medicine and surgery, would already have been in the habit of employing the term *polyp* in a medical sense, if not also in reference to *octopuses*. The situation was no better abroad: usage of the words "poulpe," "polype," and "Polyp" to mean either "octopus" or "growth" were widespread in English, German, and scientific Latin as well.⁵⁶

Given the already established meanings of the word "polype," it is not surprising that, as the science progressed, practitioners increasingly—though not uniformly—employed different terms to describe Trembley's miniature monster. Many German naturalists, for example, took advantage of the language's propensity for lengthy composites to create unique terms for specific types of polyps, including "Vielarm," "Armpolyp," and "Federbuschpolyp." Scientific consensus

⁵⁵ In some cases, but not all, the term "polyp" has been replaced by the term "tumor."

⁵⁶ "Tintenfisch" and "octopus" are only attested after 1740 in English and German, suggesting that Trembley's discovery necessitated the creation of new names for the ancient beast.

that the coral was an animal and not a plant, which followed directly from Trembley's work on polyps, led to further terminological spread: as noted above, the organism previously known as a "coral-insect" was now referred to as a "coral-polyp."

Perhaps because naturalists generally had little cause to speak of imaginary organisms in their professional work, "Hydra" also began to overtake "Polyp."⁵⁷ In the 1758 edition of his *Systema Naturae*, Linnaeus identified the animal as a member of the genus *Hydra*, and the specific species that Trembley discovered, the *Hydra polypus*.⁵⁸ In 1766, the term "polyp" disappeared from the taxonomic language, when Peter Simon Pallas (1741–1811) reclassified the *Hydra polypus* as the *Hydra viridissima*, which has remained the accepted species name to this day.⁵⁹ Nevertheless, in the 1767 edition of the *Systema Naturae*, the animal appears under yet a different name, *Hydra viridis*—with a citation of Pallas' system for good measure.⁶⁰ Today, "hydra" is the common name for the animal in English, or "hydre" in French, while in German, the term "Süßwasserpolymp," literally "freshwater polyp," is still in use.

The increasing popularity of the *Hydra* as a scientific object, coupled with the discovery of more species of "polyps," led also to the disappearance of that term from the taxonomy of

⁵⁷ The name Hydra obviously merits further discussion, since it is an expression of one of Linnaeus's precepts regarding mythological names. Chapter 2 reflects on the image of the Hydra in more detail.

⁵⁸ Carl von Linné, *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis* (Holmiae: Laurentii Salvii, 1758), 816.

⁵⁹ Peter Simon Pallas, *Elenchus zoophytorum sistens generum adumbrationes generaliores et specierum cognitarum succintas descriptiones, cum selectis auctorum synonymis* (Hagae-Comitum: Apud Petrum van Cleef, 1766), 25–32, here 31. See also the entry on *Hydra viridissimis* in Peter Schuchert et al., "World Hydrozoa Database," VLIZ, 2025.

⁶⁰ Carl von Linné, *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*, 1.II (Vindobonae: Typis Ioannis Thomae, 1767), 1320.

octopuses. In an earlier edition of his *Systema Naturae*, Linnaeus had included octopus with cuttlefish under the ancient name *Sepia*. But by 1758, in the same edition in which the “polyp” was renamed as the *Hydra*, Linnaeus attempted to tidy the taxonomic landscape by coining the new scientific Latin term “octopus.” That term, “octopus,” was formally adopted as the creature’s genus name in 1798 by Georges Cuvier (1769–1832).⁶¹ Curiously, “octopus” never caught on in French the way it did, for example, in English. In the nineteenth century, with the publication of Victor Hugo’s (1802–1885) *Les Travaillleurs de la mer* (*The Toilers of the Sea*, 1866), a more distinct term for the octopus, “pieuvre,” entered common parlance—a Norman derivation of the original “polypus.”⁶²

The polyp forced language itself to contort into polypoid forms to accommodate its very existence. The word “polyp” itself has a history of morphological comparison; in a way, the animal is destined to function as a point of comparison with other organisms. Just as Trembley and Réaumur were not the first scientists to describe the freshwater polyp, they were also not the first to apply that name to something bearing only slight resemblance to its namesake. As a metaphor for multiplicity, *polyp* ultimately does reflect the essential character of the animal.

6. Conclusion

The mnemonic function of the Linnaean system draws attention to the fact that one cannot know a natural object without engaging in the task of comparing it with other, similar objects. And

⁶¹ Georges Cuvier, *Tableau élémentaire de l’histoire naturelle des animaux* (Paris: Baudouin, imprimeur, 1798), 380.

⁶² Not until 2010 was the term *Polypus* employed for another organism, this time, a kind of Polyporus fungus. Serge Audet, “Essai de découpage systématique du genre Scutiger (Basidiomycota): Albatrellopsis, Albatrellus, Polyporoletus, Scutiger et description de six nouveaux genres,” *Mycotaxon* 111 (2010): 431–464.

since narrative, culture, and imagination, not just the raw data of sober empiricism, necessarily contribute to the network of comparisons to which one has recourse, it stands to reason that organismic analogies cannot be fully understood without some consideration for literary and cultural history.

Clearly, in the eighteenth century, the *poulpe* was an exciting—if somewhat sensationalizing—referent for Trembley’s modern wonder. The image of the *poulpe* still brought to mind gory scenes of underwater bloodshed, and the tentacles of the sea monster still inspired sublime fear and wonder. But even if in actual biological fact the octopus and polyp were very different, the image of the *poulpe* still captured the uncanny feelings that the “plant-animal” stirred. Both creatures were *things* that existed at the boundaries of human comfort.⁶³ Indeed, they were monsters.

The monstrous associations embedded in the organismic analogies that Trembley employed in his early work on the polyp had paradigmatic significance for late-eighteenth century science. These analogies communicated that the central question raised by the little animal was that of “possible behaviors,” the limits of what a given organism might be able to do. Thus, the analogy of the polyp invited scientists to test those limits themselves, and indeed, to engage in further analogization—comparing the polyp with other animals, too.

⁶³ See Bill Brown, “Thing Theory,” *Critical Inquiry* 28, no. 1 (2001): 1–22.

II: The Miraculous Hydra

Natural History is very deficient as to the larger Animals, and more so in regard to Insects: but when we come to the minute Creation, 'tis almost a *Terra incognita*: therefore here every Thing must appear wonderful and extraordinary, as the *Polype* does at present [...].

Henry Baker,

*An Attempt towards a Natural History
of the Polype*, 1743

1. Introduction

In the conclusion to the *Mémoires*, Trembley writes of the significance of his discovery for the study and appreciation of nature: “Elles doivent contribuer à nous faire penser, que ce que nous connoissons, n’est que très peu de chose, en comparaison du nombre prodigieux de merveilles que renferme la Nature: que nous connoissons encore trop peu de Parties de ce Tout admirable, qui est l’Ouvrage d’un Etre infini à tous égards [...]”⁶⁴ Here, curiously, Trembley conflates pre-modern and Enlightenment sentiments about the relationship between the creator and his creation. On the one hand, he refers to a “Being infinite in every respect”—as opposed to a “God

⁶⁴ Trembley, *Mémoires*, 4:311–312.

infinite in every respect,” thereby presenting creation in more deistic than Christian terms.⁶⁵ The word “God” never appears in Trembley’s treatise, as if to signify the disappearance of the proverbial *deus absconditus* (“hidden god”) from the sublunary realm. In that sense, this conclusion marks the *Mémoires* as the product of humanistic endeavor, of empirical science. Trembley presents himself as a student of creation, who humbly declines to respond to unanswerable questions.

On the other hand, the words “prodigieux” and “merveilles” that Trembley employs here and elsewhere in the treatise suggest more than the idea of a strange or unusual object⁶⁶: they imply that there is something almost supernatural, something miraculous about the polyp and its ilk. Yet the idea of “marvels” and “miracles” occupies an uncomfortable position within the deistic, rational-scientific worldview of the mid-eighteenth century. Voltaire (1694–1778) writes derisively of both concepts, “prodigieux” and “merveilleux,” in his entry on “History” in the *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers* (vol. 8, 1765). Although the histories of ancient Phoenicia, Egypt, Greece, and Rome abound with “merveilleux ridicule” (“ridiculous tales of superstition”), “[...] les choses prodigieuses & improbables doivent être rapportées, mais comme des preuves de la crédulité humaine; elles entrent dans l’histoire des opinions.”⁶⁷ By necessity, Voltaire’s precept, that history does not recognize events

⁶⁵ Jessica Riskin, *The Restless Clock: A History of the Centuries-Long Argument over What Makes Living Things Tick* (Chicago: The University of Chicago Press, 2016).

⁶⁶ “Il est arrivé plus d’une fois, que la précipitation, & l’amour du merveilleux, ont induit les Naturalistes en erreur, & leur ont déguisé des objets, très faciles d’ailleurs à reconnoître pour ce qu’ils étoient”; “cette merveilleuse reproduction”; “cette merveille” Trembley, *Mémoires*, 1:1–2 and 15, 2:150.

⁶⁷ [François-Marie Arouet] Voltaire, “Histoire,” in *Encyclopédie Ou Dictionnaire Raisonné Des Sciences, Des Arts et Des Métiers* (Paris, 1765), 8:220–25.

and individuals that “contradict the ordinary course of nature,” must apply to *natural* history as well.⁶⁸ As naturally occurring beings, Trembley’s polyps cannot contradict the ordinary course of nature, and it therefore seems inappropriate to refer to them as miraculous or marvelous in any way.

As Lorraine Daston and Katharine Park write in the introduction to their seminal monograph *Wonders and the Order of Nature*: “Since the Enlightenment, [...] wonder has become a disreputable passion in workaday science, redolent of the popular, the amateurish, and the childish. Scientists now reserve expressions of wonder for their personal memoirs, not their professional publications.”⁶⁹ Daston and Park argue, moreover, that between the seventeenth and eighteenth centuries, a more measured sense of appreciation of God’s creation emerged. What Trembley’s reflections on polyps and creation in general reflects, then, is an Enlightenment science in transition: even as natural, ordered explanations are offered for the most bizarre creations, the powerful sense of wonder that they evoke, and the accompanying language of marvels and miracles, is embraced and deployed in service of rational science.

Not just Trembley, but many of his contemporaries too, readily indulged in the passion of wonder, the language of marvels and miracles, in their descriptions of the freshwater polyp. As is discussed in the present chapter, the idea of the ‘miraculous polyp’ shaped the kinds of questions that scientists asked about the animal and its significance for the study of natural history. Chapter 1 argued that the polysemic name of the polyp itself encodes the marvelous new behaviors

⁶⁸ Admittedly, Voltaire distinguishes between natural history—ultimately a part of “Physics,” or what contemporarily would be called the natural sciences—and history proper—which regards the actions of humans and human society.

⁶⁹ Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150–1750* (New York: Zone Books Distributed by the MIT Press, 1998), 14–15. Subsequent citations as “*Wonders*” with page number(s).

attributed to the animal. The present chapter now demonstrates that transformations in the meaning of wonder taking place since the seventeenth century meant that the invocation of marvelousness ultimately contributed to an unstable research paradigm: one that was already superannuated in its sensationalizing tendencies, and visionary in the way it imagined the feats of which natural beings—polyps and humans alike—might be capable.

In the following, a historical overview of changes in the meaning of words like “miracle,” “marvel,” and “prodigy” between the medieval period and the Enlightenment shows that Trembley and his contemporaries worked during a key transitional period, wherein the validity of the supernatural was contested, but the epistemic and scientific value of experiences of wonder had not been neutralized completely. Thus, there is a distinct awkwardness about the narrative of marvelousness that characterized the scientific paradigm of polyp research during the mid-eighteenth century. Trembley and his contemporaries treated the animal’s regenerative abilities as a wondrous act that, through experimental methodologies, ought to be brought about and tested in order to better understand creation as a whole. Yet this research program focused less on what nature ordinarily does, and more on determining the absolute limits of nature’s law. As a result, by colonizing the logic of the miracle for itself, experimental science made the pursuit of metaphysical limits—primarily a feature of medieval ontologies of the natural and supernatural—the focus of its new, rigorously naturalistic science. In this regard, science, much like literature, inherited from the medieval *topos* of the miracle the charge of offering access to metaphysical truths by means of demonstration, and thereby making possible future feats of wonder and marvel.

2. Marvels & Modernity

In contemporary usage, the terms “miracle,” “marvel,” and “prodigy” can, to some degree, be used interchangeably in a way they would not have been 250 years ago or more.⁷⁰ One speaks of “miracles,” “marvels,” and “prodigies” metaphorically, more to express a subjective feeling of wonder, rather than to make an objective statement about the nature of the individual, organism, or event in question. It is rare, too, that anyone employs the term “prodigy” in a negative, ominous sense, as would be more appropriate to its original meaning. All three terms fall under the now likewise much less distinct category of “wonder” as a result of changes in the concept of nature itself that took place during the age of Enlightenment. At the time Trembley published his *Mémoires*, these changes were underway, but by no means complete. Consequently, in order to fully appreciate what it then meant to position the polyp as “miraculous” or “marvelous,” it is necessary to disentangle these terms from each other once again and consider their status at the time that Trembley was writing.

The authoritative source on this process of change is the monograph by Daston and Park, cited above, which charts the history of wonders from the medieval period into the age of the Enlightenment. Early medieval scholars, following in the tradition of Augustine (354–430 CE), tended not to distinguish so sharply between the natural or supernatural causes of different beings and instead “treated each thing in the created universe as a direct and separate manifestation of divine will.”⁷¹ But by the 1200s, scholars began to separate the creator from the creation, and to concern themselves more narrowly with the question of the natural order. As

⁷⁰ Broadly construed, to include also the ‘miraculous,’ and the ‘marvelous’ in English; ‘merveilleux’ in French; and ‘Wunder,’ ‘wundervoll’ in German. See Daston and Park, *Wonders*, 15–16.

⁷¹ Daston and Park, *Wonders*, 48.

Daston explains in a separate article, “The natural order itself was a matter of nature’s habitual custom rather than of nature’s inviolable law, what usually rather than what infallibly happened.”⁷² Ultimately, this new conception of nature produced new standards regarding the “proper” objects of *scientia*.

Late medieval *scientia* centered on a tripartite taxonomy of supernatural, preternatural, and natural objects. Nature, and hence all matters of “habitual custom,” could and ought to be observed, documented, and explained. The supernatural, however, “defied necessity, and therefore scientific treatment.”⁷³ Unbound by the natural order, God could act in ways that directly contradicted that order. Thus, from the perspective of medieval science, miracles—which resulted from “God’s unmediated actions”—both *were possible* and required no explanation at all. Between the natural and the supernatural, there existed the category of preternatural, or *wondrous*, beings and occurrences. These were the types of things that “happened rarely, but nonetheless by the agency of created beings,” including human beings, angels, and demons.⁷⁴ The category of wonders also included all manner of morphological oddities, monsters, and prodigies.⁷⁵

Whereas the medieval conception of nature was more flexible, “the natural order moderns inherited from the late seventeenth and eighteenth centuries is one of uniform,

⁷² Lorraine Daston, “Marvelous Facts and Miraculous Evidence in Early Modern Europe,” *Critical Inquiry* 18, no. 1 (1991): 93–124, 99. Subsequent citations as “‘Marvelous Facts’” with page number(s).

⁷³ Daston, “Marvelous Facts,” 99.

⁷⁴ Daston, “Marvelous Facts,” 97.

⁷⁵ See John Block Friedman, *The Monstrous Races in Medieval Art and Thought* (Syracuse, NY: Syracuse University Press, 2000).

inviolable laws.”⁷⁶ The new scientific rigor that followed from the methodological revolutions of Francis Bacon (1561–1626) and René Descartes (1596–1650) required that no stone, no matter how bizarre, be left unturned. Preternatural occurrences were redistributed into the categories of the supernatural and the natural; correspondingly, scientists naturalized the marvelous, drawing a sharper distinction between possible and impossible beings and events. They began to account for preternatural objects not as exceptions to but as *a fortiori* evidence for the universality of nature’s laws. If a given law is true *even* in bizarre and monstrous creatures,⁷⁷ then that law would appear to be valid across the whole of creation.

Under this paradigm, the very concept of the miracle became contested. In the chapter “On Miracles” in the *Tractatus theologico-politicus* (*Theologico-Political Treatise*, 1670), Baruch de Spinoza (1632–1677) modifies and limits the scope of the miracle:

From these premises therefore – that in nature nothing happens which does not follow from its laws, that its laws extend to all things conceived by the divine understanding, and finally that nature maintains a fixed and unchangeable order—it most evidently follows that the term ‘miracles’ can be understood only with respect to human beliefs, and that it signifies nothing other than a phenomenon whose natural cause cannot be explained on the pattern of some other familiar thing or at least cannot be so explained by the narrator or reporter of the miracle.⁷⁸

As Graeme Hunter has argued, Spinoza does not deny the existence of miracles, as has often been argued, but rather restricts them to the realm of natural occurrences.⁷⁹ In doing so, he

⁷⁶ Daston and Park, *Wonders*, 14.

⁷⁷ See Daston and Park, *Wonders*, 173–214.

⁷⁸ Benedictus de Spinoza, “On Miracles,” in *Spinoza: Theological-Political Treatise*, ed. Jonathan Israel and Michael Silverthorne (Cambridge, UK: Cambridge University Press, 2007), 81–96, here 83–84.

⁷⁹ Graeme Hunter, “Spinoza on Miracles,” *International Journal for Philosophy of Religion* 56, no. 1 (2004): 41–51.

rearticulates the miracle as a matter of solely epistemic—rather than ontological—significance. The experience of a miracle may provoke a feeling of uncertainty about the laws of nature, but it does not and cannot undermine them in any way. Rather, the miracle reveals a subjective lack of understanding, as opposed to an objective anomaly in the order of things.

Though Spinoza does not deny the existence of miracles *per se*, his argument in “On Miracles” obviously creates an opportunity for more aggressive critique, for example, by Voltaire and David Hume (1711–1776).⁸⁰ As Daston has argued, once miracles lose their “evidentiary autonomy” at the end of the seventeenth century, it is only a matter of time until their very facticity becomes questionable.⁸¹ By the mid-eighteenth century, “miracle” is re-associated with the concept of the supernatural, and therein banished from the realm of this-worldly, scientific concern once and for all. God comes to represent *only* the principle of creation, the *deus absconditus* recedes from the picture entirely, and the only miracle remaining is that of Nature itself, as a whole.

In this context, the allusions to monsters and marvels that crowd the pages of mid-eighteenth-century polyp research are striking. As is shown in the subsequent section, scientists frequently invoke the epistemic and affective notion of “wonder” foregrounded in Spinoza’s definition of the miracle. They also often make reference to the supernatural, precisely as a way of asserting, by means of a negative analogy, the polyp’s singular importance as an object of modern scientific discourse. By the end of the century, as Daston and Park argue, the *mésalliance*

⁸⁰ David Hume, “Of Miracles,” in *Enquiries Concerning Human Understanding and Concerning the Principles of Morals*, ed. Lewis A. Selby-Bigge and P. H. Nidditch (Oxford: Clarendon Press, 1979), 109–31.

⁸¹ “[...] by depriving miracles of evidentiary autonomy, [evidentialist theologians] also deprived them of their ostentive function. If miracles require the evidence of doctrine, who needs the evidence of miracles?” (Daston, “Marvelous Facts,” 120).

of science and the supernatural would be annulled entirely. But, for the time being, analogies of the monstrous and marvelous served the scientific program of the mid-eighteenth century.

3. More Than Marvelous

What struck the public as most marvelous about Trembley's discovery of the polyp was the animal's astounding reproductive and regenerative abilities. In one sense, such reactions are not so surprising. The news that the polyp could reproduce by budding identical copies of itself came hot on the heels of Bonnet's announcement that aphids could reproduce asexually.⁸² By comparison, the idea that an animal existed that could regenerate seemingly *ad infinitum* was downright bizarre.

The marvel of regeneration was thus the central theme of many public discussions of Trembley's work from the very start. The announcement of his discovery published in the 1741 edition of the *Histoire de L'Academie Royale des Sciences* begins with a striking analogical argument.

L'Histoire du Phoenix qui renaît de ses cendres, toute fabuleuse qu'elle est, n'offre rien plus merveilleux que la découverte dont nous allons parler. Les idées chimeriques de la Palingénésie ou régénération des Plantes & des Animaux, que quelques Alchymistes ont cru possible par l'assemblage & la reunion de leurs parties essentielles, ne tendoient qu'à rétablir une Plante ou un Animal après sa destruction; le Serpent coupé en deux, & qu'on a dit se rejoindre, ne donnoit qu'un seul & même serpent; mais voici la Nature qui va plus loin que nos chimères. De chaque morceau d'un même animal coupé en 2, 3, 4, 10, 20, 30, 40 parties, &, pour ainsi dire, haché, il renaît autant d'animaux complets & semblables au premier.⁸³

⁸² Dawson, *Nature's Enigma*, 6.

⁸³ Académie royale des sciences, ed., "Animaux coupés & partagés en plusieurs parties, & qui se reproduisent tout entiers dans chacune," *Histoire de l'Académie royale des sciences* (Paris), 1741, 33–35. Subsequent citations as "'Animaux coupés & partagés en plusieurs parties'" with page number(s).

The structure of the analogical argument is fascinating, because its purpose is to demonstrate the superiority of the polyp to the mythological creatures named. It departs from the premise that the polyp and the monster are similar because they each exhibit preternatural abilities of regeneration. The phoenix can be resurrected, the serpent can be rejoined, and the polyp can be cut into as many pieces as the scientist likes. This first initial positive analogy, however, casts into relief a second negative analogy: that the same preternatural processes claimed by the phoenix and the serpent cannot lead to the production of more phoenixes or serpents than one had to begin with. Thus, in comparing the polyp with these fictional creatures, the gentlemen of the academy conclude that the entirely natural polyp is, in fact, “more marvelous” than any of them.⁸⁴

Trembley invested a tremendous effort into publicizing “ce Polype extraordinaire.”⁸⁵ In what Marc J. Ratcliff has characterized as a “strategy of generosity,”⁸⁶ the naturalist corresponded with scientists across Europe, ensuring that the awareness of his little marvel was far reaching. His correspondents included Réaumur in Paris, Martin Folkes (1690–1754) in London, Jan Frederik Gronovius (1686–1762) in Leiden, and Johannes Nathanael Lieberkühn (1711–1756) in Berlin. Trembley also sent polyp experimentation kits to each of his contacts, which included instructions and supplies for cultivating polyps, as well as polyp specimens and

⁸⁴ “cette espèce de prodige” (“Animaux coupés & partagés en plusieurs parties,” 34).

⁸⁵ Trembley, *Mémoires*, 1:15.

⁸⁶ See Marc Ratcliff, “Abraham Trembley, the Polyp and New Directions for Microscopical Research,” in *The Quest for the Invisible: Microscopy in the Enlightenment* (Farnham, UK & Burlington, VT: Ashgate Pub. Limited, 2009), 105. Subsequent citations as ““The Polyp and New Directions for Microscopical Research”” with page number(s).

descriptions of his experimental method.⁸⁷ Réaumur and Folkes, in particular, also demonstrated the animals' strange abilities to the scientific community in both public and private presentations. By the time his *Mémoires* were published in 1744, the polyp had become generally well known.

The wonder that many scientists expressed in response to the polyp's biology was matched by widespread doubt that the animal really did exist. In fact, skeptics were so many in number that they had their own nickname—the so-called *incrédules*, unbelievers.⁸⁸ As Virginia P. Dawson explains: “To Trembley’s contemporaries, regeneration from parts seemed to introduce an unwelcome element of chance into the regular structure of living beings and implied that regeneration might be an attribute of matter independent of rational plan.”⁸⁹ If that were true, then that meant that Trembley and his polyp had dealt a nasty blow to the concept of Nature’s inviolable law introduced by modern scientific rationality. Thus, lest they be forced to accept such a severe violation of the mechanics of nature, the *incrédules* felt that, at best, the polyp-phenomenon must be some sort of elaborate practical joke.

In London, Folkes faced jeers and taunts from the audiences of his demonstrations. The sense of disbelief was registered in print, as well. Henry Fielding (1707–1754), for example, published a satirical letter to the Royal Society regarding another marvelous species, the Chrysipus, or Guinea—a golden coin capable of spontaneous generation. The name of Fielding’s fictional “organism,” Chrysipus, translates as “gold-foot,” and therein explicitly mocks Trembley’s “many-foot.” In addition to making obvious gestures toward alchemy, Fielding’s

⁸⁷ In fact, Trembley was the first scientist to successfully transport aquatic specimens across Europe. Ratcliff, “The Polyp and New Directions for Microscopical Research,” 104.

⁸⁸ Ratcliff, “The Polyp and New Directions for Microscopical Research,” 108.

⁸⁹ Dawson, *Nature’s Enigma*, 8.

mocking treatise apes the credulity of the learned societies by, for example, invoking the rhetoric of superlatives in the *Academie Royale*'s announcement of the polyp: "I come now, in the last Place, to speak of the Virtues of the Chrysipus; In these it exceeds not only the Polypus, of which not one single Virtue is recorded, but all other Animals and Vegetables whatever."⁹⁰ Where the polyp exceeds the myth of the phoenix, the Chrysipus exceeds the myth of the polyp.

According to Ratcliff, the public dissections organized by Réaumur and Folkes successfully silenced skepticism about the "marvelous animal."⁹¹ The consequence of that cycle of doubt and belief was not the neutralization of the polyp and its natural historical significance. Both the demonstrations, which almost had the character of a public ordeal, and the notion of unbelievers encouraged the association of the polyp with the incredible, the marvelous. In his *Vénus physique* of 1745, Pierre Louis Maupertuis (1698–1759) would introduce the idea of regeneration from parts as follows: "Mais cela pourroit-t-il surprendre, lorsqu'on saura quelle est l'autre maniere dont les Polypes se multiplient? Parlerai-je de ce prodige; & le croira t-on?"⁹² Maupertuis does not doubt the reality of the polyp in the slightest, but nevertheless still invokes marvels in order to capture the novelty of the science.

The public development of the polyp's marvelous narrative bred further invocations of the marvelous throughout the scientific literature of the period. An anonymous author writing one year later in the British Royal Society's *Transactions* of 1742 compares the polyp to "some

⁹⁰ Henry Fielding, *Some Papers Proper to Be Read before the Royal Society, Concerning the Terrestrial Chrysipus, Golden-Foot or Guinea* (London: J. Roberts, 1743), 28.

⁹¹ Ratcliff, "The Polyp and New Directions for Microscopical Research," 108.

⁹² Pierre Louis Moreau de Maupertuis, *Vénus physique* (Paris, 1751), 93.

very remarkable Monsters that have appeared in the World.”⁹³ Similarly, the British naturalist Henry Baker (1698–1774), in his treatise *An Attempt towards a Natural History of the Polype* (1743), repeatedly employs the terms “wonderful” and “amazing” when reporting the operations that Trembley performed: “But the most amazing Part of Mr. Trembley’s Account, is, what he tells us, concerning his Operations on these Creatures.”⁹⁴ Elsewhere in his *Vénus physique*, Maupertuis further echoes the rhetoric of the Paris Academy, calling the animal: “Hydre plus merveilleux que celui de la fable; on peut le fendre dans sa longueur, le mutiler de toutes les façons; tout est bientôt réparé; & chaque partie est un animal nouveau.”⁹⁵ And when August Johann Rösel von Rosenhof (1705–1759) describes the operations that he performs on the body of the polyp in the third volume of his journal *Der monatlich herausgegebenen Insecten-Belustigung* (Delight in Insects Published Monthly, 1755), he calls his many-headed creations “Wunderthiere,” “Mißgeburten,” and “sonderbare[] Creaturen.”⁹⁶ In just a few years, the polyp had become one of the most important bizarre truths evidencing the miracle of nature.

4.1. Performing Miracles

In his treatise *L’homme machine* (“Machine Man”) of 1748, Julien Offray de La Mettrie (1709–

⁹³ Anonymous, “Part of a Letter,” *Philosophical Transactions of the Royal Society* 42 (1742): 227. Quoted from Schwartz, *Worm Work*, 107.

⁹⁴ See also Baker’s allusions to “the wonderful Restoration of these Creatures” and the “wonderful Manner” in which they regenerated. Henry Baker, *An Attempt towards a Natural History of the Polype* (London: R. Dodsley, 1743), 32, 94, and 99.

⁹⁵ Maupertuis, *Vénus physique*, 94.

⁹⁶ August Johann Rösel, *Der monatlich-herausgegebenen Insecten-Belustigung* (Nürnberg: Johann Joseph Fleischmann, 1746–1761), 3:489–491. Subsequent citations with “*Insecten-Belustigung*” with volume and page number(s).

1751)⁹⁷ invokes the miracle when comparing the work of the Swiss physician J.C. Amman (1669–1724), who created a method for teaching deaf-mutes, with Trembley’s experiments with polyps: “A man who owes the miracles he performs to his own genius [Amman] is, to my mind, superior to one who owes his to chance [Trembley].”⁹⁸ Here, in his pejorative fashion, La Mettrie distinguishes between two sorts of miracles: the *active* miracles of genius and the passive miracles of chance. Amman’s miracle serves as evidence of his own brilliance, just as the pre-modern miracle certified divine providence. The miracle of chance, on the other hand, reflects not the greatness of the man, but of his experimental object. Though La Mettrie invokes the miracle ironically, the connection draws attention to the unsettled relationship between the two phenomena during the 1740s.

As the public dissections of polyps organized by Folkes and Réaumur demonstrate, the meaning of the experiment changed once miracles and marvels were banished from scientific inquiry. The abolition of old standards of evidentiary proof creates the need for new methodologies of divining nature’s truths and new standards for evaluating empirical evidence. John Zammito explains in his monograph *The Gestation of German Biology* that conflicting interpretations of experimental and mathematical Newtonianism in the late-seventeenth and early-eighteenth centuries led to heated debates about the role of speculation in scientific

⁹⁷ Some of the staunchest opponents of systematist thinking, materialists in France and Switzerland, spoke of the work of the scientist. Notably, this group included many thinkers in Trembley’s own scientific sphere—Réaumur, Georges-Louis Leclerc, Comte de Buffon (1707–1788), La Mettrie, and Denis Diderot (1713–1784). Buffon, whose *Histoire Naturelle* had a more popular reception, was sometimes “disparaged as either (or simultaneously) a speculative (and/or) a popularizing ‘stylist.’” The reception history notwithstanding, he made essential contributions to the history of the experimental method. See Zammito, *The Gestation of German Biology*, 111. Chapter 3 deals with the differences between Germanic and Francophone science.

⁹⁸ Julien Offray de La Mettrie, “Machine Man,” in *Machine Man and Other Writings*, trans. Ann Thomson (Cambridge & New York: Cambridge University Press, 1996), 1–40, here 12.

enquiry.⁹⁹ Experimental Newtonians favored more empirical methodologies, preferring to let the data itself reflect the truth of nature. Mathematical Newtonians, on the other hand, pursued a systematic theorization of nature on the level of principles. Broadly speaking, empiricists accused systematists of fantastical speculation about the unknowable, while systematists accused empiricists of insufficient attention to the higher principles underlying natural phenomena.

Arguably, in championing the necessity of sensible proof for any work that ought to have epistemic value, experimental Newtonians, in particular, colonized the logic and function of the miracle for themselves. In the classical sense, the miracle is a supernatural event that contradicts the natural order in order to demonstrate some providential principle. Conversely, in the modern era, the experiment is a natural ‘miracle’ that contradicts or confirms present understanding of the natural order in order to demonstrate some physical principle. The experimenter takes on God’s role and generates the moments of marvel that he requires to probe the laws of nature. Here, one might invoke Spinoza’s concept of the miracle as an as yet inexplicable, though nevertheless entirely *natural*, phenomenon in order to argue more specifically that the Scientific Revolution caused not the demise of the miracle, but rather a substantive transformation in the nature and meaning of miracles.

At the same time, the history of polyp dissection draws attention to the more dubious aspects of a science still influenced by the legacy of the miracle. For the focus in one of Trembley’s most famous experiments—the creation of miniature “Hydras”—is not on the “natural” abilities of the polyp, not on the patterns that the natural order spontaneously reveals, but on the very strange and extreme things of which the animal is capable under the

⁹⁹ See the chapter “Making Life Science Newtonian” in Zammito, *The Gestation of German Biology*, 37–70.

circumstances of experimentation. Were that not the case, more attention might be paid to the process of budding, which occurs naturally, than to the creation of new polyps via surgical operation. And even though the point might be made that budding had already been discovered forty years prior, from the perspective of a scientific community that had paid no attention to van Leeuwenhoek's letter on the matter, both discoveries would have seemed relatively new. Thus, evidently, what fascinates the scientists of the mid-eighteenth century, is not the natural abilities of the polyp as such, but the opportunity that modern science creates for exaggerating natural habits via experimentation to the point that they transform into preternatural marvels.

This tension between the pull of the wondrous and the demands of empiricism is evident even in the *Mémoires* themselves. On the one hand, Trembley was staunchly anti-theoretical. In the conclusion to the *Mémoires*, he writes: "La Nature doit être expliquée par la Nature, & non par nos propres vûes, qui sont trop bornées pour envisager un si grand Objet dans toute son étendue. La beauté de la Nature paroît certainement davantage, quand ce que nous en connoissons, n'est pas mêlé avec nos Imaginations."¹⁰⁰ He generally avoided speculation about invisible chains of cause and effect, preferring instead to provide a thorough documentation of his observations.

At the same time, there is something decidedly *wonderful* about the kinds of experiments Trembley performed on his polyps. As Lenhoff and Lenhoff put it, some of the more "playful" experiments that Trembley performed included: "deliberately tangling up the arms of a long-armed polyp" to see if it could "disentangle them without help," tricking a perch into eating a "polyp that is itself in the process of swallowing a kind of worm much favored" by the fish, and of course engaging in all manner of sectioning and inversion experiments.¹⁰¹ Born as it might

¹⁰⁰ Trembley, *Mémoires*, 4:312.

¹⁰¹ Lenhoff and Lenhoff, *Hydra*, 1:25.

have been from an almost boyish curiosity, Trembley would not have characterized this work as anything but strict, in the Lenhoffs' words "accurate," empiricism. He evidently saw no problem with permitting the play of the mind drive his search for empirical truths, at the same time that he insisted that description and not explanation constituted the scientist's primary responsibility.

4.2. Sweet Science

If Trembley's science tends to reveal what the organism is capable of, as opposed, for example, to what it ordinarily does, then that places the scientist in interesting, perhaps uncomfortable, proximity to the literary artist. Both are more concerned with limits, boundaries, and extremes than with constructing a normalized model of the natural world. That is, they seek to perform their own kind of miracle—one in the form of the experiment, the other in the form of the work of art. One might, from a modern perspective, describe this as a highly *unscientific* attitude toward the work of uncovering natural truths, since it privileges the inclinations of the scientist over the products of nature as they choose to exhibit themselves. At the same time, Trembley's contemporaries, like La Mettrie in the passage quoted above, made strong arguments for a more creative scientific operation.

One of the most emphatic defenses of creative experimentation is to be found in Diderot's *Pensées sur l'interprétation de la nature* (*On the interpretation of Nature*, 1753).¹⁰² In Diderot's mind, the best scientists are creative "geniuses" who "[...] à qui la nature aura donné, comme autrefois à Epicure, à Lucrece, à Aristote, à Platon, une imagination forte, une grande

¹⁰² All citations of Diderot's original French from the *DPV* edition: Denis Diderot, *Œuvres complètes*, ed. Hans Dieckmann et al., 25 vols. (Paris: Hermann, 1975). Subsequent citations as "*DPV*" with volume and page number(s).

éloquence, l'art de présenter ses idées sous des images frappantes et sublimes!"¹⁰³ This gift of a vivid imagination in particular is key for Diderot. Frequently, he asserts, the thought process behind experimentation does not appear to follow any coherent line of reasoning. His empiricists are "extravagant" thinkers: "[...] car quel autre nom donner à cet enchaînement de conjectures fondées sur des oppositions ou des ressemblances si éloignées, si imperceptibles, que les Rêves d'un malade ne paraissent ni plus bizarres ni plus décousus[?]"¹⁰⁴ In other words, scientific fact originates from the realm of the unbelievable, yet imaginable.

Diderot's mad scientist seems to come quite close to performing a miracle in the conventional sense, conjuring new ideas and new discoveries out of thin air, creating unprecedented analogies in his manner of thinking, experimenting, and writing. He synthesizes poetic, rhetorical, and critical thinking to generate apparently "strange" and "disjointed" hypotheses about the natural world, operating with analogies in a way that dispenses entirely with the initial burden of plausibility. In fact, there is almost an inverse relationship, here, between the plausibility and genius of a scientific discovery. This scientist's discoveries matter precisely because the similarities drawn seem so remote, so surprising. Thus, Diderot's vision of extravagant science is based at bottom on a miracle of analogy.

It is not just that other scientists and *philosophes* spoke of their work in creative terms, however. It is also the case that the literary authors of Trembley's age also invoked scientific categories in their own aesthetic treatises, thereby bringing the analogy of the work of the scientists and the literary artist into focus. One year before Trembley's close encounter of the polypoid kind, the Swiss philologists Johann Jakob Bodmer (1698–1783) and Johann Jakob

¹⁰³ *DPV*, 9:42.

¹⁰⁴ *DPV*, 9:49.

Breitinger (1701–1776) penned two important essays on the generative relationship between empiricism and fantasy in works of poetry. Drawing on the French Neo-Classicist model of *la belle nature*—the idea that the true artist perfects what he finds in nature—these theses challenge the idea that simple empiricism is the “correct” mode of artistic production, and hence that poetry need not aim to imitate nature as experienced perfectly.¹⁰⁵

Instead, Bodmer and Breitinger demonstrate that artists necessarily exercise a vivid imagination in their invention and presentation of details that, if not actually matters of fact, nevertheless function as if they were, at least within the realm of the work of art. In his *Von dem Wunderbaren in der Poesie* (On the Marvelous in Poetry, 1740), Bodmer defends John Milton’s (1608–1674) *Paradise Lost* (1667) against Voltaire’s criticism that heavenly war “[...] etwas wäre, das die blossе Einbildung hervorgebracht hätte, und die menschliche Natur überstiege” and therefore defies human understanding and interest.¹⁰⁶ In fact, that which surpasses the *sensible* world—insofar as the angels occupy a natural world that is *supersensible* to humans—is not only viable but, indeed, potentially the subject of masterful art. What is required, in any case, is recourse to “Wissenschaft,” to a comprehensive body of knowledge about the poetic subject that can make the ungraspable graspable.¹⁰⁷

¹⁰⁵ See Jill Anne Kowalik, *The Poetics of Historical Perspectivism: Breitinger’s Critische Dichtkunst and the Neoclassic Tradition* (Chapel Hill: University of North Carolina Press, 1992).

¹⁰⁶ Johann Jakob Bodmer, *Critische Abhandlung von dem Wunderbaren in der Poesie: und dessen Verbindung mit dem Wahrscheinlichen. In einer Vertheidigung des Gedichtes Joh. Miltons von dem verlohrnen Paradiese; der beygefüget ist Joseph Addisons Abhandlung von den Schönheiten in demselben Gedichte* (Zürich, Switzerland: Conrad Orell, 1740).

¹⁰⁷ “Wenn jezo ein Poet weiter gehet, und diese gesammelten abgebrochenen Nachrichten mit einander vergleicht, ergänzt, ausführet, verbindet, so ist auch dieses mehr als ein Hirngespinnst und leere Einbildung, es hängt an etwas würcklichem und geschehenem, wovon wir Gewißheit haben, und weil Ordnung und Verknüpfung der Umstände darinnen ist, so ist es auch nicht Unwahrheit, es ist Möglichkeit, es ist Wahrheit nach einem gewissen Satz; und von dieser Art ist

Similarly, in *Critische Dichtkunst* (Critical Poetic Theory, 1740), elaborating on an aesthetic principle dating back to Aristotle, Breitinger makes novelty one of the central contributions of moving works of art, where that novelty would be the value added by the innovative poet; within the category of art generally, he defines the wonderful and the fantastic as offering particular forms of novelty.¹⁰⁸ At bottom, Bodmer and Breitinger argue that the generation of fantastic worlds must be grounded in the realm of scientific plausibility; that is, that the form of scientific accuracy should underlie the exploration of the imagination.

The concept that best captures this nexus of science and literature in the generation of miraculous analogies is that of “sweet science.” Amanda Jo Goldstein defines “sweet science” as follows:

the tropes, figures, images, and metaphors formerly thought to adorn or obscure the simple evidence of sense may instead index fidelity to it—may constitute the best possible linguistic register for aspects of objective activity sidelined by the philosophical pursuit of “clear and distinct ideas.”¹⁰⁹

Here, poetic contemplation is not antithetical to or even apart from scientific observation, but foundational to it. Science lives in the play of ideas and therefore also in the play of words, images, and meanings. Thus, even when a strict empiricist like Trembley resists the Baconian method of induction and the pursuit of “general rules,”¹¹⁰ to say nothing of Cartesian clarity or

alle die Wissenschaft, um welche die Poesie sich bekümmert.” Bodmer, *Critische Abhandlung von dem Wunderbaren in der Poesie*.

¹⁰⁸ Johann Jakob Breitinger, *Critische Dichtkunst, worinnen die poetische Mahlerey in Absicht auf die Erfindung im Grunde untersucht und mit Beyspielen aus den berühmtesten alten und neuern erläutert wird* (Zürich: C. Orell und Comp., 1740).

¹⁰⁹ Goldstein, “Sweet Science,” 1–34, here 9.

¹¹⁰ Ratcliff takes note of the irony that Trembley was not at all a metaphysician, yet still had an incredible impact on contemporary developments in the field. See Ratcliff, “The Polyp and New Directions for Microscopical Research,” 103.

distinctness,¹¹¹ he nevertheless may actively and creatively exploit the relationship between the wondrous in nature and the act of wondering about nature. In other words, the fact that wondering stops for the empiricist with the act of observation itself does not mean that wondrousness disappears from his science. What matters for the “sweet scientist” is that the imagination is used as a tool for approaching not metaphysical but physical truths.

Science as articulated by Diderot cleaves to art as articulated by Bodmer and Breitingner, in an inverse relation: for them, scientific imagination is a tool for making *physical* truths sensible to human beings. Freshwater polyps, like angels, represent a sphere of nature that is separate but related to the world experienced by human beings. Angels, being of the heavens, belong to the superlunary realm, while polyps occupy the sub-sublunary realm. One exists in super-telescopic, the other in microscopic relation to the human being. Just as human beings struggle to comprehend heavenly beings and their world, they also struggle with the monstrous realms of biological oddities of the freshwater polyp. Through imagination, human beings access at least a rich approximation or model of these worlds that, in turn, offers novel insights into certain metaphysical truths: on the one hand, supersensible reality or the truth of heaven, and on the other subsensible reality or the truth of nature—the material basis of all existence. Thus, describing polyps as they do, in terms of the miraculous, Trembley, the Paris Academy, and other acolytes participate like Bodmer’s Milton in cultivating sensitivity to a wondrous para-reality foundational to the perceptible world of human beings. The poetic ground of empirical knowledge means that narrative is essential to all steps in the scientific process.¹¹²

¹¹¹ René Descartes, *The Philosophical Writings of Descartes*, ed. John Cottingham et al. (Cambridge: Cambridge University Press, 1984), 24.

¹¹² In the essay “Anthropologische Annäherung an die Aktualität der Rhetorik,” Blumenberg elucidates the rhetorical character of the scientific endeavor as the progressive pursuit of consensus: “[...] die Geschichte der Wissenschaft gab Aufschluß darüber, daß auch Verifikation

4.3. The Hydra

The concept of “sweet science” is useful for framing the *narrative* of the Hydra that Trembley presents in his *Mémoires*. In Volume IV, Trembley introduces a second name for the polyp, “Hydre,” an allusion to the many-headed beast slain by Hercules and Iolaus.

One pense bien, qu’après être parvenu à faire des Hydres, je ne m’en suis tenu là. J’ai coupé les têtes de celui qui en avoit sept; &, au bout de quelques jours, j’ai vu en lui un prodige qui ne le cède guères au prodige fabuleux de l’Hydre de Lerne. Il lui est venu sept nouvelles têtes; & si j’avois continué à les couper à mesure qu’elles pousoient, il n’y a pas à douter que je n’en eusse vu pousser d’autres. Mais, voici plus que la Fable n’a ôsé inventer. Les sept têtes, que j’ai coupées à cette Hydre, ayant été nourries, sont devenues des Animaux parfaites, de chacun desquels il ne tenoit qu’à moi de faire une Hydre.¹¹³

Trembley employed “Hydre” sparingly, only in discussions of his dissections of polyps in the fourth volume of the *Mémoires*, but his terminology had a significant impact on the animal’s subsequent reception.

What is fascinating about this gesture is that it introduces a new, human element to the narrative. By making a distinction between the “Polype” and the “Hydre,” Trembley enshrines the importance of the intervention of the scientist. That is, by using both terms, he plays with the idea that he, the scientist, is just as capable as nature of producing his own “prodigies” that surpass the productions of the mythological past. The essence of the scientist’s occupation is the pursuit of Nature’s absolute limits in a process of monstrous iteration.

To put a finer point on it, what Trembley does in alluding to the legend of the Hydra is to

den Typus der Zustimmung auf Widerruf repräsentiert, daß die Publikation jeder Theorie einen Appell impliziert, die angegebenen Wege ihrer Bestätigung nachzugehen und ihr das Placet der Objektivität zu geben, ohne daß durch diesen Prozeß je endgültig ausgeschlossen werden kann, daß auf anderen Wegen anderes gefunden und Widerspruch erhoben wird.” See Hans Blumenberg, “Anthropologische Annäherung an die Aktualität der Rhetorik,” in *Wirklichkeiten in denen wir leben: Aufsätze und eine Rede* (Stuttgart: P. Reclam, 1981), 104–136, here 112.

¹¹³ Trembley, *Mémoires*, 4:246.

implicate himself, the scientist, in the historical record as a modern Hercules. As Oppian stressed, a *poulpe* can only be laid low by a monster as cunning and as dangerous as itself. And in the classical sources, both Hercules and the Hydra of Lerna are beings of monstrous origin and power. The Hydra is a vicious monster that repulses human domination, violating the laws of death just as it violates the laws of birth. It is the offspring of the half-snake, half-woman Echidna and the hundred-headed dragon Typhon. When severed, each of the Hydra's heads grows back, making the monster virtually undefeatable. Although Hercules had been conceived of Zeus and the human woman Alcmene, after the child was born, Zeus tricked Hera into nursing the infant, which bestowed the superhuman strength the hero would one day need to confront the fearsome, almost invincible Hydra. Only a demigod like Hercules, who is likewise unhindered by mortal-natural limits, could ever even think of defeating this monstrous creature.

The name "Hydra" returns the reader to the moment of invention through struggle at the scene of experimentation. It frames the polyp as a slippery monster in miniature doing battle against the Herculean "miracle-maker." The scientist instantiates the Herculean myth, stepping in almost as a sort of Echidna, creating his own monster: it is hard to imagine that, in its natural habitat, the polyp frequently has cause or the necessary conditions to transform into a seven-headed hydra. Yet this is something that it can do readily and repeatedly, in a variety of permutations of heads and limbs. Only in captivity, under "unnatural conditions"—only under the scalpel can the polyp perform the spectacular feats that it in nature would otherwise have no reason to perform. What the pressures of population density do for the grasshopper and the locust,¹¹⁴ the scientist's *strength of imagination* does for the polyp and the hydra; in fact, from

¹¹⁴ Climate cycles of drought followed by heavy rainfall followed by rapid vegetation growth can drive up population density, triggering a population of transition from solitary to gregarious

the moment Trembley alludes to the myth, “Polype” is the name for the organism prior to and separate from any operation, while “Hydre” refers to the creature transformed. The scalpel creates the beast, and the pen, through the words “Polype” and “Hydre,” mythologizes that transformation. One might even go so far as to say that Trembley’s pen and scalpel are actors in the invention of a new species.

The creation of the Hydra through a struggle with the polyp equates the work of “making miracles” with Herculean struggle. It is not merely the case that in the body of the polyp nature surpasses myth, but rather that through his incisions, and by engaging in scientific experimentation, Trembley himself performs feats of science that reveal these miraculous truths. In fact, it is his duty and his destiny to intervene in the regular course of nature’s laws: “The seven heads, which I cut off from this Hydra, having been fed, became perfect Animals, from each of which it was up to me to make a Hydra.” That it was “up to” Trembley to create the Hydra suggests that the essence of the scientist’s occupation is the pursuit of Nature’s absolute limits in a process of monstrous iteration. This scientist is even more fearsome than Echidna, who births the monstrosity, even more vengeful than Hera, who nourishes it, even more powerful than Hercules, who kills it, and even more inventive than a modern-day Hesiod, recording the marvels of history for the interest and edification of posterity. He is also the necromancer who transmogrifies the conditions of life and death. His laboratory is the site of a modern microcosmology, wherein the entire story of creation and history unfolds and rewrites itself under the scalpel. Thus, it is not only the polyp that surpasses myth, but also the scientist.

behavior and swarm. Stephen J. Simpson, “A Journey towards an Integrated Understanding of Behavioural Phase Change in Locusts,” *Journal of Insect Physiology* 138 (April 2022): 104370.

5. Conclusion

The polyp existed somewhere between the categories of the monstrous and the miraculous—categories that each held particular significance for the development of Enlightenment science. Secondary literature on historical polyp research evidences the import of this polarity: for example, even though it is not the subject of his study, Ratcliff employs the language of “miracle” throughout his own account, while Schwartz demonstrates through many rich examples that eighteenth-century scientists frequently referred to the animals as a “little machine” or a “little monster,” following Trembley’s own terminological habits.¹¹⁵ Hence, Emma Planinc’s suggestion in her 2024 monograph *Regenerative Politics* that “the polyp was proclaimed a miracle” and not a monster is incorrect.¹¹⁶ In fact, the evidence suggests that scientists did not prefer one interpretation over the other, and instead perceived the freshwater polyp as a miraculous “little monster.”

The language of wonders in the texts discussed in this chapter reflects the fact that the polyp-phenomenon produced a major paradigm shift.¹¹⁷ In a concrete sense, Trembley has been credited with the invention of biology, the elaboration of an ultra-modern, highly rigorous scientific methodology, and the introduction of ideas and images that would lead to major revolutions in the fields of metaphysics, zoology, and anthropology.¹¹⁸ For at least a century and

¹¹⁵ Schwartz, *Worm Work*, 77.

¹¹⁶ Emma Planinc, “The Palingenetic Consciousness,” in *Regenerative Politics* (New York: Columbia University Press, 2024), 32–62, here 45–48.

¹¹⁷ The word “paradigm” is employed in Kuhn’s sense of a “universally recognized scientific achievements that, for a time, provide model problems and solutions to a community of practitioners” (Kuhn, *The Structure of Scientific Revolutions*, 10).

¹¹⁸ Lenhoff et al., *Hydra*, 16.

a half, the polyp was as important a medical model as mice and zebra fish are in the twenty-first century.¹¹⁹ Thus, in addition to shedding light on Nature's more regular children and providing novel insights into the miracle of Nature itself, the polyp was also a miracle another sense: a phenomenon for which the explanation is *not yet* known, an exception that proves an *unknown* rule—*exceptio probat regulam ignorabilem*. In this Spinozan articulation of the concept of the miracle, the polyp spurs the production of new knowledge. That is, it inspires the scientist to bring forth new miracles.

To speak of the polyp miracle is to speak of the hopes that eighteenth-century scientists and philosophers held for themselves and for humankind. In this metaphorical field, the polyp is “miraculous” because of its morphology, with a body plan that straddles the boundary between the plant and animal kingdoms. Its vegetal nature enables it to produce self-similar parts seemingly infinitely,¹²⁰ so that it is able to resist and nearly transcend the organismic tendency toward death and decay. Because it defies death, its form of life is also very different from every other creature in the animal kingdom. Its very code of determination is one of infinite *re-determination*, insofar as its parts can readily serve the function of any other: no elephant can repurpose its trunk to function as an ear. These “miraculous” qualities invite feelings of active “marvel” in the human observer, who can intervene in the biological determination of the polyp to non-determination, but only to create even more fantastic situations in which this “miracle” can reproduce itself. The polyp *allows* the scientist to learn about life by making and changing it at will. It is “miraculous” by virtue of the fact that it *allows* the human scientist to become a

¹¹⁹ Brigitte Galliot, “Hydra, a Fruitful Model System for 270 Years,” *The International Journal of Developmental Biology* 56, nos. 6–8 (2012): 411–423.

¹²⁰ In reality, the severed polyps frequently either died or failed to regenerate, and never achieved the stature of a fully-grown, unaltered polyp.

“miracle-maker.” Thus, the polyp becomes embroiled in the great thought experiment of the Enlightenment, the question of possible worlds and their meaning for the human being’s pursuit of aesthetic and moral perfection.¹²¹

¹²¹ “[...] the Enlightenment will perform the thought experiment of other and different worlds especially in accordance with its function of criticizing man and his notion that he has a privileged status in the cosmos; the self-assertion of reason, it will argue, requires emergence from teleological comfort, from anthropocentric illusion.” Hans Blumenberg, *The Legitimacy of the Modern Age*, trans. Robert M. Wallace (Cambridge, Mass.: MIT Press, 1983), here 153. Subsequent citations as “*The Legitimacy of the Modern Age*” with page number(s).

Part II

III: The Serpent, the Elephant, & the Clockmaker

1. Introduction

In Plato's *Protagoras*, old Protagoras tells the story of how the gods fashioned mortal creatures from a mixture of the elements of earth and fire. He then explains that, "[...] when they were about to bring them into the light of day, they [the gods] charged Prometheus and Epimetheus to deal to each the equipment of his proper faculty."¹²² Epimetheus suggested to Prometheus that they would divide the responsibility into two parts; he would "[...] do the dealing himself; 'And when I have dealt, [...] you shall examine.'" Epimetheus was judicious in his role, granting each creature what it required to survive: "[...] he attached strength without speed to some, while the weaker he equipped with speed; and some he armed, while devising for others, along with an unarmed condition, some different faculty for preservation."¹²³ Epimetheus was judicious, that is, until it came to the human beings:

Now Epimetheus, being not so wise as he might be, heedlessly squandered his stock of properties on the brutes; he still had left unequipped the race of men, and was at a loss what to do with it. As he was casting about, Prometheus arrived to examine his distribution, and saw that whereas the other creatures were fully and suitably provided, man was naked, unshod, unbedded, unarmed [...].¹²⁴

Thinking quickly, Prometheus stole fire from Hephaestus and the arts from Athena. Thus, while other organisms have been well-equipped with physical tools and attributes to survive on Earth,

¹²² Plato, "Protagoras 321c.," in *Laches; Protagoras; Meno; Euthydemus*, trans. W. R. M. Lamb, Loeb Classical Library 165 (Cambridge, MA: Harvard University Press, 2014), 129.

¹²³ Plato, "Protagoras 321c.," 129, 131.

¹²⁴ Plato, "Protagoras 321c.," 131.

human beings alone survive because of their cleverness.¹²⁵

In such an account of creation, the differences between organisms are fixed before even a single mortal being walks or creeps or crawls across the face of the earth. A divine being, in this case the Titan Epimetheus, has already determined precisely how each organism will interact with its environment and with its neighbors. There is no sense of change over time, of the development of different abilities. Creatures of one sort could never become more or less like creatures of another, because traits are distributed as singular and unchanging gifts.

By the second half of the eighteenth century, the notion of the fixity of nature and of animal traits still informed many aspects of natural philosophical thought. A majority of scientists defended a classical eschatology, according to which the earth and its inhabitants remained largely unchanged since their forms were fixed by God at the dawn of creation. Nevertheless, the fossils of animals familiar in every regard besides their prodigious size caused some to question the validity of the Neoplatonist, Christian model of creation. Proponents of transformism—Georges-Louis Leclerc, Comte de Buffon (1707–1788), Erasmus Darwin (1731–1802), and Jean-Baptiste de Lamarck (1744–1829) for example—argued that the fossil record proved that animal forms change over time, anticipating Charles Darwin’s (1809–1882) systematic explanation of the mechanisms of evolution by natural selection in the mid-nineteenth century.

Naturally, the figure of the polyp, with its ability to take on bizarre and monstrous new forms, created yet more difficulties for the notion of intelligent design. If the universe had been created by a rational being—i.e. the clockmaker-god of the Scientific Revolution—then a rational plan must also underlie all that exists. From this perspective, the polyp is merely a

¹²⁵ Plato, “Protagoras 321c,” 133.

symbol of the inscrutability of Nature. Human beings may, with their limited capacities, struggle to understand the divine construct, but the law of nature is nevertheless universal, without exception. On the other hand, regeneration from parts casts a dark shadow on this image of the universe, for it undermines the integrity of the very concept of the singular *indivisible* individual. The formal bonds of nature that once appeared to dictate the differences between a single or multiple animals, or even plants and animals generally, lose their strength. Living matter itself determines the form that it will take.

The opposition between what can be termed the teleological and materialist interpretations of the polyp occupies the thematic center of Part II of this dissertation, which considers the differing responses by Francophone and Germanophone scientists to the metaphysical questions that Trembley's discovery raised. As discussed in Part I, thinkers across Europe regarded the polyp as a wonder of modern science, because it possessed a nature far removed from anything hitherto experienced or documented. The analogies upon which scientists relied to make sense of the wondrous polyp ultimately failed to explain the sublime mystery of regeneration from parts. Thus, the polyp's seemingly miraculous biology posed a fundamental challenge to modern scientific practice. How could rational science make sense or grab hold of something so elusive and "intractable"?¹²⁶ The responses to this question tended to follow two general paths. Whereas Francophone materialists tended, broadly, to view regeneration as a sign of nature's formal flexibility, in the German-speaking lands, the answer was often to suppress the "miraculousness" of the polyp and to focus instead on the animal's simplicity and baseness compared to higher organisms.

¹²⁶ Schwartz, *Worm Work*, 1 and 73.

One domain, in which French- and German-speaking scientists litigated the very laws of nature via the body of the polyp was, curiously enough, the ancient natural historical concept of a natural enmity between elephants and serpents, which retained some relevance into the modern era. From Aristotle to Pliny, natural historians regarded the elephant as the most intelligent, most human-like of all the animals, and the shadowy serpent, by contrast, as a dangerous—and in the Christian tradition evil—force. This paradigm, though mostly obsolete by the mid-eighteenth century, still shaped the language and images that scientists employed when writing about nature, including the analogy of elephants and humans. The polyp, upon discovery, entered this conceptual arena as kin to serpentine creatures like the lowly worm, capturing the threat that it posed to the epistemological status quo of the mid-eighteenth century.

As is argued in the following, the elephant-serpent paradigm shaped the way Francophone and German thinkers made sense of the freshwater polyp. After a brief introduction to the negative analogy between elephants and serpents in ancient and medieval texts, the chapter offers a reading of Diderot's series of three dialogues, "Le Rêve de d'Alembert" ("D'Alembert's Dream"). In the dialogues, a fictionalized mathematician Jean Le Rond d'Alembert (1717–1783) reflects on the malleable nature of matter itself by considering the integrity of the formal boundaries between worms and elephants, polyps and humans. Here, polyps represent the inherent flexibility of natural law; concepts such as "normal" and "natural" are only provisional categories, describing the state of matter as it is presently perceived—not an enduring condition of the entire cosmos. Ultimately, this reading of Diderot serves as a foil for the subsequent analysis of the attempts by German metaphysicians and theologians to neutralize the consequences that the polyp's regenerative abilities seemed to have for the concept of natural law. In their view, fanciful notions of the mixing of polypoid and elephant forms, to say nothing

of polyp and human forms, were just that—fanciful. Thus, when speaking of the polyp, a number of German thinkers invoke the negative analogy of the polyp and the elephant in order to reinforce a concept of intelligent design. The forms that exist are proper and perfect just as they exist, and they must exist precisely in that way as a result of their creator’s divine, if ineffable, wisdom. Thus, ultimately, the serpent-elephant paradigm casts into relief the ways in which the polyp contributed to the move toward nominalist materialism in French sciences, and a move toward Neoplatonist idealism in Germany.

2. The Serpent & the Elephant

Pre-Christian natural histories provided the paradigm for the narrative of an eternal war between “good” elephants and “evil” serpents. At the time, neither elephants nor serpents were regarded as essentially good or bad. The term “drakon” (δράκων), meaning dragon or serpent, referred to harmless snakes and serpentine monsters alike—Typhon, Echidna, and the Hydra, for example. Drakon was often employed, too, in a religious context. Similarly, the war elephant was as familiar in the Hellenic world as the elephant of peace. In *Historia Animalium* (History of Animals), Aristotle (384–322 BCE) writes that “The tamest and gentlest of all the wild animals is the elephant, for there are many things that it both learns and understands: they are even taught to kneel before the king.”¹²⁷

In fact, pre-Christian tradition recognized more similarities than differences between elephants and serpents. Both represented the wondrous in nature. For Herodotus (5th century BCE), elephants and flying serpents both exemplify the strangeness of geographic peripheries—

¹²⁷ Aristotle’s remarks on elephants set the paradigm for subsequent natural histories. Aristotle, *History of Animals*, trans. A. L. Peck, Loeb Classical Library 439, 3 vols. (Cambridge, MA: Harvard University Press, 1965), 3:391.

the *terra incognita*.¹²⁸ Similarly, Aristotle attributes unnaturally long life to elephants, up to 300 years, and the geographer Strabo (64/65 BCE–24 CE), citing Artemidorus of Ephesus (c. 100 BCE), describes “serpents thirty cubits in length which overpower elephants and bulls.”¹²⁹ This attention to the marvelousness of both creatures is reflected in language too: the word *thēria* (θηρία), meaning wild beast, was employed to describe both the elephant and the *drakon* Typhon.¹³⁰

The notion of an analogy between elephants and serpents is even more present in the Hindu and Sanskrit traditions. Like “*thēria*,” the Sanskrit word “*nāga*” could refer to different kinds of marvelous beasts. The term originally described a race of divine serpentine beings who lived underground near bodies of water. Thus, the primary meaning of *nāga* is “serpent,” but it can in some contexts refer to elephants.¹³¹ Relatedly, in the Hindu and Buddhist religious contexts, both animals possessed certain divine attributes, like wisdom. Their conceptual proximity is reflected in the famous Hindu parable, in which a group of blind men make false judgments about the elephant based on partial information; there, the first man touches the elephant’s trunk, and concludes that the animal is a serpent.

¹²⁸ “In [Libya] are the huge snakes and the lions, and the elephants and bears and asps, the horned asses, the dog-headed men and the headless that have eyes in their breasts, as the Libyans say, and the wild men and women, besides many other creatures not fabulous.” Herodotus, “Book IV: Chapter 192,” in *The Persian Wars*, vol. 2, trans. Alfred Denis Godley, Loeb Classical Library 118 (Cambridge, MA: Harvard University Press, 1921), 395.

¹²⁹ Strabo, “Book XVI: Chapter IV: Section 17,” in *Geography*, vol. 7, trans. Horace Leonard Jones, Loeb Classical Library 241 (Cambridge, MA: Harvard University Press, 1930), 337.

¹³⁰ Branko Van Oppen De Ruiter, “Monsters of Military Might: Elephants in Hellenistic History and Art,” *Arts* 8, no. 4 (2019): 160.

¹³¹ Jean Philippe Vogel, *Indian Serpent-Lore; or, The Nāgas in Hindu Legend and Art* (London: Arthur Probsthain, 1926), 129.

Based on this historical and metaphorical context, enmity that may exist between the elephant and the serpent in the Pre-Christian world is a result of positive rather than negative analogies. Both animals are wondrous beasts of magnificent strength, wisdom, and divinity. Nevertheless, the tendency around the end of the millennium to exaggerate the violence of the serpent, combined with the rise of Christianity, caused natural historians in the West increasingly to esteem the elephant and vilify the serpent.

The paradigm of the metaphysical opposition between elephants and serpents ultimately emerges in Pliny's *Naturalis Historia*, which shaped not only the bestiary tradition of the Middle Ages, but also the approach to natural history in the eighteenth century. The first several sections of Book VIII, regarding terrestrial animals, describe the elephant's many fantastic qualities, as well as its eternal struggle with the dragon—still understood as a mighty serpent. Pliny depicts the elephant as the most human of all beasts: it is intelligent, religious, docile, merciful, and wise. The elephant's natural enemy is the dragon, by contrast a vicious, shadowy, gluttonous creature. Of their enmity, Pliny writes that the dragon:

[...] submerge themselves in rivers and lie in wait for the elephants when drinking, and rising up coil round the trunk and imprint a bite inside the ear, because that place only cannot be protected by the trunk; and the snakes are so large that they can hold the whole of an elephant's blood, and so they drink the elephants dry, and these when drained collapse in a heap and the serpents being intoxicated are crushed by them and die with them.¹³²

Here, the ancient notion of an essential equality in the two beasts is mostly retained, insofar as the battle ends in the mutual slaughter of the animals. Neither animal is guaranteed the victor, because in the balance of things, the mass of the elephant is comparable to the skill of the dragon. Most importantly, though, this account emphasizes in a way that its predecessors do not

¹³² Pliny the Elder, "Book VIII," in *Natural History*, trans. Harris Rackham, Loeb Classical Library 353 (Cambridge, MA: Harvard University Press, 1938), 27, 29.

the relative innocence of the elephant. In truth, the dragon, in its villainy, brings about its own demise by selecting such a massive—and implicitly, such a *good*—victim.

Christian bestiaries adopted Pliny’s interpretation of the two animals, repurposing it as eschatological allegory. The Aberdeen Bestiary, for example, tells that the serpent has always possessed an “angular” (*angulosus*), “shadowy” (*umbras*), and “slippery” (*lubricus*) nature, from its earliest ancestor, the serpent of the Garden of Eden.¹³³ Correspondingly, “[t]he big elephant and its mate represent Adam and Eve,”¹³⁴ that is, the human compact with God and the pursuit of salvation. The bestiary goes on to explain that the elephant represents each stage in that process in the following retelling of the arc of the Gospel:

And at once the dragon seduced them [Adam and Eve] and caused them to be outcasts from their citadel, that is, because they displeased God. Then came the big elephant, meaning the law, and did not raise up mankind, any more than the priest raised the man who fell among thieves. Nor did the twelve elephants, that is, the company of prophets, raise mankind, just as the Levite did not raise the wounded man we spoke of. But the elephant capable of understanding, that is our Lord Jesus Christ, who, although greater than all, became the smallest of all, because he humbled himself, becoming obedient unto death that he might raise up mankind.

Harkening back to the ancient paradigm, the heroes of Judeo-Christian history—Adam and Eve, Moses, the Good Samaritan, the Apostles, and Jesus—are all elephants; the dragon of Hell attempts, at every step, to undermine them. Now, in the context of humankind’s salvation, the wise and humble “elephant capable of understanding” guides humankind toward its divine telos,

¹³³ “The Aberdeen Bestiary,” c 1200, MS 24, fol. 65v, Aberdeen University Library. Subsequent citations as “The Aberdeen Bestiary” with folio number(s). The English text above is from the transcription provided by the archive.

¹³⁴ “The big elephant and its mate represent Adam and Eve. For when they were in the flesh pleasing to God, before their sin, they did not know how to mate and had no understanding of sin. But when the woman ate the fruit of the tree, that is to say, she gave her man the fruit of the mandrake, the tree of knowledge, then she became pregnant, and for that reason they left Paradise” (“The Aberdeen Bestiary,” fols. 10r–10v.).

while devilish dragons or serpents tempt them to deviate from that path—hence their “angular,” “slippery,” creeping bodies. Crucially, the equality of the animals has disappeared, and the odds necessarily favor one side over the other. It is because of God that the elephant is absolutely great in its proximity to—in fact, equivalence with—God, the serpent absolutely low in its distance from God. In this version of the story, the serpent can never defeat its natural and metaphysical opposite, the elephant.

The Plinian and Christian interpretations of the elephant and the serpent continued to influence Western natural historical thought through the early-modern period.¹³⁵ However, in the eighteenth century, Pliny’s legacy began to fray. With the development of new standards of empiricism, some naturalists doubted the merit of ancient natural history, with its penchant for marvelous tales—hence Voltaire’s rejection of most ancient natural history.¹³⁶ Yet just as frequently, others invoked Pliny as a model for modern scientists. Réaumur was known to colleagues as the Pliny of his age,¹³⁷ while Buffon, in the first discourse in the *Histoire Naturelle, générale et particulière* (*Natural History, General and Particular*, 1749), offers glowing praise for his ancient predecessor.

D’ailleurs les Anciens qui ont écrit sur l’Histoire Naturelle étoient de grand hommes, & qui ne s’étoient pas bornés à cette seule étude; ils avoient l’esprit élevé, des connoissances variées, approfondies, & des vues générales, & s’il nous paroît

¹³⁵ In his “Apologie de Raimond Sebond” (“Apology for Raimond Sebond,” 1575–1576), Michel de Montaigne (1533–1592) writes: “[S]o many of their actions bring elephants close to human capacities that if I wanted to relate in detail everything that experience has shown us about them, I would easily win one of my regular arguments: that there is a greater difference between one man and another than between some men and some beasts.” See Bryan Alkmeyer, “Remembering the Elephant: Animal Reason before the Eighteenth Century,” *PMLA* 132, no. 5 (2017): 1149–65.

¹³⁶ See the introduction to Chapter 2 of this dissertation.

¹³⁷ William A. Smeaton, “Réaumur: Natural Historian and Pioneer of Applied Science,” *Endeavour* 7, no. 1 (1983): 38–40.

au premier coup d'œil qu'il leur manquât un peu d'exactitude dans de certains détails, il est aisé de reconnoître, en les lisant avec réflexion, qu'ils ne pensoient pas que les petite choses méritassent dans ces derniers temps; & quelque reproche que les Modernes puissent faire aux Anciens, il me paroît qu'Aristote, Théophraste & Pline qui ont été les premiers Naturalistes, sont aussi les plus grands à certains égards.¹³⁸

The loftiness that Buffon attributes to Pliny and other ancient natural philosophers is echoed in Diderot's *Pensées*, wherein a similar coterie of "creative geniuses" is praised for elevating the study of nature. Per Aristotle's precepts regarding the difference between history and poetry—the relation of particular and universal truths, respectively—Buffon seems almost to portray Pliny not as a natural historian, but as a natural poet.

This tension between the fantastic and the empirically true led to a clear bifurcation in Pliny's legacy, as reception of the elephant-serpent opposition demonstrates. On the one hand, concrete allusions to these sensational passages continue to appear in works of fiction and poetry. At the same time, assertions of the negative analogies between elephants and serpents all but disappear, while associations of each animal with goodness and badness respectively persist. Pliny and Aristotle's characterization of the elephant as inherently gentle and good does not disappear. Likewise, the continued influence of the Christian association of serpents and serpiform animals with evil is almost self-evident: the topos of the serpent of Hell is as alive in eighteenth century literature as it ever was.

Meanwhile, in literature as in science, in addition to still operative apprehension toward serpentine creatures, the serpiform worm was also haunted by the sins of its most ancient relative.¹³⁹ As Janelle A. Schwartz discusses in her monograph *Worm Work*, polyps were not

¹³⁸ Georges Louis Leclerc Buffon, *Histoire naturelle, générale et particulière* (Paris: De L'Imprimerie royale, 1749), 1:43.

¹³⁹ Since Aristotle, worms and serpents were frequently treated together, sometimes as part of one and the same class of animals. Though this classification pattern had begun to change, still

exempt from classical revulsion toward vermicular creatures,¹⁴⁰ that is, scientists looked at the creatures with feelings of marvel and wonder as much as feelings of disgust. Everything about both the worm and the polyp seemed problematic: They were not just vile like the serpent of paradise, they were also *low*, and it would defy reason to conceive of them any other way. Consequently, comparison of the polyp and the elephant came to represent the idea of a spectrum of perfection: the size, intelligence, and behavior of the elephant reflected its biological superiority. By contrast, the polyp does little more than eat and reproduce. It moves only in order to achieve those goals. It possesses no conceivable intelligence. Hence, its peculiar regenerative abilities can only be explained as an attribute of the lowest common denominator in the animal kingdom, the absolute minimum of what is required for something to be an animal. If God had produced nature according to a coherent plan, then even if the polyp was no worthy *enemy* to the elephant, it was its absolute opposite. In a word, compared with the elephant, the polyp was the farthest thing from a miracle imaginable.

Ultimately, the war between elephants and serpents represents a problem of epistemology. The elephant is a massive creature of the light, and hence paradigmatically *visible* and *graspable*. Goodness itself inheres in the animal's characteristic intelligibility, since something that permits itself to be known can harbor no evil. And indeed, the gentle and honorable elephant is apparently just as virtuous as the human being who admires it. The good elephant is supposed to be the type of thing that cannot escape the illuminating gaze of the scientist; and yet where the hubris of understanding goes, the evil, ungraspable serpent follows.

figures like Réaumur and Diderot sometimes grouped them together. See Schwartz, *Worm Work*, 109.

¹⁴⁰ Schwartz, *Worm Work*, 10.

The “angular” creature clings to the shadows, moving orthogonally away from the linear path of intellectual and spiritual progress. It reminds the observer that the elephant’s manifestness is an illusion. The bad serpent creeps in as an ever-present reminder that the sphere of knowable things is limited.

3. Worms, Elephants, and *Polypes-humaines*

In his philosophical dialogue “Le Rêve de d’Alembert,” Diderot plays with the concept of zoological and metaphysical opposites in a series of reflections on the nature of matter and consciousness. In the first of three dialogues, Diderot portrays a conversation with his friend and collaborator d’Alembert regarding the processes by which matter organizes itself into different beings endowed with “sensitivity” and “consciousness.” The fictionalized Diderot refers to matter as “living points.” He endeavors to convince the skeptical d’Alembert that every being exists as a concrescence of once separate, now “continuous,” “living points.” By *degrees*, these living points find their way to each other and achieve greater and greater organismic complexity. This complexity is defined by a simultaneous condition of “contiguity”: “living points” adhere to each other, as it were, to form individual parts that constitute the greater whole.

This continuum of material tendencies does not seem to be a completely immutable quality in individual species, at least not over long stretches of time. Diderot argues that: “avec une matière inerte, dispose d’une certaine manière, imprégnée d’une autre matière inerte, de la chaleur et du mouvement on obtient de la sensibilité, de la vie, de la mémoire, de la conscience, des passions, de la pensée”¹⁴¹ The process does not deterministically have to produce only the types of organisms that presently exist and no others, such that any combination of traits and

¹⁴¹ *DPV*, 17:105.

attributes is theoretically possible, even an “clavecin sensible et animé était encore doué de la faculté de se nourrir et de se reproduire, il vivrait et engendrerait de lui-même ou avec sa femelle de petits clavecins vivants et résonnants”¹⁴² Any number of combinations and recombinations is conceivable.

The differences between animals are therefore unstable: the morphological boundaries separating any two forms—for example, the elephant and the worm—are liable to dissolve completely.

Si la question de la priorité de l’œuf sur la poule ou de la poule sur l’œuf vous embarrasse, c’est que vous supposez que les animaux ont été originairement ce qu’ils sont à présent. Quelle folie! On ne sait non plus ce qu’ils ont été qu’on ne sait ce qu’ils deviendront. Le vermisseau imperceptible qui s’agite dans la fange, s’achemine peut-être à l’état de grand animal; l’animal énorme qui nous épouvante par sa grandeur, s’achemine peut-être à l’état de vermisseau, est peut-être une production particulière et momentanée de cette planète.¹⁴³

Here, Diderot explodes the notion that the stark differences between the elephant and the worm prove the teleological integrity of Nature’s organization. Any configuration of matter to any end is, strictly speaking, possible. Hence, the term “species” cannot refer to a *law* governing the way “living points” concreate into elephants, worms, people, or polyps, but only to *tendencies* that are subject to infinite modification. Even if one imagines that grand organisms like the elephant (or the human being) represent a metaphysical ultimate, that nevertheless does not mean that Nature exempts these creatures from biological ‘regression,’ or more generally from the formal changes that material flux must cause. Organismic hierarchies like oppositional zoologies are in fact illusory, ever provisional conditions of matter.

¹⁴² *DPV*, 17:103.

¹⁴³ *DPV*, 17:97–98.

In the subsequent dialogue, the idea of the infinite possible manifestations of matter leads to grand musings about other worlds and the many ways in which *human* biology and society might change. The fictional d’Alembert processes the conversation he has just had in a dream, but he appears so upset by the conversation that he talks in his sleep, engaging his friends Madame L’Espinasse and Dr. Bordeu. In this second, even more fantastic dialogue, the polyp and the human being assume the roles of the worm and the elephant, respectively, in the passage above. At one point, L’Espinasse reads from her transcript of d’Alembert’s musings:

La différence de la grappe d’abeilles continues et de la grappe d’abeilles contiguës est précisément celle des animaux ordinaires, tels que nous, les poissons, et des vers, des serpents et des animaux polypeux; encore toute cette théorie souffre-t-elle quelques modifications...¹⁴⁴

Notably, d’Alembert explicitly invokes the image of the polyp as a “snakelike creature.” As a continuation of the discussion of worms transforming into elephants or elephants transforming into worms, this remark closes the loop, so to speak: that is, the evocation of the ancient opposition is complete, only to be undone again. Diderot’s theory of matter means that the metaphysical superstructure of good and bad, low and high animals must come tumbling down. Just as the *nāga* is a sign that obscures all differences between elephants and snakes, vital matter is the principle that elides all differences between “ordinary animals” and polyps.

What this revolution in the understanding of material, zoological differences implies is not just that old differences disappear, but also that new analogies may one day emerge. A moment later, the sleeping d’Alembert exclaims: “Eh bien, Philosophe, vous concevez donc des polypes de toute espèce, même des polypes humains? ... Mais la nature ne nous en offre

¹⁴⁴ *DPV*, 17:123.

point.”¹⁴⁵ D’Alembert cannot suppress his disbelief at this idea, and yet, Diderot’s philosophy does suggest that a human-polyp could exist. Polyps and human beings primarily differ in the strength of the bonds that maintain their organismic contiguity. The individual parts of polyps can be separated from each other without causing the “living points” that constitute them to return to a state of passive sensibility—in other words, without dying. By contrast, human beings require a continuous contiguity of parts in order to survive, without which, the elements of their bodies must return to a condition of passive sensibility and disperse. The polyp and the human being exist on either end of a biological continuum, in which the morphology of an organism is defined by the tendency of matter to form different sorts of bonds of continuity and contiguity. However, just as there is nothing preventing an elephant from becoming like a worm, or a worm like an elephant, there is also nothing preventing a human being from ridding itself of the burden of continuity, or the polyp from becoming ever more burdened by it. Thus, in Diderot’s view, the polyp serves as proof that matter itself contains the possibility of morphological fluctuation.

This simple conclusion opens up a whole horizon of miraculous possibilities. Though it is true that “we do not find any such thing in nature,” the fictional d’Alembert muses jokingly that there might this very moment exist elsewhere in the universe organisms that are equal parts polypoid and humanoid. If not presently or on this planet, then perhaps:

Dans Jupiter ou dans Saturne des polypes humains! Les mâles se résolvant en mâles, les femelles en femelles; cela est plaisant [...] L’homme se résolvant en une infinité d’hommes atomiques qu’on renferme entre des feuilles de papier comme des œufs d’insectes qui filent leurs coques, qui restent un certain temps en chrysalides, qui percent leurs coques et qui s’échappent en papillons, une société d’hommes formée, une province entière peuplée des débris d’un seul, cela est tout à fait agréable à imaginer...¹⁴⁶

¹⁴⁵ *DPV*, 17:124.

¹⁴⁶ *DPV*, 17:125–126.

Perhaps even bolder than speculation about extraterrestrial life is the idea that even *human beings* are only one chapter in the history of matter's many reconfigurations. Perhaps, human beings and human qualities are mere precursors to something better, or as Bordeu wonders: "Qui sait si ce n'est pas la pépinière d'une seconde génération d'êtres séparée de celle-ci par un intervalle incompréhensible de siècles et de développements successifs ?"¹⁴⁷ The provisional nature of human beings, such as it is, means that the bipedal mammals that presently exist might *not* be the telos of Nature.

For d'Alembert and even more so for Bordeu, the novel *image* of the human-polyp is not as important as what it represents: the possibility of taking hold of the process of generation that Diderot puts forth in the first dialogue and actively shaping human beings for the better. Indeed, this is what the polyp itself means for the human being. Because the polyp *is* an animal, and therefore some analogy is possible between it and the human being, the human observer cannot help but wonder about the conditions that could cause *his* biology to eventually resemble the polyp's and become similarly miraculous. That could merely be an entirely arbitrary matter of time, but perhaps human beings could themselves make a contribution. The image of the hatchery, for example, evokes Trembley's "hydra," the product of the scientist's craft of "miracle making." D'Alembert himself envisions such a brave new world—albeit a far less cynical one than the one imagined by Aldous Huxley (1894–1963): "Une chambre chaude tapissée de petits cornets, et sur chacun de ces cornets une étiquette, guerriers, magistrats, philosophes, poètes, cornet de courtisans, cornet de catins, cornet de rois."¹⁴⁸ If the human being is not a fixed concept but indeed entirely susceptible to change and reformation, then perhaps, the polyp whispers to

¹⁴⁷ *DPV*, 17:125–126.

¹⁴⁸ *DPV*, 17:127.

him, the scientist has the Herculean power to play with the tendencies behind his own limitations. Perhaps, a more perfect union, even in the biological sense of the word, is possible.

4. Zoological Opposites

“Le Rêve de d’Alembert” occupies a peculiar position in the present history. Diderot composed the dialogues in 1769, but they were not published until 1782.¹⁴⁹ In effect, readers in the 1780s would have been engaging with metaphysical discourses of the late 1760s. The other oddity in these dialogues’ reception in Germany is the fact that they appeared between August and November 1782 in the *Correspondance Littéraire*, a cultural newsletter edited by Jacques-Henri Meister (1744–1826) and disseminated to a handful of Enlightened courts across Europe. This complicates the matter of circulation for a number of reasons: scholarly attempts to reconstruct Meister’s subscription list are ongoing—though the consensus is that they continued to grow over the years. Moreover, only some of the handwritten-manuscripts still exist in state archives. It is therefore not entirely clear which members of Diderot’s German readership might have gained access to the dialogues.

It is possible, though, to reconstruct possible routes of circulation by considering the case of Goethe, who makes reference to “Le Rêve de d’Alembert” in the introduction to his *Zur Morphologie* (On Morphology, 1817).¹⁵⁰ Goethe most likely gained access to Diderot’s dialogues via his friend and patron, the Duke Karl August (1757–1828), who subscribed to the *Correspondance Littéraire* from 1775 onward. It is not surprising that the duke would have shared not just the 1782 editions, but many other editions, of the literary newsletter with his

¹⁴⁹ It was republished as a standalone text in 1830.

¹⁵⁰ See Chapter 5 for a more detailed discussion of Goethe’s response to Diderot.

beneficiary, one of Germany's most highly regarded literary authors.¹⁵¹ Based on this model, it is conceivable that other patrons who subscribed to the *Correspondance Littéraire* may also have shared copies of the newsletter with their beneficiaries. That would put writers and philosophers with connections to courts in Braunschweig, Saxe-Gotha, Württemberg, and Darmstadt at least in reach of the manuscript copies of the *Correspondance Littéraire*, and therefore Diderot's dialogues.¹⁵²

If German readers had gained access to "Le Rêve de d'Alembert," then they would have found in it a text that confirmed many of their existing opinions of the French *philosophe*. On the one hand, Diderot the literary author enjoyed relative popularity in Germany.¹⁵³ Herder and Schiller regarded Diderot an exception in the otherwise "lifeless" world of French literature and aesthetics. They interacted with Diderot and his works, directly and indirectly, and encouraged Goethe to do so as well.¹⁵⁴ After his death in 1784, Diderot's papers found their way into Germany, where they fell into the hands, for example, of Dalberg and Schiller. On the other hand, Diderot's radical materialism was sometimes greeted with apprehension, because it

¹⁵¹ Goethe was ennobled in 1782. Thus, another vector of transmission might have been cultural exchange resulting from the increasing status of the bourgeois intellectual class.

¹⁵² Subscribers included Louise-Dorothea von Saxe-Gotha (1754–1813), George de Hesse-Darmstadt (from 1765), Elisabeth Friederike Sophie von Brandenburg-Bayreuth, Duchess of Württemberg (from 1768), August de Saxe-Gotha, Prinzessin Louise (1768–1803). See Joseph R. Smiley, "The Subscribers of Grimm's *Correspondance Littéraire*," *Modern Language Notes* 62, no. 1 (1947): 44–46.

¹⁵³ See, for example: Anne Saada, "Diderot en Allemagne au XIX^e siècle," *Diderot Studies* 31 (2009): 197–221; Jules Barbey d'Aurevilly, *Goethe et Diderot* (Paris: Librairie Alphonse Lemerre, 1913); Treuherz, "The Reception of French Materialism in Enlightenment Germany, 1739–1789."

¹⁵⁴ See Roland Mortier, *Diderot en Allemagne (1750–1850)* (Paris: Presses universitaires de France, 1954).

contradicted the generally more organized world view of the German vitalists. Thus, the remarkable dialogues exhibited, from the German perspective, Diderot at his very best and worst.

One emblem of the divergence of German from French scientific thinking is the tendency of some German writers to represent the elephant and the polyp as biological opposites, in an attempt to suppress the seemingly miraculous aspects of polyp biology. Like Diderot, these writers were familiar with the Plinian tradition, and therefore also with the concept of elephant and serpentine opposites. Since it is difficult to discern whether or to what extent “Le Rêve de d’Alembert” reached audiences beyond the immediate circle of court, it is not possible to establish direct connections between Diderot and the authors discussed below. Nevertheless, since these writers engage the same metaphorological history as Diderot, one may conclude that the Frenchman’s ideas about worms transforming into elephants and *polypes-humaines* would have struck them as singularly repulsive.

Allusions to the ability of polyps and elephants alike to go into the world and seek nutrition served as evidence of the purposive organization of the universe: it is good and reasonable that Nature has endowed all animals with the abilities appropriate to their needs; and conversely, their needs are appropriate to the anatomies they have been given. In the sixth edition of *Makrobiotik: oder die Kunst das menschliche Leben zu verlängern* (Macrobiotics, or the Art of Prolonging Human Life, 1796), Christoph Wilhelm Hufeland (1762–1836) states that the difference between plants and animals lies fundamentally and lawfully in the way that these organisms take in nutrients: “der unsichtbare Polyp hat so gut, wie der Elephant, diesen auszeichnenden Character des Thiers, ein *Maul* und einen *Magen*.”¹⁵⁵ Similarly, in a poem

¹⁵⁵ Christoph Wilhelm Hufeland, *Makrobiotik: oder die Kunst das menschliche Leben zu verlängern* (Jena: Akademische Buchhandlung, 1796), 138.

published in the *Magazin für Frauenzimmer* (Magazine for Ladies), the speaker describes the ability to eat as a gift from Nature that all animals from the polyp to the elephant share:

Sie gab dem Stier das Horn zum muth'gen Streite.
Dem Pferd stählt sie mit hartem Huf den Fuß.
Lehrt jedes Thier sich schaffen seine Beute,
Vom Elephant bis zum Polyp im Fluß.¹⁵⁶

The miracle, here, lies not in what either of the animals does, but in how Nature has created them.

The other side of this argument is that no condition can exist in which, for example, an elephant exchanges any of its abilities with the polyp. In his treatise entitled “Entwurf eines Systems der transzendentalen Chemie” (Sketch of a System of Transcendental Chemistry, 1787), Johann Melchior Beseke (1746–1802) argues that all existence is made up by teleological concrescences of fundamental elements, and that each way of organizing matter is perfect in itself, so to speak. The differences between species simply cannot be overcome: “[...] so wenig eine Steinpflanze durch Umwandlung ein Rosenstrauch werden kann, eben so wenig kann ein Polyp durch Umwandlung ein Elefant, und ein Elefant ein Mensch werden.”¹⁵⁷ In his “Aphorismen über Zeugung” (Aphorisms on Procreation, 1793), published in Karl Philipp Moritz’s (1756–1793) journal *Gnotti Sauton* (1783–1793), Johann Christian August Grohmann (1769–1847) follows Beseke in entertaining and then excluding the possibility that elephants and polyps could have mutually fungible morphologies:

Alle Formen waren in dem unendlichen Reiche der Schöpfung befasst — alles sollte sich an einander anschliessen — alles sich von einander entfernen —

¹⁵⁶ Anonymous, “Die gütige Mutter Natur. Nach der zweiten Ode des Anakreons,” *Magazin für Frauenzimmer*, June 1785, 195.

¹⁵⁷ Johann Melchior Gottlieb Beseke, *Entwurf eines Systems der transzendentalen Chemie* (Leipzig: In der Joh. Gottfr. Müllerschen Buchhandlung, 1787), 250. Subsequent citations as “*Entwurf eines Systems der transzendentalen Chemie*” with page number(s).

Polypen- und Elefantenmassen, die weitesten Enden, in einer Kontinuität sich einander vereinigen:—alle Formen der Zeugung waren also zugleich da—wollte die Natur nicht mit ihren Werken Spiel treiben, Elephantengebürge wie Polypen, und Polypen wie Elefanten sich fortpflanzen lassen. Einfache Organisationen umfaßten einfache Mittel, vielfache auch vielfache—Polypen polypenartige Ergießungen—Elephantengebürge auch gebürge-mäßige Zeugungen.¹⁵⁸

The polyp and the elephant are paradigmatic of a rule of absolute distance that is repeated throughout nature: every kind of being is a unique point on a plane that is equally distant from every other point. That rule of forms pre-exists all things, and even if a mind like Diderot's can twist the kaleidoscope of possible organizations of matter, this is something Nature herself would never do. Hence, Beseke fundamentally rejects the concept of an ecological White Elephant party, tantamount to miracle in the old paradigm, something that factually cannot occur.

Beseke's argumentation reflects an attempt to neutralize the problematic infinities that the polyp represents for many others,¹⁵⁹ but it therein casts into relief the danger to all knowledge systems that the polyp represented. Of the possibility of biological translations between polyp and elephant forms, Beseke insists that: "Wer als Naturforscher die ewigen und unwandelbaren Gesezze der Natur kennt, nach welchen keine solche Umwandlung statt hat, der wird einen solchen Gedanken zu fassen nicht im Stande seyn."¹⁶⁰ This is a curious formulation: Beseke regards reason as a limit, which prevents the scientist from even comprehending (fassen) the idea of an alternative construction of the natural world.

This view of the polyp's role in scientific discourse could not be farther away from Diderot's representation, or from Trembley's dictum that the polyp represented all of the

¹⁵⁸ Johann Christian August Grohmann, "Aphorismen Über Zeugung," *ΓΝΩΘΙ ΣΑΥΤΟΝ Oder Magazin Zur Erfahrungsseelenkunde*, 1793, 8–42.

¹⁵⁹ Beseke, *Entwurf eines Systems der transzendentellen Chemie*, 250.

¹⁶⁰ Beseke, *Entwurf eines Systems der transzendentellen Chemie*, 250.

miraculous things that are not yet known: here, they represent all of the miraculous things that cannot exist and therefore cannot be known. Ultimately, what the polyp becomes in the paradigm of zoological opposites is a symbol of the ungraspable thing whose dangers have been neutralized, the Hydra *after* every head has been severed and cauterized. It is the miracle that explodes the scientific dream of making perfect sense of the natural world.

5. Conclusion

The story of serpents, elephants, and polyps reflects the gradual recession of God out of the sphere of sublunary relevance over the course of the eighteenth century. According to Hans Blumenberg, pre- and early-Christians often viewed the creator-figure as a Neoplatonic “executor of a world plan that is consistent in itself and makes its own uniqueness manifest, and whose ideal status means precisely that any rational being must recognize in it (and accordingly put into effect) the necessary characteristics of a world as such, so that productive and theoretical insight converge on this model.”¹⁶¹ The idea of the active presence of God in the material world naturally creates all sorts of dicey paradoxes: How can God possess absolute power and have created a reality that follows such precise, incontrovertible rules? Should he not by his own divinity be exempt from the necessity of the laws he has created? In opposition to traditional Platonism, nominalists concluded that God would have to have bowed out after the work of creation had been done if the integrity of his and Nature’s integrity were to remain intact. Thus, the nominalist God:

[...] stands with His work in the widest horizon of noncontradictory possibilities, within which He chooses and rejects without enabling the result to exhibit in any way the criteria governing His volition. Much of what He could create, He does not choose to create—for nominalistic thought, that is the difference between the origin

¹⁶¹ Blumenberg, *The Legitimacy of the Modern Age*, 152.

of the world and a process of natural causality, from which the whole of the possible effect always results.¹⁶²

The universe as it now exists functions according to the plan that God has set forth; God permits it to be and change in the way that he created it; the philosophers now concern themselves with divining the rules according to which this creation emerged.

Broadly speaking, positions on the polyp as on the question of God's hand in the construction of nature were drawn according to national lines. Many of the Francophone *savants* promulgated a more capacious view of natural law. As noted in Chapter 2, natural historians like Buffon and Trembley preferred to give accounts of nature that prescribed no system but rather emphasized the particularity of each unique natural object. But as has been demonstrated in the present chapter, some *philosophes*, like Diderot, went much further, extrapolating from Trembley's discovery the obliteration of Cartesian distinctions between the mechanistic beast and the ensouled human being: If the difference between the plant and the animal is not so clear as once thought, then the same may very well be true of the difference between animals and human beings in general. And if animals and human beings are much more similar than not, then questions about the materiality of the soul can be put to rest.¹⁶³ Thus, for the most extreme materialists, animals like the polyp were irrefutable evidence of the infinite possible organizations of matter. The animal therein totally undermined the integrity of the human being's morphological and hence moral exceptionalism.

By contrast, in Germany, the metaphysical anarchy of the French attracted fierce

¹⁶² Blumenberg, *The Legitimacy of the Modern Age*, 152.

¹⁶³ See the chapter "Bonnet's Response to the Discovery and the Worm with Two Tails" in Dawson, *Nature's Enigma*, 137–54.

accusations of “Spinozism” and atheism.¹⁶⁴ There, a stricter sense of the teleological coherence of natural objects reigned. Thus, the lowly polyp was sand in the gears of the clockwork of creation. Precisely because it was the sort of creature that was so difficult to pin down, it posed a challenge even to the idea that there *was* a plan behind the reality that scientists hoped to explain. The solution to the problem was to naturalize the animal, denude it of its marvelous potential. The Germans could not deny the common biological inheritances of the polyp and the rest of animal creation, but they could not accept it as evidence that material reality had emerged and continued to evolve more or less at random. Even if Nature eluded human understanding, it must function according to some rational plan—even if that plan remains inscrutable to human beings with their limited understanding.

Ultimately, what Diderot and his imagination do with the polyp, the elephant, and the human being is diametrically opposed to what appears in the works of Beseke and Grohmann. The materialist dispenses with the rigid opposition between seemingly lowly and great animals in favor of a natural order in which anything is possible. The lawlessness of his concept of natural law, though, does not amount to the disintegration of the human ideal *per se*. It does seem that matter *wants* to become human-ish, insofar as it tends, according to Diderot, toward greater complexities of need, and insofar as the peoples of other planets, polypoid or not, conceivably have better ways of being and living than human beings do. Thus, metaphysical anarchy might mean the end of humankind. It might also mean that hitherto unimagined feats of perfection are possible. Ultimately, German thinkers would address this bifurcation through a dialectical process, accepting the animal’s exceptional qualities *and* reifying its position in a specific, unchanging part in the hierarchy of nature. In this way, the polyp could illustrate the principle of

¹⁶⁴ Zammito, *The Gestation of German Biology*, 105–106.

intelligent design, whether or not the human observer had yet come to grasp the particular rules of that design.

IV: Human Polyps

1. Introduction

Not all German naturalists shared Beseke's apprehension about the association of the polyp with miraculous metamorphoses. There were other thinkers who joined the Francophone materialists in marveling at the animal, if in a somewhat more moderate sense than Diderot. For example, the insectologist August Johann Rösel von Rosenhof (1705–1759) was clearly swept away by his own feelings of polypoid wonder. In the first essay on polyps in the third volume of the journal *Der monatlich herausgegebenen Insecten-Belustigung* (Delight in Insects Published Monthly, 1746–1761), Rösel describes his initial disbelief at, then enthusiastic acceptance of, the miraculous little animal. The essay begins with a series of incredulous rhetorical questions that prime the reader for the story of the insectologist's "conversion": "Sollte es wohl möglich seyn [...]," "Ja ist es glaublich [...]," and "Ist es wohl zu verwundern, wenn ich einer solchen Nachricht meinen Beyfall versaget [...]."¹⁶⁵ Once an *incrédule*, Rösel is able to accept Trembley's work as more than "Fabeln und Märlein" as soon as he has witnessed the miracle himself.¹⁶⁶

Correspondingly, some German works on polyp biology also struck a more mythologizing tone, in keeping with the Plinian tendencies of Trembley and the gentlemen of the *Académie Royale*. Though German writers, critics, and philosophers frequently disagreed with their French counterparts on how to employ ancient models of style, rhetoric, and form, they agreed that their Hellenic and Roman predecessors had set the paradigm for the theory and

¹⁶⁵ *Insecten-Belustigung*, 3:433.

¹⁶⁶ *Insecten-Belustigung*, 3:434.

practice of art, science, and philosophy.¹⁶⁷ Thus, a sense of drama and action drives some of these polyp narratives. In his *Handbuch der Naturgeschichte* (Handbook on Natural History, 1779), Johann Friedrich Blumenbach (1752–1840) comments on the “unendlich starke Reproduktionskraft” of the polyp, which makes it “fast unzerstörbar.”¹⁶⁸ Here, the adjective “unzerstörbar,” indestructible, evokes a violent scene, over which the threat of total decimation looms. This is a creature that is not just difficult to wound, it is in fact near-impossible to destroy. Johann Gottfried von Herder (1744–1803), too, evokes a battle scenario in his *Ideen zur Philosophie der Geschichte der Menschheit* (Ideas on the Philosophy of the History of Humankind, 1784): “Wie ein gereizter oder zerschnittener Muskel mehr Kraft äussert, so äussert ein gequälter Polyp alles, was er kann, um sich zu erstaten und zu ergänzen.”¹⁶⁹ Here, Herder likens the soft, gelatinous body of the polyp, ironically, with sturdy muscle. The vigorous powers of flesh are hardly diminished—in fact, they are amplified—in the polyp’s gooey form. Both of these descriptions frame the polyp as a *poulpe*-like creature; something fierce, indomitable, and crafty.

The presence of the polyp in Herder’s treatise on the philosophy of history reflects a tendency to make reference to polyps in the context of anthropological, rather than strictly biological and metaphysical, contexts. To put a finer point on it, during this period, analogies between the polyp and the human being start to emerge in some of the canonical texts of late-

¹⁶⁷ See Ritchie Robertson, “Ancients, Moderns and the Future: The Querelle in Germany from Winckelmann to Schiller,” in *Ancients and Moderns in Europe: Comparative Perspectives*, ed. Paddy Bullard and Alexis Tadié (Oxford, UK: Voltaire Foundation, 2016), 257–275.

¹⁶⁸ Johann Friedrich Blumenbach, *Handbuch der Naturgeschichte* (Göttingen: Johann Christian Dieterich, 1779), 25.

¹⁶⁹ Johann Gottfried von Herder, *Ideen zur Philosophie der Geschichte der Menschheit* (Riga & Leipzig: Hartknoch, 1784), 119.

eighteenth century humanism, such that one may speak of a tendency to think about human beings and human affairs through the lens of the polyp. Much of this writing occupies an intellectual space somewhere between, at the synthesis of, French nominalist vital materialism and German Neoplatonic teleologies. The polyp-human analogies invoked in these texts represent neither the destruction nor the rigidity of the natural laws that produce all natural organizations, but instead the possibility of progressive change according to an eudaemonistic ideal in all domains of experience. In other words, polyp-human analogies facilitated the transference of the idea of material flexibility from the domain of biology to the domain of human action, providing further evidence that human beings might plausibly hope for and work toward a more just, more equitable, more happy organization of their material reality.

The present chapter tracks the dispersion of polyp-human analogies into late-Enlightenment anthropology during the end of the eighteenth century, in order to reframe this humanism as a polyp-humanism, concerned with the tender science of universal happiness. The chapter begins by arguing that already in the earliest German reception of polyp-science, as evidenced by Rösels engagement with the French sources, there are signs of a subtle anthropomorphization of the animal. Here, the analogy between polyps and human beings is latent, never stated explicitly, but it palpably sets the stage for later work. The chapter then proceeds to three examples from the 1780s and 1790s that evince the development of polyp-humanism more concretely. In *Über den Bildungstrieb und das Zeugungsgeschäfte* (On the Formative Drive and the Process of Generation, 1781), Blumenbach makes the polyp-human analogy part of the origin story of his novel concept of the *Bildungstrieb*, or formative drive, which embeds a principle of flexibility in the very laws of nature. Then, in his lecture “Ueber die Verhältnisse der organischen Kräfte” (On the Relations Between Organic Forces) of 1793, Carl

Friedrich Kiehmeyer (1765–1844) builds on Blumenbach’s science of comparative morphology, analogizing the polyp with the blossoming of the human spirit. By arguing that human culture shares a structure with the polyp, Kiehmeyer explicitly bridges the worlds of biology and anthropology. Finally, in his *Briefe über die ästhetische Erziehung des Menschen* (Letters on the Aesthetic Education of the Human Being, 1795), Friedrich Schiller compares Ancient Greek society with the nature of the polyp, thereby establishing a polypoid principle as an essential part of his theory of aesthetic education. As this progression shows, by the end of the eighteenth century, via the analogy of the polyp-human, German anthropologists had synthesized French nominalism and German Neoplatonism in the form of a concept of nature defined by a telos of progressive transformation toward the ultimate goal of happiness.

2.1. Rösel & the Ladder of Creation

Published between 1746 and 1761, Rösel’s illustrated journal *Der monatlich herausgegebenen Insecten-Belustigung* made the world of insects accessible to German intellectuals.¹⁷⁰ The artist and naturalist reported on advancements in the field of entomology and provided personal accounts of his own research and experiments. This work was evidently of great utility to other scientists of his age. The *Insecten-Belustigung* furnished Linnaeus with much of the information that he used to construct his taxonomic system.¹⁷¹ Blumenbach, too, as is discussed in the next section, consulted the journal in his research. At the same time, the *Insecten-Belustigung* was also a vector of transport of scientific knowledge into the worlds of culture and anthropology.

¹⁷⁰ Even though Rösel’s influence on late-eighteenth century science is palpable, the scholarship on the naturalist and illustrator himself is not extensive.

¹⁷¹ Michael S. Engel and Niels P. Kristensen, “A History of Entomological Classification,” *Annual Review of Entomology* 58, no. 1 (2013): 585–607.

The first edition of Rösels *Insecten-Belustigung* appeared in 1746, two years after Trembley published his *Mémoires*. Although the collection of essays and prints does not yet include Rösels own work with polyps, it is nevertheless of interest because it features a translation of a passage from the recently published *Traité d’Insectologie* (Treatise on Insectology, 1745), alongside a copy of Bonnet’s model of the ladder of nature,¹⁷² in which the polyp plays a central role. Moreover, the translation of this passage on polyps and the ladder of being is followed by commentary by Rösels himself. Thus, the 1746 edition of *Insecten-Belustigung* is a fascinating document of the earliest reception of Francophone polyp-science in Germany.

Unlike the anti-theoretical Trembley, Bonnet is prepared to speculate about the polyps significance for a modern scientific understanding of the structure of nature. Yet, though he is a materialist like Diderot, Bonnet is *not prepared* to make such radical predictions about the existence of *polypes-humaines* on Jupiter or Saturn. The polyp, by Bonnet’s estimation, does not imply that the entire order of nature is entirely flexible or subject to fantastic transformations. Rather, Bonnet argues that the polyps “admirables propriétés” show “[...] qu’il y a une gradation entre toutes les parties de cet univers.”¹⁷³ At the same time, Bonnet’s construct of the ladder of creation is also not as rigid as Beseke’s. Rather, Bonnet represents creation as a smooth spectrum of morphological gradations, and the polyp the creature as an intermediate species.

¹⁷² *Insecten-Belustigung*, 1:[22]. Charles Bonnet, *Traité d’insectologie* (Paris: Chez Durand, 1745), xxvii–xxviii.

¹⁷³ Bonnet, *Traité d’insectologie*, xxviii. In his translation of Bonnet, Rösels renders “admirable” as “wunderbar” rather than “bewundernswert.” Strictly speaking, both can be appropriate translations of the word. However, “bewundernswert” would be slightly more appropriate, since the original French “admirable” implies that the object elicits the admiration of the subject; whereas “wunderbar” modifies the meaning of the phrase somewhat to emphasize the “wonderful” qualities of the animal.

En effet, si nous parcourons les principales productions de la Nature, nous croirons aisément remarquer qu'entre celles de différentes classes, & même entre celles de différens genres, il en est qui semblent tenir le milieu, & former ainsi comme autant de points de passage ou de liaisons.¹⁷⁴

The polyp's biology complicates the stark division between “plants” and “animals.” The negative analogies between the kingdoms do not seem to apply to this particular creature. Thus, intermediate species like the polyp cast into relief the ways in which the abstract categories that scientists employ belie strong analogies between neighbors on the ladder of life.

After his translation of Bonnet, Rösel offers thoughts of his own on the materialist's interpretation of the polyp's meaning for the study of natural history. Given the discomfort of many Germans with French materialism, Rösel offers a curiously favorable interpretation of Bonnet's thesis.

Diese Leiter, welche der Autor nur als einen Versuch darstellt, und die vielleicht nicht von jedem vor vollkommen wird angesehen werden, zeigt doch genugsam, wie viele natürliche Dinge es gebe, die sich unter keine Haupt-Art oder Classe bringen lassen. Gleichwie aber dieses bey allen natürlichen Dingen insgemein sich so verhält: so finden wir ein gleiches auch bey jeder Haupt-Art insbesondere, wann wir solche wieder in Classen, Geschlechter und Sorten eintheilen wollen.¹⁷⁵

For Rösel, the existence of intermediate species makes every aspect of the delineation of the taxa untenable. The products of nature are to be treated, rather, in their individuality and variety. For the natural historian, this implies the pursuit of a fundamentally empiricist, as opposed to systematist, methodology.

By arguing against abstract, systematist taxonomies via Bonnet and the freshwater polyp, Rösel takes a clear stance against Linnaeus's attempts to make nature more easily legible to scientific practice. He therein sides, implicitly, with another Francophone scientist, Buffon, one

¹⁷⁴ Bonnet, *Traité d'insectologie*, xxvii–xxviii.

¹⁷⁵ *Insecten-Belustigung*, 1:[26].

of Linnaeus's most vocal critics. In Volume I of his *Histoire Naturelle*, Buffon argues that the variety is the rule of nature, and therefore, that taxonomic systems obscure rather than decode natural truth. Botanists broadly, Buffon argues, and Linnaeus most notably all commit

cette erreur de principe qui leur est commune à toutes, & qui consiste à vouloir juger d'un tout, & de la combinaison de plusieurs tous, par une seule partie, & par la comparaison des différences de cette seule partie: car vouloir juger de la différence des plantes uniquement par celle de leurs feuilles ou de leurs fleurs, c'est comme si on vouloit connaître la différence des animaux par la différence de leurs peaux ou par celle des parties de la génération; & qui ne voit que cette façon de connoître n'est pas une science, & que ce n'est tout au plus qu'une convention, une langue arbitraire, un moyen de s'entendre, mais dont il ne peut résulter aucune connoissance réelle?¹⁷⁶

Rösel's rejection of taxonomy and preference for a somewhat more materialist interpretation of nature is not only ironic, since Linnaeus often relied on the *Insecten-Belustigung* for the construction of his *Systema Naturae*, but also somewhat surprising, since Buffon's materialism was equally, if not at times more, controversial.

In the context of this dissertation's ongoing reflections on organismic analogies, Bonnet and Rösel problematize the role that analogies necessarily play in the construction of knowledge hierarchies. In order to classify kingdoms, phyla, classes, orders, families, and genera, the taxonomist must generate formal analogies between different groupings of species. In doing so, he must privilege certain kinds of physical analogies over others. He strives to make reasoned judgments about which positive and negative analogies take precedence over others, but the constant discovery of new species casts the provisional nature of these judgments into relief. Organismic analogies are therefore in themselves constitutionally mysterious, playful, constantly shifting in relevance and meaning. A being like the polyp, which appears to straddle a boundary

¹⁷⁶ Buffon, *Histoire naturelle, générale et particulière*, 15–16. The discussion of Linnaeus occurs later, and is presented as a more detailed example of the problem with all arbitrary systems, Buffon, *Histoire naturelle, générale et particulière*, 37–41.

between kingdoms, reminds the scientist to exercise more flexibility in reading the fickle forms of nature.

2.2. The Anthropomorphized Polyp

Later in the first edition of the *Insecten-Belustigung*, Rösel expresses his wish to acquire polyp specimens in order to reproduce Trembley's incredible experiments himself. However, it is not until the installment of 1755, nine years later, that he presents an extended account of the freshwater polyp. By this point, many new polyp species with different characteristics have been discovered, but Rösel still cleaves relatively closely to Trembley's monograph as a model. In many ways, the insectologist's engagements with Trembley and his work demonstrate flexibility in reading *and* writing the forms of nature—for, in his approach to understanding and representing the creature, Rösel makes a number of highly unconventional, transformational decisions.

Initially, Rösel only sets out to reproduce Trembley's experiments, particularly in creating Hydras of his own. "Nachdem mir nun mein Versuch mit diesem Polyp gelungen war, bekam ich Lust, wo nicht eine fünfzig Köpfe tragende Creatur, dergleich ehemals die im lernäischen Morast lebende Schlange gewesen seyn soll; doch ein mit fünf Köpfen versehenes Wunderthier aus meinen Polypen zu machen."¹⁷⁷ Here, Rösel does not shy away from the idea of the miraculous polyp—his term "Wunderthier"—he embraces it. By evoking Trembley's rhetorical paradigm, Rösel accentuates the idea of possibility, of testing the natural limits of the animal's abilities, just as Trembley had done. Like Trembley, too, by reiterating the allusion to

¹⁷⁷ *Insecten-Belustigung*, 3:489.

the Hydra of Lerna, he implicates himself in the supernatural narrative as a modern Hercules, creating miracles of his own.

Soon, however, Rösel becomes curious about how he might himself, according to the logic of miraculous superlatives discussed in Chapter 2, surpass even Trembley in the creation of *even more* fantastic monsters. He experiments with creating *Wunderthiere* with heads sprouting from heads, branches sprouting from other branches, and pairs of “legs” and “feet.” Bearing in mind that polyps generally only grow to be about a centimeter in length, the reader has to appreciate the delicacy of the operation. These dizzyingly complex, filigreed monsters represent an unprecedented rearticulation of the natural structure of an organized being.

In the way they are represented in the illustrations, Rösel’s many-armed and many-legged polyps ultimately hint at the form of higher, indeed, human beings (Fig. 2). Figure 3 of Table LXXXI in Rösel’s *Insecten-Belustigung* depicts two two-legged hydras that appear to be dancing with each other. Their bodies and legs are almost wrapped around each other, as though they were performing an intimate tango. The two-legged hydra in Figure 5 on the same page appears to walk across the page. Both of its “feet” are oriented in the same direction, echoing the specific anatomical symmetry of the bipedal mammal. The hydra in Figure 4 on that page has taken a confident stance, its two legs splayed like a general or a king. There is something undeniably animated, social, and human about each of these polyps.

The way Rösel organizes each figure on the page likewise contributes to this subtle anthropomorphization of the polyp. As if to invoke Bonnet’s image of the polyp in the ladder of being, each hydra depicted is slightly more complex than the previous one. Figures 1 and 2 in Table LXXX represent two- and three-headed hydras, while the hydra in Figure 5, Table LXXXI, the last in the sequence and the one that appears to be walking, has nine heads emerging

from three necks. Just as life from the polyp to the human becomes increasingly sophisticated, from the left to the right side of the page, Rösel's *Wunderthiere* become increasingly human.

Comparison of Rösel's illustrations with other similar biological illustrations from the period show that they are part of a playful development in the representations of polyps. The etchings of polyps that Pierre Lyonet (1706–1789) produced for Trembley's *Mémoires* represent polyps in motion (Fig. 1). In fact, Lyonet's representation of the polyp's characteristic mode of locomotion—the performance of little somersaults—was copied in many other scientific illustrations of polyps. Yet this is a portrayal of the animal that highlights a characteristic behavior rather than an imaginative fancy. Conversely, the polyp-illustrations by Adam Wolfgang Winterschmidt (1733–1796) in the work *Mikroskopische Gemüths- und Augen-Ergötzung* (Microscopic Delights for the Spirit and Eye, 1759–1763) by Martin Frobenius Ledermüller (1719–1769) pay homage to the style and ideas of both Lyonet and Rösel: Winterschmidt represents the scene of experimentation, the glass and the compound microscope, as well as marvelous looking *Wunderthiere* like Rösels. Where the clean lines and simple elegance of Lyonet's illustrations reflect the thoroughness of Trembley's science, and the sequential organization of Rösel's illustrations emphasize a progression of increasing complexification, Winterschmidt's diagram exhibits a sense of exuberance that the page barely contains—the “arms” of the polyp reach into an imaginary space behind the borders of the table, hinting at the possibilities that the experimental scene contains.

The playfulness that inspired Winterschmidt is reflected in the way Rösel represents true-to-nature renderings of polyps alongside images of his own “Wunderthiere.” Nothing in the visual language of the illustrations suggests that there is a meaningful difference between natural polyps and created hydras—both the “Tier” and “Wunderthier” self-evidently belong to the

natural order. By framing the relationship between polyps and hydras in this way, Rösel naturalizes the idea of gradual yet radical metamorphoses. He does not go quite so far as Diderot as to declare the possibility of the existence of *Polypenmenschen*, but he does imply that there is a natural ground to scientific creativity that makes it almost indistinguishable from the divine creativity that produces all organismic life. In this sense, Rösel's anthropomorphic polyps emphasize the active role of the Enlightenment scientist in shaping nature: the malleability of the polyp's body makes it a canvas for the creative scientist.

Ultimately, the possibility, only hinted at in Rösel's polyp illustrations, that there might be a shared biological structure between humans and polyps, prompts the beholder to wonder about the degree to which human reality might also be subject to the miraculous laws of the polyp. Thus, though Rösel depicts polyps with human features, rather than humans with polyp features, the illustrations in the *Insecten-Belustigung* occupy a similar conceptual space as the *polypes-humaines* in "Le Rêve de d'Alembert." That is, both Diderot and Rösel generate an analogical space occupied by both human beings and polyps, wherein the beholder can imagine what it would mean for the laws of the polyp to apply to the laws of the human being or vice versa. This is a creative and flexible cognitive space, in which the imagination is free to anthropomorphize the polyp or polypomorphize the human being. And in that realm, it is possible to imagine that the malleability of nature that the polyp represents creates certain possibilities for the creative, human scientist.

Illustrations

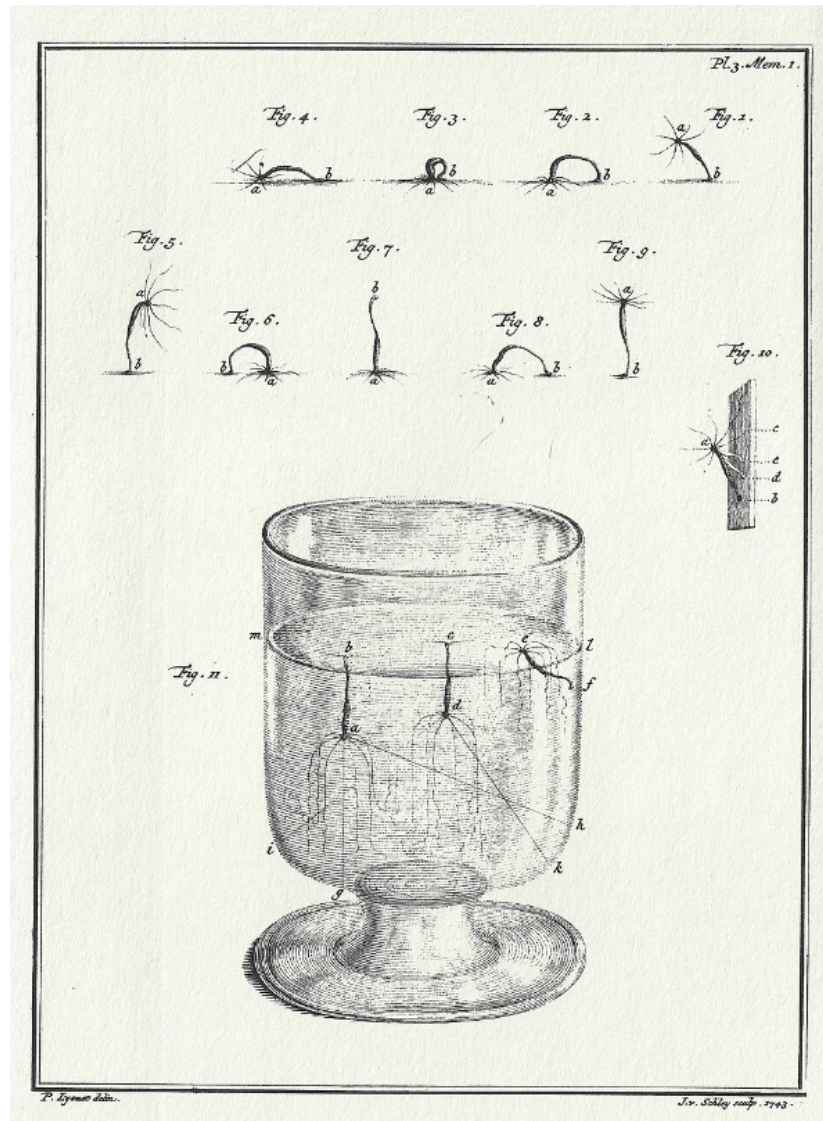


Figure 1. Pierre Lyonet, polyp locomotion, engraving. In Abraham Trembley, *Mémoires pour servir à l'histoire d'un genre de polypes d'eau douce* (Leiden: Jean & Herman Verbeek, 1744).

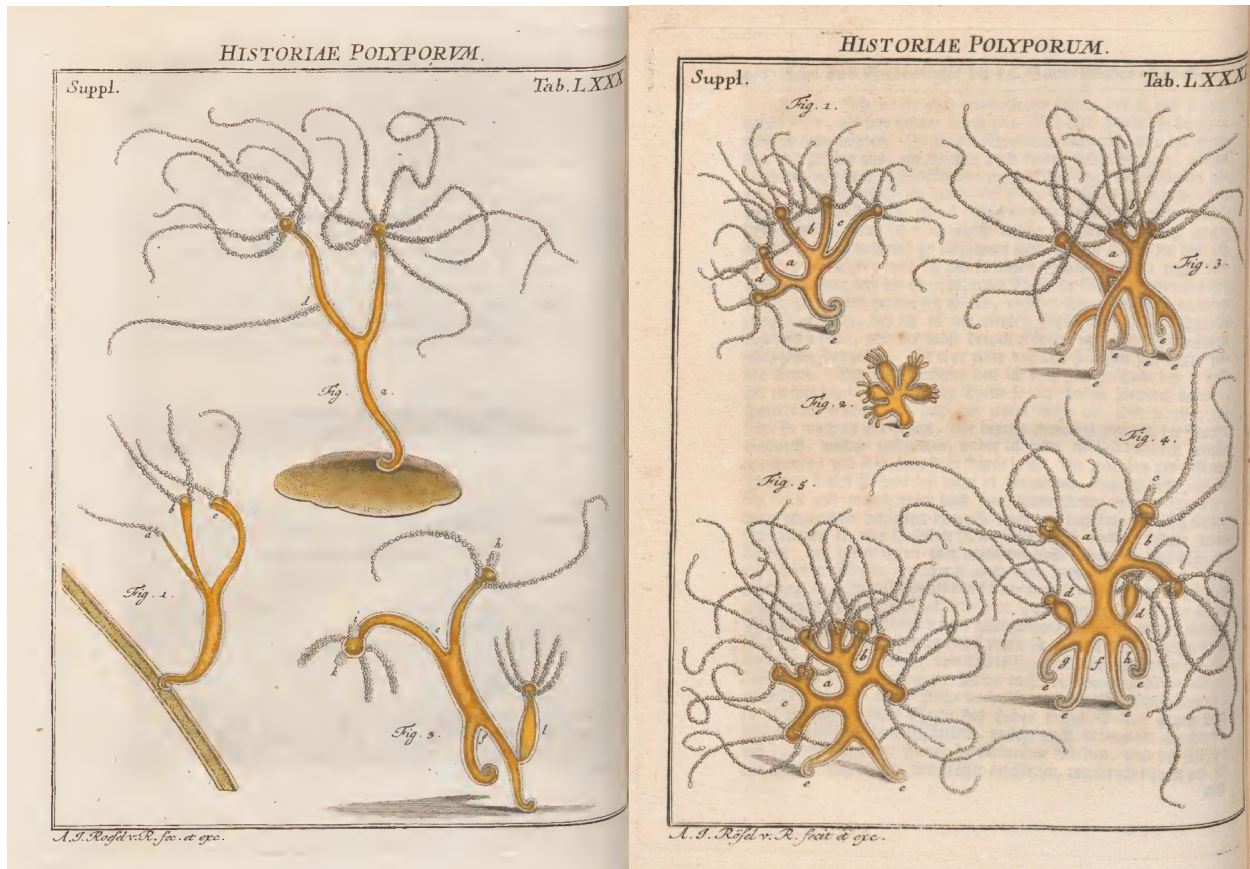


Figure 2. August Johann Rösel von Rosenhof, freshwater polyps and *Wunderthiere*, engraving. In *Der monatlich herausgegebenen Insecten-Belustigung*, vol. III (Nuremberg, 1755), Tables LXXX and LXXXI.

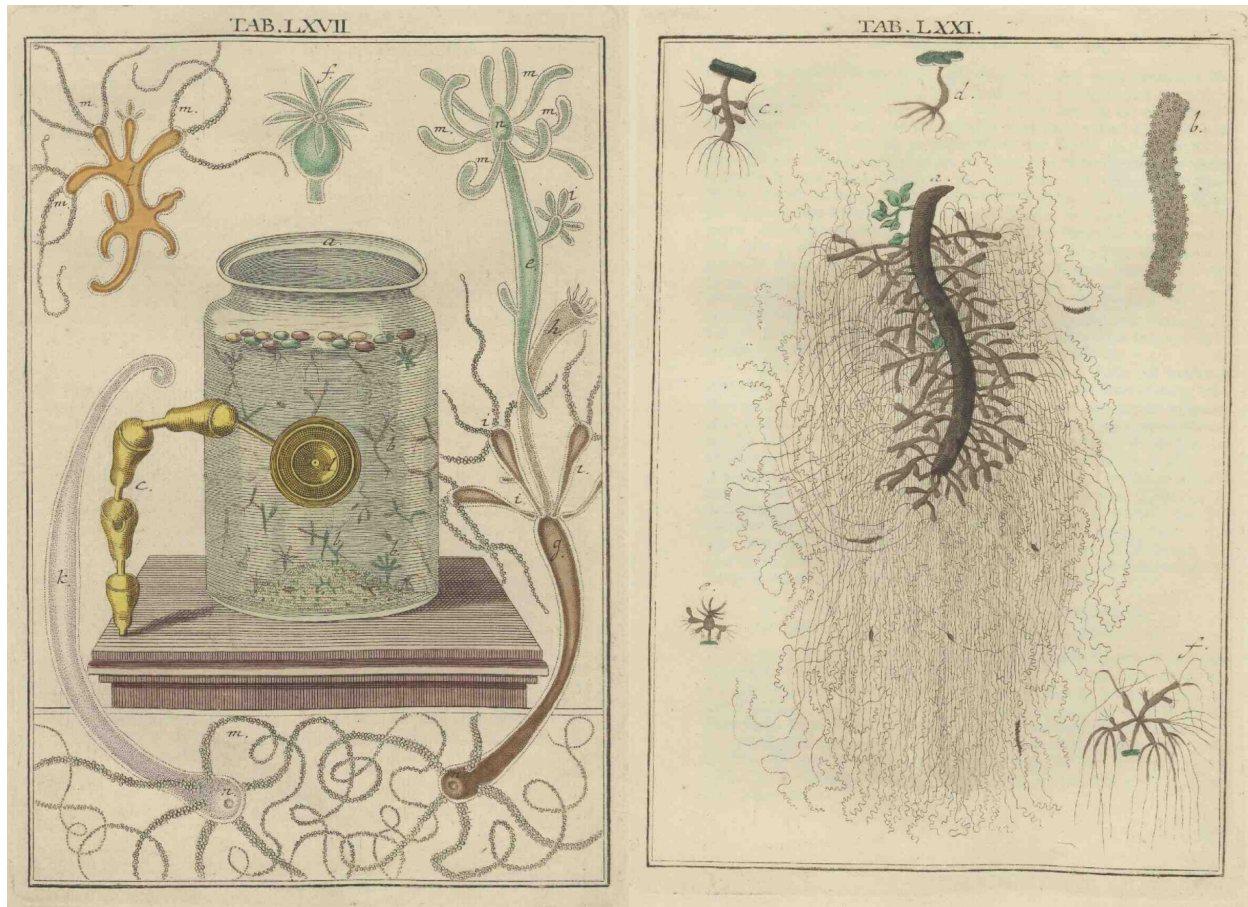


Figure 3. Adam Wolfgang Winterschmidt, microscopic polyp scene, engraving. In Martin Frobenius Ledermüller, *Mikroskopische Gemüths- und Augen-Ergötzung* (Nuremberg, 1759–1763).

3. Blumenbach on the *Bildungstrieb*

The tension between the real and the marvelous is a defining feature of the progression in polyp science from Rösel to Blumenbach. Rösel's anthropomorphizations of the polyp, his representations of *Wunderthiere* side-by-side with "natural" polyps, blur the line between the miraculous world of the polyp and the natural world of the human being. Blumenbach's move consists in firmly closing the door to the marvelous, while at the same time probing more deeply the question of what the apparent analogies between the polyp and the human being mean about the order of nature. For, whereas Rösel's anthropomorphization of the polyp remains implicit throughout the illustrations in the *Insecten-Belustigung*, in the treatise *Über den Bildungstrieb und das Zeugungsgeschäfte*, Blumenbach makes an explicit analogy between the polyp and the human being the basis of his argument.

The work opens with a curious anecdote that places the origin of the idea of the *Bildungstrieb* in a novel encounter with the freshwater polyp.

Vor ohngefähr drey Jahren, da ich einige Ferientage auf dem Lande zubrachte, fand ich in einen [sic] Mühlbache eine artige Art grüner Armpolypen, die sich durch einen langgestreckten spindelförmigen Körper, und kurze meist steife Arme von der gemeinen grünen Gattung auszeichneten, und mit deren Wundern ich meiner Gesellschaft einen Theil ihrer Zeit vertreiben sollte. Theils das warme trockene Sommerwetter, noch mehr aber die dauerhafte Constitution dieser Polypengattung begünstigte die bekannten Reproductionsversuche die wir damit anstellten, so, daß die Wiederersetzung gleichsam zusehends von statten zu gehen schien.¹⁷⁸

If the event that Blumenbach describes took place "Vor ohngefähr drey Jahren," then that places it at some time in 1777 or 1778—two to three years after Johann August Ephraim Goeze (1731–

¹⁷⁸ Johann Friedrich Blumenbach, *Über den Bildungstrieb und das Zeugungsgeschäfte* (Göttingen: Johann Christian Dieterich, 1781), 9.

1793) translated Trembley's *Mémoires* into German.¹⁷⁹ In a concrete sense, by referencing the "bekannte Reproduktionsversuche," Blumenbach is capitalizing on the renewed interest in polyp science that the translation would have ignited. At the same time, the date makes the omission of any direct reference to either Goeze or Trembley rather striking, especially since Blumenbach, like Rösel, invokes the narrative of "Wunder" to describe the polyp's regenerative abilities, which Trembley himself had helped to cultivate.

In fact, Blumenbach's invocation of "Wunder" is part of a somewhat aggressive rhetorical tactic designed to amplify significance of his own contribution to rational science. As the narrative continues, the anatomist explains that although the experiments unfolded as predicted, the group of friends noticed something peculiar that is generally omitted from scientific literature on the polyp.

Schon den zweyten dritten Tag waren den verstümmelten Thieren wieder neue Arme, Schwänze u. s. w. angewachsen: nur bemerkten wir immer sehr deutlich, daß die neu ergänzten Polypen bey allen reichlichen Futter doch weit kleiner als vorher waren: und ein verstümmelter Rumpf, so wie er die verlohrenen Theile wieder hervortrieb, auch im gleichen Maaße recht sichtlich einzukriechen, und kürzer und dünner zu werden schien u. s. w.¹⁸⁰

In a footnote at the end of this paragraph, Blumenbach argues that the expectation of "Merkwürdigkeiten," that is, the expectation of a marvelous feat of regeneration, is to blame for the tendency to overlook this deficiency in polyp regeneration. Here, Blumenbach implicitly discredits numerous, predominately Francophone, scientists for disseminating a narrative that ultimately obscured the true nature of freshwater polyp. Only "der sorgfältige Rösel," he notes,

¹⁷⁹ Abraham Trembley, *Des Herrn Trembley Abhandlungen zur Geschichte einer Polypenart des süßen Wassers mit hörnerförmigen Armen*, trans. Johann August Ephraim Goeze (Quedlinburg: Christoph August Reußner, 1775).

¹⁸⁰ *Über den Bildungstrieb*, 9–10.

seems to have been aware that polyps aren't able to fully regenerate tissue when they are severed.¹⁸¹ There is not a little irony in Blumenbach's representation of Rösel as the only scientist to see past the "Merkwürdigkeiten" of the polyp, when Rösel himself was so fascinated by the process of creating his own "Wunderthiere."

Ultimately, Blumenbach represents this moment of insight beyond the illusion of the narrative of the miracle in true Enlightenment fashion as the source of his epiphany. Bringing the polyp *back down to earth* allows him to see not the negative analogies between the polyp and all other organisms, but rather to recognize for the first time their many significant positive analogies. As the anecdote continues, Blumenbach explains how, upon returning to the city, he visited a patient suffering from a bone infection.

Der Schade war über dem Knie, und offen, und auch die weichen Theile zu einer tiefen Grube ausgeeitert. Es besserte sich nachher, aber so wie die Lücke im Fleisch nach und nach wieder mit Gallerte oder Narbe angefüllt wurde, so senkte sich auch das benachbarte gesunde Fleisch im gleichen Grade allgemach nieder, schien gleichsam zu schwinden, so daß endlich die Narbe in der Grube und das Fleisch am Rande derselben einander fast gleich stunden, und jene nur noch eine breite aber ziemlich flache Delle machten. Also mutatis mutandis der gleiche Fall wie bey meinen grünen Polypen aus dem Mühlgraben.¹⁸²

The comparison of the human knee with "meinen grünen Polypen" shows Blumenbach that the polyp's ability to regenerate tissue is much more natural, much less marvelous than previously thought.

The crux of Blumenbach's logic here lies in his phrase "Mutatis mutandis," or "with the necessary changes having been made." Self-evidently, the human patient could never regenerate

¹⁸¹ "Es ist zwar ganz wol begreiflich wie ein solcher kleiner Umstand von manchen Beobachtern entweder in der Erwartung grösserer Merkwürdigkeiten ganz übersehen oder aber nicht anmerkungswerth gefunden worden. Doch scheint der sorgfältige Rösel drauf geachtet zu haben. Hist. der Polypen im 3. B. der Insectenbelustig. S. 490" (*Über den Bildungstrieb*, 10).

¹⁸² *Über den Bildungstrieb*, 10–11.

an entire amputated leg—that would indeed be a miracle. Then again, polyps do not have “legs” or “bones” or “muscles” the way human beings do, such that the regeneration of even half the mass of a polyp cannot be quite so complicated a process. Thus, the appropriate comparison between polyps and human beings, if a comparison is indeed to be made, must lie only in tissue regeneration, not in whether both organisms are capable of regenerating entire sections of their bodies. And in this regard, both the polyp and the human being are indeed similar. The analogy holds.

The rhetorical gesture behind the phrase “*mutatis mutandis*” is thus to invoke all negative analogies precisely in order to demonstrate the validity of the analogical claim. It is obvious for any reader that the polyp and the human being cannot be any more different from one another. Their anatomies seem to exhibit nothing but negative analogies. And yet, if in spite of so much difference, similarities do exist, then the anatomist is justified in wondering about the extent and source of the similarities.

More specifically, Blumenbach concludes from the analogy between the polyp and the human first, that it is plausible that a single unifying principle of nature is responsible for the similarities between these two creatures, and therefore second, that this principle of nature is valid for every other type of organized life, no matter how similar to or different from polyps or human beings they may be. He calls this principle of organization the *Bildungstrieb* or formative drive.

Daß in allen belebten Geschöpfen vom Menschen bis zur Made und von der Ceder zum Schimmel herab, ein besondrer, eingeborhner, Lebenslang thätiger wirksamer Trieb liegt, ihre bestimmte Gestalt anfangs anzunehmen, dann zu erhalten, und wenn sie ja zerstört worden, wo möglich wieder herzustellen.¹⁸³

¹⁸³ *Über den Bildungstrieb*, 12.

Here, in the very definition of the formative drive, Blumenbach builds on the rhetorical gesture of his “mutatis mutandis” by invoking yet more seemingly implausible analogies between the human being and the maggot, the cedar tree and mold spore. This is not an elision of difference in the manner of Diderot’s *polype-humaine*, and it is obviously not a rigid reassertion of the divine necessity of natural forms precisely as they exist. Rather, in a synthesis of both approaches, Blumenbach employs the logic of organismic analogies to assert the generation of manifold beings according to a limited number of simple processes as universally valid across nature.

By invoking the polyp as the emblem of a universal principle of formation, Blumenbach expands on Bonnet’s interpretation of the animal—which Rösel had translated and republished in the 1746 edition of his *Insecten-Belustigung*. Bonnet had argued that the polyp demonstrates the gradations between all of the kinds of organized life that exist. That argument establishes the polyp as representing, in a general sense, analogies between closely related kinds of organisms. Blumenbach goes a step further and makes the polyp the symbol of analogies that exist between all organisms, regardless of their similarity or dissimilarity. That is a much bolder claim about the structure of nature, and that is part of the reason why the polyp and the human are necessary, because there could not be any two animals any more different from each other.

Blumenbach makes the analogy between polyps and human beings explicit with his statement “mutatis mutandis etc.” He deliberately pulls the polyp into the scope of human affairs as a way of understanding the structure of nature as a whole. Whereas the more conservative German Neoplatonists discussed in Chapter 3 focused their attention on the immutability of the negative analogies between polyps, elephants, and other complex organisms, Blumenbach evidently regards the polyp-analogy much differently. For him, the analogy between the polyp

and the human is a welcome sign that there is order in the apparent chaos of nature.

4.1. Kielmeyer on Compensation

Blumenbach's treatise focuses largely on the issue of anatomy, but in his 1793 lecture "Ueber die Verhältnisse der organischen Kräfte," Kielmeyer expands the scope of the polyp-human analogy to include matters of education.¹⁸⁴ The lecture, delivered on the occasion of the Duke Carl Eugen's 65th birthday, and only months before his death, is one of only a few writings by Kielmeyer that survive. The modest Karlsschule professor, whose students included major early biologists like Georges Cuvier (1769–1832), Gottfried Reinhold Treviranus (1776–1837), and Lorenz Oken (1779–1851) preferred lecturing to publishing. Thus, despite the exhortations of his colleagues and students, Kielmeyer did not even publish the manuscript of the 1793 address himself. Yet, he was nevertheless widely read and discussed, as a result of "the circulation of unofficial manuscripts, correspondence or the gossip of his Karlsschule and Tübingen students."¹⁸⁵

The lecture at the Karlsschule was remarkably well-received throughout Germany. According to Azadpour and Whistler: "The Speech directly or indirectly inspired every major contribution to the philosophy of the organism in Germany at the turn of the nineteenth

¹⁸⁴ The original German is cited from the 1793 edition of Kielmeyer's lecture. Carl Friedrich Kielmeyer, *Ueber die Verhältnisse der organischen Kräfte unter einander in der Reihe der verschiedenen Organisationen, die Geseze und Folgen dieser Verhältnisse* (1793). Subsequent citations as "Ueber die Verhältnisse der organischen Kräfte" with page number(s).

¹⁸⁵ Lydia Azadpour and Daniel Whistler, "Editors' Introduction," in *Kielmeyer and the Organic World: Texts and Interpretations*, ed. Lydia Azadpour and Daniel Whistler (London, UK: Bloomsbury Academic, 2021), 1–10, here 3.

century.”¹⁸⁶ Herder, Goethe,¹⁸⁷ and Friedrich Wilhelm Joseph Schelling (1775–1854)¹⁸⁸ all engaged with Kielmeyer’s ideas, which continued to influence the study of biology in Germany into the nineteenth century.¹⁸⁹ Thus, although Kielmeyer’s renown is dwarfed by the status of many of his acolytes, his work clearly contributed directly to their success.

In “Ueber die Verhältniße der organischen Kräfte,” Kielmeyer argues that all organisms, from the polyp to the human being, achieve their forms as the result of a push-and-pull between different forces. The doctrine of forces or “Kräfte” was well-established in German life sciences by the end of the eighteenth century. Kielmeyer’s list of forces builds on this tradition. Sensibility describes the “Fähigkeit mit Eindrücken, die auf die Nerven oder sonst gemacht werden, gleichzeitig Vorstellungen zu erhalten.”¹⁹⁰ Irritability describes “die Fähigkeit mancher Organe [...] auf Reize sich zusammenzuziehen, und Bewegungen hervorzubringen.”¹⁹¹ Reproduction describes “die Fähigkeit der Organisationen, sich selbst ähnliche Wesen

¹⁸⁶ Azadpour and Whistler, “Editors’ Introduction,” in *Kielmeyer and the Organic World*, 1–10, here 3.

¹⁸⁷ “At Goethe’s request, Kielmeyer obtained, annotated lavishly, and sent on to Goethe in Weimar two sets of these notes” (Zammito, *The Gestation of German Biology*, 255). Part III of the dissertation considers the connection between Kielmeyer and Goethe further.

¹⁸⁸ Kate Rigby, “Art, Nature, and the Poesy of Plants in the Goethezeit: A Biosemiotic Perspective,” *Goethe Yearbook* 22, no. 1 (2015): 35; Robert J. Richards, *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe*, Science and Its Conceptual Foundations (Chicago: University of Chicago Press, 2002). Olivier Rieppel, “Species Are Individuals—the German Tradition,” *Cladistics* 27, no. 6 (2011): 629–645, here 630–631.

¹⁸⁹ “Throughout the twentieth century, Kielmeyer was mentioned in almost all biological works (including histories of biology) as the most important forerunner of Haeckel.” Kai Torsten Kanz, “Kielmeyer’s Fame and Fate,” in *Kielmeyer and the Organic World*, 11–26, here 20.

¹⁹⁰ *Ueber die Verhältniße der organischen Kräfte*, 9.

¹⁹¹ *Ueber die Verhältniße der organischen Kräfte*, 9.

Theilweise oder im Ganzen nach- und anzubilden.”¹⁹² Secretion describes “die Fähigkeit aus der Saftmasse dieser selbst unähnliche Materien von bestimmter Beschaffenheit wiederholt an bestimmten Orten abzusondern.”¹⁹³ Propulsion describes “die Fähigkeit, die Flüssigkeiten in den festen Theilen in bestimmter Ordnung zu bewegen und zu vertheilen.”¹⁹⁴ Processes of compensation ensure that excesses or lacks in some domains are accounted for in others.

Kiellmeyer’s central innovation is his theory of “Compensation” or “Ausgleich” for describing how these forces are distributed in nature.¹⁹⁵ Nature, according to Kiellmeyer, always pursues “der größtmöglichen Ausgleichung aller Kräfte,” and so it relies on a variety of compensatory mechanisms in order to achieve the ultimate goal of equilibrium.¹⁹⁶ Generally speaking, an organism may exhibit excesses in one domain or another, but “[...] je mehr eine dieser Kräfte auf einer Seite ausgebildet worden, desto mehr wurde sie auf einer andern Seite vernachlässigt.”¹⁹⁷ Likewise, “mit dem Verschwinden der einen Kraft [tritt] die andere hervor[.]”¹⁹⁸ One way or another, the development of the organism is constrained by the degree to which each force acts through or upon it.

¹⁹² *Ueber die Verhältnisse der organischen Kräfte*, 9.

¹⁹³ *Ueber die Verhältnisse der organischen Kräfte*, 9.

¹⁹⁴ *Ueber die Verhältnisse der organischen Kräfte*, 10.

¹⁹⁵ Kiellmeyer employs the terms “Compensation,” “Ausgleich,” “Ausgleichung,” and other synonyms interchangeably, but does not, as such, provide a single term to unify the whole conceptual framework. Generally, secondary literature on Kiellmeyer employs the phrase “law of compensation,” though in truth, Kiellmeyer speaks of a range of *laws* that operate together to determine the morphology of an organism.

¹⁹⁶ *Ueber die Verhältnisse der organischen Kräfte*, 41.

¹⁹⁷ *Ueber die Verhältnisse der organischen Kräfte*, 35–36.

¹⁹⁸ *Ueber die Verhältnisse der organischen Kräfte*, 38.

For example, if an organism suffers either a deficit or surfeit of irritability, Nature makes up for this imperfection by amplifying or curtailing its reproductive force. Creatures such as mammals are not very prolific breeders but they are generally very intelligent. That intelligence provides individual members of the species with the creativity to survive in diverse situations, such that they do not need to rely on high birth rates to maintain the species. On the other hand, “[...] je mehr alle Arten von Aeüßerungen der Reproduction in einem Organismus vereinigt sind, desto eher ist Empfindungsfähigkeit ausgeschlossen, und desto eher weicht Selbst Irritabilität.”

¹⁹⁹ Many organisms have no need for elaborate sense-apparatuses because they are able to reproduce in great numbers and in a variety of ways.²⁰⁰ The system of compensation therefore means that the “great machine” of life consists of many different kinds of “organizations” that are each subject in different ways to a constant push and pull between determination and free expression. The restriction of one faculty always, for Kiemeyer, creates a “freer space” in which the other faculties may elaborate and refine themselves. Determination and freedom are two sides of the same organismic coin.

Kiemeyer’s approach to compensation treads the narrow path defined by naturalists from Linnaeus to Blumenbach. Unlike Linnaeus, who prescribes strictly formal, decontextualized categories, Kiemeyer focuses on the analogy of processes and products.²⁰¹ He is not strictly interested in defining different species, so much as understanding the principles by which the

¹⁹⁹ *Ueber die Verhältnisse der organischen Kräfte*, 35.

²⁰⁰ Kiemeyer speaks of the “TastungsMaschinen” that the organism employs for navigating its environment. *Ueber die Verhältnisse der organischen Kräfte*, 16.

²⁰¹ Susanne Lettow argues that Kiemeyer here develops a concept of homologies that his student Oken would later build on. See the chapter “Reproduction, Production and the Earth: The Place of Sex in Kiemeyer’s ‘Economy of the Organic World’” in *Kiemeyer and the Organic World*, 171–186, especially 176.

variety of species that exist could come about. Simultaneously, he does not argue, like Diderot, that the present natural order is, effectively, a crapshoot: nature is flexible, but by no means lawless. Indeed, his theory of compensation gives an account of how the gradations of the ladder of being as conceived by Bonnet might come about. Still, Kielmeyer also deviates from strict Neoplatonism, insofar as his concept of compensatory mechanisms accommodates a high degree of freedom and flexibility within “the great machine” of nature. Additionally, Kielmeyer tellingly does not frame compensation itself as a “Kraft” or force in its own right, as Blumenbach did with the *Bildungstrieb*. Rather, the concept of compensation describes a tendency in the way each of the forces interact with each other to contribute to the *Bildung* of an organism. Thus, as has oft been noted, Kielmeyer’s work synthesizes a more modern, empirically grounded, de-anthropomorphized theory of the development of species.

4.2. Compensation & the Polyp

In the course of the lecture, Trembley’s freshwater polyp becomes a key symbol of the freedom of biological organization in all living things. Kielmeyer first mentions the polyp, because it and other diminutive invertebrates seem to contradict a secondary law of compensation: that more prolific organisms produce smaller young with simpler body forms such that the force of reproduction is itself “weniger ausdauernd” in these animals.²⁰² Yet he notes also that “[...] gerade die Würmer, bei denen eben so im Verhältniße Gegen die Fische einige Einschränkung ihrer Fruchtbarkeit bemerkt wird, es sind, bei denen sich künstliche Reproduction und natürliche *partielle* im höchsten Grad äussert.”²⁰³ “[T]hose worms” include the polyps that Trembley

²⁰² *Ueber die Verhältniße der organischen Kräfte*, 30.

²⁰³ *Ueber die Verhältniße der organischen Kräfte*, 31.

transformed into hydra, the snails that survived decapitation by Lazzaro Spallanzani (1729–1799), and the sea anemones that revealed the “Wunder der Polypen” to Jacques-François Diquemare (1733–1789).²⁰⁴ These examples of artificial reproduction allow Kielmeyer to formulate a revised secondary law of compensation: that prolific animals that nevertheless exhibit a weak reproductive force will compensate through “metamorphoses that the body withstands” and other strange means of maintaining and continuing life.

The lesson to be drawn from the polyp, then, is that Nature permits even the most extreme anatomical oddities to emerge within the limits of a handful of general laws, the laws of compensation. Compensation is thus as much a principle of lack, of deficiency in the organism, as it is a principle of creativity and innovation. Where one avenue of expression is foreclosed to the organism, another becomes a vast horizon. The polyp is the ultimate symbol of the generative balance between restriction and creativity, and it is in this sense that the human being is, for Kielmeyer, like a polyp.

In the final part of “Ueber die Verhältnisse der organischen Kräfte,” Kielmeyer turns his attention to the application of the theory of compensation to the human organism. Human beings possess, like other organisms, their own unique distribution of the forces of life: they are restricted in the force of reproduction, but in them, the force of sensibility has reached the highest degree of freedom. Compensation thus also governs the particular features of their enhanced *Geisteskräfte*:

Auch der menschliche Geist zeigt in den Perioden seiner Entwicklung das Verhältniß der Kräfte, die sich in ihm vereinigen, verändert. Empfindungen sind die Gespielinnen des Kindes, Fantasie die Auserwählte des Jünglings, und Verstand der treue Begleiter des Manns. Eine geht aus der andern wie Saamen aus Blumen, und Blumen aus Zweigen hervor, und mit entwikeltem Saamen der einen, wird auch die Blüthe der andern welker. Aber nicht allein in den verschiedenen

²⁰⁴ *Ueber die Verhältnisse der organischen Kräfte*, 32.

Lebensperioden ist ein solcher Wechsel der Kräfte des menschlichen Geistes bemerklich. Verschiedenheit der Umstände stellt diese ihre Entwicklungen aus einander in kürzern Perioden zusammengedrängt beim nemlichen Menschen dar.²⁰⁵

The human sensorium, imagination, and intellect coexist in delicate relationship, each balancing the excesses of the other. To say that humans are like plants is, in this case, not just to provide an evocative image, but to assert a shared faculty that is every bit as real as the visible differences they produce. Here, Kiemeier gives a biological account of culture, superimposing the law of compensation in the realm of biological *Bildung* onto its counterpart, the realm of cultural *Bildung*: education.

Education is the mechanism by which the human being compensates for physical lack. And education is what makes the human being like a polyp: “Bei jeder Entziehung die er [der Mensch] auf einer Seite erfährt, ergänzt sich sein Geist wie der Polype auf einer andern.”²⁰⁶ This remarkable statement does a few things. First, in a general sense, it emphasizes just how essential the discovery of the polyp was to Kiemeier’s thinking, since it is the only organism to which he refers multiple times across the lecture. Second, more specifically, it completes the analogy of the human being and the plant by introducing the image of the famous “plant-animal.” By heaping analogy on analogy, Kiemeier demonstrates his commitment to the analogical method of the study of natural history. Third, by introducing the image of the polyp, he creates an avenue for comparing the realm of freedom of one organism with the realm of freedom of another. For the polyp, the body is the object of a miraculous “artificial reproduction”; for the human being, it is the mind. But both animals engage freely in the *art* (techne) of constructing their own invisible

²⁰⁵ *Ueber die Verhältnisse der organischen Kräfte*, 44.

²⁰⁶ *Ueber die Verhältnisse der organischen Kräfte*, 45.

prostheses for navigating the challenging natural world.

Finally, and perhaps most importantly, Kiehmeyer's analogy of the polyp and the human being as *free* by virtue of the law of compensation emphasizes the miraculous creation of bonds between organisms. The relatively simple operation of slicing a polyp in half to create two distinct entities is analogized to the complex relationship between growing individuals and their teachers and caretakers. The polypoid supplementation of the human *Geisteskräfte* is a vulnerable process that cannot be completed in isolation. Without "care and nurturing":

[I]ang einwirkende ungünstige Umstände können die schönsten Strahlen unsers Geistes erlöschen, dafür niedern Kräften ein bleibendes Uebergewicht geben, und wir verlieren damit den Charakter unsers Geschlechts, jene Erstattungs Fähigkeit, oder mit andern Worten, die Fähigkeit unter allen äußern Umständen glücklich zu seyn.²⁰⁷

Thus, by analogizing the human being and the polyp, Kiehmeyer ties a biological knot around the relationship between the Enlightenment concepts and institutions of education, freedom, and self-actualization.

It appears, from Kiehmeyer's account, that a polypoid structure governs each level of growth: the mind, the body, and the organization of the societal whole all function according to a law of compensation, creating equilibrium from the surfeits and deficits that natural contingency has supplied. No human being is capable of achieving the ideal expression of their own being without the help of others. In humans, the process of growth left unattended can only produce creatures of excess or lack, of monsters in one domain or another. The human animal compensates for its natural excesses by learning. Nor is it only the shortcomings of organism that education corrects, but the failings, too, of the whole species as an organization. By virtue, then, of their own biological destiny, human beings *must* pursue the path of self-discovery and

²⁰⁷ *Ueber die Verhältnisse der organischen Kräfte*, 46.

improvement in conjunction with their community.

5. Die Bestimmung des Polypen

Schiller's *Briefe über die ästhetische Erziehung des Menschen* have often been read in the context of eighteenth century biological and anthropological research,²⁰⁸ but references to Kiemeyer's work are notably absent from this body of scholarship. Yet there are good historical and philosophical reasons to read their accounts of human development together. Like Schiller, Kiemeyer was a graduate of the Karlsschule, meaning that both men were educated on the same fundamental curriculum. And even though one alumnus made a veritable enemy of the duke Carl Eugen, while the other was selected to give a lecture in honor of his birthday, the education that they received led them down similar intellectual paths. Given, then, that Schiller began work on the *Ästhetische Briefe* within a year of the publication of Kiemeyer's "Ueber die Verhältnisse der organischen Kräfte," and given the immediate success of that lecture within Schiller's own circle, the resonances between these two works merit some reflection: for they both regard the emergence of human culture from the law of nature itself and both employ images of polypoid-humanity to do so.

²⁰⁸ See for example: Tim Mehigan, "Schiller after Kant: The 'Unexpected Science' of the Briefe Über Die Ästhetische Erziehung Des Menschen," *Kant-Studien* 111, no. 2 (2020): 285–302. Wolfgang Riedel, "Philosophie des Schönen als politische Anthropologie. Schillers Augustenburger Briefe und die Briefe über die ästhetische Erziehung des Menschen," *Philosophical Readings* 5 (2013): 118–71. Jeffrey L. High, "Writings from Schiller's Time at the Karlsschule in Stuttgart (1773–1780)," in *The Palgrave Handbook on the Philosophy of Friedrich Schiller*, ed. Antonino Falduto and Tim Mehigan (Cham: Springer International Publishing, 2023), 91–128.

The human being is governed by two distinct drives: the sensuous drive or *Stofftrieb* and the formal drive or *Formtrieb*.²⁰⁹ The sensuous drive is concerned with the human being's physical existence: "Materie [...] heißt hier nichts als Veränderung oder Realität, die die Zeit erfüllt; mithin fordert dieser Trieb, daß Veränderung sei, daß die Zeit einen Inhalt habe"²¹⁰ The sensuous drive encompasses everything that the human animal needs in order to persist in its extensivity,²¹¹ both for immediate survival—food and shelter, safety from danger—and for general flourishing: the bonds of love and sex, a means of reproduction. In contrast, the form drive represents that which gives the human animal its ideal existence, its intensity.²¹² The form drive is concerned with the objects of reason, with matters of morality, justice, and the pursuit of freedom.

Der zweite jener Triebe, den man den Formtrieb nennen kann, geht aus von dem absoluten Dasein des Menschen oder von seiner vernünftigen Natur und ist bestrebt, ihn in Freiheit zu setzen, Harmonie in die Verschiedenheit seines Erscheinens zu bringen und bei allem Wechsel des Zustands seine Person zu behaupten.²¹³

Through the need for freedom and morality, in short, given to it by Nature, the human being intervenes in Nature and gives order to the arbitrary phenomena of sensuous existence.

Though the notions of the formal and sensuous drives are not introduced until the twelfth letter, they already inform his interpretation of Ancient Greek society in the sixth. In this letter,

²⁰⁹ Citations of the *Ästhetische Briefe* are from Friedrich Schiller, *Schillers Werke: Nationalausgabe*, ed. Julius Petersen et al., 42 vols. (Weimar: Hermann Böhlaus Nachfolger Weimar, 1943). Subsequent citations as "NA" with volume, letter, and page number(s).

²¹⁰ NA, 20: §12, 344.

²¹¹ "Extensivität" (NA, 20: §13, 348).

²¹² "Intensität" (NA, 20: §13, 348).

²¹³ NA, 20: §12, 345–346.

Schiller reflects on the tendency of recent political states toward a more exclusively mechanistic, formal organization, in opposition to the fluid organicism found in Ancient Greece:

Jene Polypennatur der griechischen Staaten, wo jedes Individuum eines unabhängigen Lebens genoß und, wenn es noth that, zum Ganzen werden konnte, machte jetzt einem kunstreichen Uhrwerke Platz, wo aus der zusammenstückelung unendlich vieler, aber lebloser Theile ein mechanisches Leben im Ganzen sich bildet.²¹⁴

Here, the images of the polyp and the clockwork represent the sensuous and formal drives respectively. Compared to the states of European modernity, the Ancient Greece of Schiller's history better nurtures that material existence of the human being. Thus, the polyp's miraculous body is isomorphic with the sensuous and spontaneous state of being that is possible within the more perfect political structure of Ancient Greece. Its nature encodes the Hellenic world as a body polypedic with the capacity to freely suspend or produce the condition of individuality. For it and for the Greeks, wholeness and fragmentation are only transitory states, and the movement from one condition to the other is not motivated from without but from within. The individual is able to exist in and for community, because it already carries that principle in itself, and neither fusion with nor separation from the communal whole leads to the abolition of its individuality.

The dichotomous positioning of the "Uhrwerk" and the "Polypennatur" illustrates the ways in which the formal principle is problematic for sensuous existence of the human being and vice versa. Namely, the *Formtrieb* is interested only in the ideal ordering of things in nature according to the moral law: "Wenn der Künstler an einem Uhrwerk zu bessern hat, so läßt er die Räder ablaufen; aber das lebendige Uhrwerk des Staats muß gebessert werden, indem es schlägt, und hier gilt es, das rollende Rad während seines Umschwunges auszutauschen."²¹⁵ Under the

²¹⁴ NA, 20: §6, 323.

²¹⁵ NA, 20: §3, 314.

conditions of mechanistic statehood, polypoid bodies, which cannot momentarily suspend their extensive being for the purpose of improvement, cannot sustain the statesman's tools: the individual rejects and succumbs to the sharp impression of the law. That is, in the clockwork state, every fragment is *made* to conform to a political principle defined *a priori*, regardless of subjective, sensuous experience. The parts of the societal whole are not bound together by anything but the simultaneous submission to a rational plan. To borrow Diderot's metaphysics, mereological relationships are merely contiguous, but not continuous, such that the political whole is reduced to a collection of organs without a body.²¹⁶

Ultimately, Schiller's program of aesthetic education calls for the balance of chronometric rationality and polypoid sensuality, the harmonization of form and matter through a third principle, that of the *Spieltrieb*, the play drive: "Der Spieltrieb also, als in welchem beide verbunden wirken, wird das Gemüth zugleich moralisch und physisch nöthigen; er wird also, weil er alle Zufälligkeit aufhebt, auch alle Nöthigung aufheben und den Menschen sowohl physisch als moralisch in Freiheit setzen."²¹⁷ In a state of play, the human being is freed, momentarily, from over-determination by either the formal or material principle. The rational faculty of the human being respects its materiality, and sensuality is independently driven to pursue perfection. Under these conditions, the human being is truly free:

Diese mittlere Stimmung, in welcher das Gemüth weder physisch noch moralisch genöthigt und doch auf beide Art thätig ist, verdient vorzugsweise eine freie Stimmung zu heißen, und wenn man den Zustand sinnlicher Bestimmung den physischen, den Zustand vernünftiger Bestimmung aber den logischen und

²¹⁶ See the chapter "Body without Organs" in Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (Minneapolis: University of Minnesota Press, 1983), 9–15.

²¹⁷ *NA*, 20: §14, 354.

moralischen nennt, so muß man diesen Zustand der realen und aktiven Bestimmbarkeit den ästhetischen heißen.²¹⁸

It is of crucial significance for the concept of the play-drive that Schiller here engages in the eighteenth century discourse of the “Bestimmung des Menschen,” variously translated as the determination, destiny, or constitution of the human being.²¹⁹ By integrating the philosophy of “Bestimmung” into the framework of play, Schiller insists that the aesthetic state does not merely represent a condition preferable to the spiritual bifurcation of modernity, but that the path toward individual and societal perfection is in fact the telos of humanity. When humanity embraces the state of play, then: “Wir sind nicht mehr Individuen, sondern Gattung; das Urtheil aller Geister ist durch das unsrige ausgesprochen, die Wahl aller Herzen ist repräsentirt durch unsre That.”²²⁰ In other words, *the* natural function of the human species is the reconciliation of form and matter, of that which is polypoid and mechanical within it.

The importance of the term “Gattung” in the *Ästhetische Briefe* with specific regard to the history of polyp-thinking needs to be emphasized: purely quantitatively, its significance is reflected in the fact that, in total, the word “Gattung” appears 24 times. Schiller’s articulation of the play drive is, first and foremost, a definition of the human species: “der Mensch spielt nur, wo er in voller Bedeutung des Worts Mensch ist, und *er ist nur da ganz Mensch, wo er spielt.*”²²¹

²¹⁸ NA, 20: §20, 375.

²¹⁹ See Laura Anna Macor, *Die Bestimmung des Menschen (1748–1800): eine Begriffsgeschichte* (Stuttgart: Frommann-Holzboog, 2013).

²²⁰ NA, 20: §12, 347.

²²¹ NA, 20: §15, 359.

Only in a state of play does the human being truly express what it means to be a human being. At the same time, play is not at all unique to the human species, not even to the animal kingdom.²²²

Selbst in der unbeseelten Natur zeigt sich ein solcher Luxus der Kräfte und eine Laxität der Bestimmung, die man in jenem materiellen Sinn gar wohl Spiel nennen könnte. Der Baum treibt unzählige Keime, die unentwickelt verderben, und streckt weit mehr Wurzeln, Zweige und Blätter nach Nahrung aus, als zu Erhaltung seines Individuums und seiner Gattung verwendet werden. Was er von seiner verschwenderischen Fülle ungebraucht und ungenossen dem Elementarreich zurückgibt, das darf das Lebendige in fröhlicher Bewegung verschwelgen. So gibt uns die Natur schon in ihrem materiellen Reich ein Vorspiel des Unbegrenzten und hebt hier schon zum Theil die Fesseln auf, deren sie sich im Reich der Form ganz und gar entledigt.²²³

Every rung in the ladder of being enjoys at least partial freedom in the state of play; the human being is distinguished from every other creature not by the characteristic of play itself, but by the capacity to play in ever greater proximity to the infinite ideal. This distinction matters, because it implies that Nature in fact orders itself according to a taxonomy of play, and that life can be grouped and coherently described according to style, intensity, abstractness, etc. of play. Therefore, lively beings have their own cultures that are, after all, definitive of their species and comparable with human culture. Which is to say that humankind and human culture are not insulated from Nature, but expressions of it.

²²² Already Schiller includes animals in reflections on moral character and action written during his time at the Karlsschule. His dissertation *Versuch über den Zusammenhang der tierischen Natur des Menschen mit seiner geistigen* (Essay on the Connection between the Animal and the Intellectual Nature of the Human Being, 1780) describes the reverberations between animal existence and cognitive processes in human beings: physical health helps sustain psychological health, and vice versa, while chronic illness and pain can diminish it. The point that the dissertation drives at is that, as Jeffrey L. High summarizes: “it is in fact the body that makes moral improvement and happiness possible.” High, “Writings from Schiller’s Time at the Karlsschule in Stuttgart (1773–1780),” 125.

²²³ *NA*, 20: §27, 406.

From the perspective of species of play, the attribution of polypoidy to the Greeks takes on a slightly different valence. To briefly recall Diderot's "Le Rêve de d'Alembert," the polyp, the "plant-animal," is the *symbol* of the unity of all beings in a single tendency of Nature toward playful recombination. Though Diderot's metaphysics is conceptually quite far away from Schiller's in crucial ways, they do share this vision of Nature as tending toward play. In Schiller, as in Diderot, the polyp is a species that manifests Nature's playfulness for all to see, precisely because it is, in Schillerian terms, a creature of a seemingly infinite surplus of life—the exchange of morphologies costs it nothing, and it seemingly defies coercion by continuously producing ever more life. Hence, it embodies the idea of the fullest possible realization of Nature's plan of play for a given species, and *that* is the quality that it shares with Schiller's Greeks. Greek society was so constructed that each of its individuals, living in the fullness of their being, came closest to expressing "die Totalität der Gattung," the totality of the human species.²²⁴

Likewise, connections can be drawn between Schiller's approach to polypoid play and Kiemeier's notion of the polypoid structure of human culture. For Kiemeier, human beings make excellent compensators because they do not survive in spite of their physical weakness, but because they have developed cultures of learning and self-improvement. Similarly, for Schiller, human beings compensate for moral and empathic weaknesses by developing institutions for correcting them: "Seine Kultur wird darinn bestehen: *erstlich*: dem empfangenden Vermögen die vielfältigsten Berührungen mit der Welt zu verschaffen [...]: *zweytens* dem bestimmenden Vermögen die höchste Unabhängigkeit von dem empfangenden zu erwerben [...]."²²⁵ Thus, while

²²⁴ NA, 20: §6, 322.

²²⁵ NA, 20: §13, 349. See for example Schiller's speech "Die Schaubühne als moralische Anstalt betrachtet" (1784).

Kiellmeyer and Schiller may approach the question of the human species from different disciplinary perspectives, they converge in their similar articulations of an anthropology of balance.

Moreover, both Schiller and Kiellmeyer present the human species as constitutionally in disequilibrium. Human beings are the product of nature and thus are animals like any other. Yet nature has endowed this particular creation with a capacity for compensation that exceeds any other. Culture is the means by which these creatures bring their sensuous and moral excesses into proportion. By means of culture—by means of play—the individual and the community alike, in a continuous process of mutual enrichment, transform and refine nature’s products for the better. If, for Kiellmeyer, community safeguards species character by compensating the “preponderance” of lower forces, then for Schiller the play drive expresses “die Totalität der Gattung,” the totality of the human species, through the aesthetic amelioration of licentious and moralistic instincts. At bottom, compensation and play lead through adjacent theoretical landscapes toward a common perception, that humanity’s fate lies in its culture.

6. Conclusion

As this chapter has shown, late eighteenth-century reflections on the nature of the human being invoked the positive analogy of the polyp in order to make the case for the human animal’s own innate adaptive capabilities. Building on an intellectual habit of anthropomorphizing the polyp, as Röseler did in his *Insecten-Belustigung*, thinkers like Blumenbach, Kiellmeyer, and Schiller, as well as their contemporaries, employed the polyp-human analogy as a tool for uncovering the principle of potentiality underlying all terrestrial life.

The embrace of the polyp as a symbol of human flexibility over the second half of the eighteenth-century places familiar features of the German late enlightenment into a different context. The development in the human individual of qualities of autonomy, morality, cultural refinement, and sociability are not elements of the human being's triumph over nature, but expressions thereof. In fact, the human organism is by nature *dependent* on the development of these virtues for its own survival and flourishing. At the same time, they are the locus of the human being's great creativity, and it is precisely through these species traits that human beings make changes to themselves and to their world in order to facilitate their own happiness. Thus, through the lens of the polyp, the human being appears as a highly flexible, adaptable animal, capable of unprecedented feats of moral and political transformation. Comparison with the polyp, then, reveals that there is likewise a touch of the miraculous in the nature of the human being.

This polypoid form of humanism, this polyp-humanism, revels in the almost cyclical process of individuation, of self-actualization, that the polyp represents. There is indeed an organizing principle that underlies all nature, a telos that governs the metamorphoses of life. But the coherent structure of all organismic growth is not so rigid that individuals from the polyp to the human being must always express the character of their species in precisely the same way. Rather the forces of internal and external exigencies and the wants and desires of the individual exist in reciprocal relation to one another. Polyp-humanism therefore does not seek *mastery over nature*, the cultivation of a subjectivity impregnable to all physical or psychological harm. Rather its telos is a disposition of receptivity, "Empfänglichkeit" in Schiller's idiom. The polyp-human, as a concept, exemplifies adaptability and resilience in the face of hardship, and creative genius in the construction of new and happier ways of being.

Part III

Jedes Existierende ist ein Analogon alles
Existierenden: daher erscheint uns das Dasein
immer zu gleicher Zeit gesondert und verknüpft.
Folgt man der Analogie zu sehr, so fällt alles
identisch zusammen; meidet man sie, so zerstreut
sich alles ins Unendliche. In beiden Fällen stagniert
die Betrachtung, einmals als überlebendig, das
anderemal als getötet.

Johann Wolfgang von Goethe,

Wilhelm Meisters Wanderjahre (1829)

The Literary *Umwelt*: A Theoretical Note

In *Streifzüge durch die Umwelten von Tieren und Menschen* (1934), the biologist Jakob von Uexküll (1864–1944) defines the concept of the *Umwelt* as the perceptual field that surrounds an organism, constructed from the various elements of the *Umgebung* (objective surroundings) with which they tend to interact.²²⁶ In the foreword to the book, Uexküll employs the metaphor of the “Seifenblase” to illustrate his novel concept:

Wir beginnen einen solchen Spaziergang am besten an einem sonnigen Tage vor einer blumenreichen Wiese, die von Käfern durchsummt und von Schmetterlingen durchflattert ist, und bauen nun um jedes der Tiere, die die Wiese bevölkern, eine Seifenblase, die ihre Umwelt darstellt und die erfüllt ist von allen jenen Merkmalen, die dem Subjekt zugänglich sind. Sobald wir selbst in eine solche Seifenblase eintreten, gestaltet sich die bisher um das Subjekt ausgebreitete Umgebung völlig um. Viele Eigenschaften der bunten Wiese verschwinden völlig, andere verlieren ihre Zusammengehörigkeit, neue Bindungen werden geschaffen. Eine neue Welt entsteht in jeder Seifenblase.

Every inhabitant of the sunny field constructs a unique version of the field for itself. They may or may not be sensitive to the same aspects of their physical surroundings, depending on differences in the kinds of apparatuses Nature has given them for engaging with those surroundings. Thus, the same object may appear entirely differently—perhaps not at all—in the soap bubbles, the *Umwelten*, of two different animals.

Notably, in Uexküll’s conception, the human *Umwelt* seems to be the most complete of all existing *Umwelten*. The different inhabitants of the sunny field evidently have more limited *Umwelten*, but the perceptual field of the human being is so expansive, that even the soap bubbles of other species may present themselves as meaningful signs to human observers. As

²²⁶ Jakob von Uexküll and Georg Kriszat, *Streifzüge durch die Umwelten von Tieren und Menschen: Ein Bilderbuch unsichtbarer Welten* (Berlin, Heidelberg: Springer Berlin Heidelberg, 1934), 22.

this dissertation has argued, though, the *Umwelten* of human beings may also be subject to change, precisely because they can interact with the *Umwelten* of other beings. The scientific and philosophical texts of late eighteenth-century humanism feature a preponderance of polyp-human analogies. These analogies played an important role in reflecting on the idea and destiny of humanity. During this time, biological models of polypoidy in human life and society imply not just a similarity in developmental processes, but also the possible imbrication of the physical and spiritual requirements of individual organisms within the greater organization of all life. For creative thinkers from Diderot to Schiller, the polyp represented a new relationship to the frontiers of experience. That is, the animal's peculiar biology implied that the human being might regard the open horizon of the future as an invitation to dream up new possibilities of being and becoming. The idea of the polyp-human analogy, especially in the imaginative mode of Diderot, implies a transformation of the human *Umwelt* through its interactions with the strange little species.

The expansion of the horizon of perception and expectation in the wake of the rise of polyp-science suggests that the human *Umwelt*, insofar as it encompasses artifacts of culture and politics, is every bit as malleable as the human animal. Thus, Part III of this dissertation is concerned with what this imbrication of polyp and human worlds meant for literature during the late eighteenth century. More specifically, it focuses on the soap bubble of one figure in particular, Johann Wolfgang von Goethe, whose status as a representative figure is broadly recognized in the designation of the late-eighteenth century as *die Goethezeit*. The following two chapters demonstrate through the analysis of Goethe's notebooks, letters, and literary production how a polyp-humanist lens might reveal features of the text that a singularly humanist lens would obscure.

Methodologically speaking, if the critic is to identify polypoid features in the *Umwelten* of human beings, then she must be prepared to enter into the *Umwelten* of polyps herself. A singularly humanist approach might focus on the individual as the locus of *Bildung*. It is not that the world beyond the individual does not exist, or that the world beyond the individual has no impact on the process of subject formation. Instead, the individual is itself the telos of this entire objective ecology. In the context of the novel, of the *Bildungsroman* in particular, the humanist lens determines *a priori* that the individual is the telos of the fictional world; that all persons, objects, and events must be evaluated based on the extent to which they contribute to or inhibit the *Bildung* of the protagonist.

By contrast, viewing humanity itself as polypoid means that the concept of the “individual” must lose some of its formal rigidity, for organicism, vitalism, and flexibility are the by-words of polyp-humanism. It is untenable to prescribe a single form to a substance capable of expressing many different forms. Thus, polyp-humanism prioritizes “individuality” over “the individual”: that is, the purpose of polyp-humanistic endeavors is not the generation of “individuals” with hard contours, sharply delineated from their environments. Rather, it is the creation of an environment in which individuality may express itself. It is not a monolithic notion of the human individual that orders the system, but a softer notion of individuality, as a flexible, ever-changing, ever-developing property of all organisms. Thus, *Bildung* refers to this ongoing process of self-redefinition, as opposed to the assimilation of every individual into a universal program of education.

In the analysis of the *Bildungsroman*, one would focus on the figure of Wilhelm, obviously, as the primary locus of *Bildung*, as readings of the novel often do. And so one of the reasons it is common to read *Wilhelm Meisters Lehrjahre* as an *anti-Bildungsroman*, is because it

is common to look only at the single trajectory of the title character. But in its ideal form, the *Bildungsroman* of polyp-humanism portrays *Bildung* as a process that is always happening all of the time. It is focused less on whether a single, titular character reaches a determinate condition by the end of the novel, and more on the extent to which the environment portrayed is the most conducive to the happy expression of each individuality portrayed in the book. Thus, from the perspective of polyp-humanism, Wilhelm's children are the two most interesting figures of *Bildung* in *Wilhelm Meisters Lehrjahre* and are far more important than the titular character for understanding how the processes of formation are portrayed in the novel.

V: Polyps and die *Goethezeit*

1. Introduction

In a letter to Schiller of 27 July 1799, Goethe complains about being too busy to focus on his writing: “Die Geschäfte sind polypenartig, wenn man sie in hundert Stücke zerschneidet, so wird jedes einzelne wieder lebendig.”²²⁷ It is notable that Goethe makes reference to the experimental context: Nature does not itself cut up the polyp into one hundred pieces, that is something humans do. Moreover, he takes it for granted that Schiller is familiar enough with this context to understand the allusion. From his perspective, there is nothing obscure about polyp science. Quite the opposite: because polyp science is so contemporary, it is capable of making sensible not only the analogy of objects, polyps, and business, but the human being’s emotional experience of these things. Evidently, by the end of the century, the polyp functions as a sign of a particular form of organization even in casual references to the creature outside of the context of morphology or biology.

The diffusion of the polyp into general culture creates different opportunities for analysis. Of concern are not only scientific and philosophical interpretations of the creature, but also more general, cultural considerations. At the very least, Goethe’s frequent use of the term “polypenartig” in his scientific notes indicates that the narrative arc begun in Chapter 1, regarding the entrance of the *polypus* into the analogical ordering of scientific reality, had come full circle. Where the many-footedness of the ancient creature figured the scientific discourse of the mid-eighteenth century, the morphology of the miniature one now shaped the conceptual landscape of the late-eighteenth century. In turn, in the age of modernity and of the rupture

²²⁷ Citations of Goethe’s letters from Johann Wolfgang von Goethe et al., *Briefe* (Berlin: De Gruyter, 2020), here 14.II:105. Subsequent citations as *Briefe* with volume and page number(s).

between the classical and Enlightenment ideologies, Goethe's writings reflect the potential for healing in all things *polypenartig*.

Since an exhaustive discussion of Goethe's engagement with every author hitherto mentioned would go beyond the scope of the present dissertation, this chapter offers a broad overview of Goethe's exposure to "polyp-literature," followed by a more granular discussion of his engagement with two thinkers in particular. Goethe's reactions to French Materialism broadly and Diderot's "Le Rêve de d'Alembert" reflect a discomfort with the most fantastic interpretations of the polyp, similar to the responses recorded by Beseke and others. Yet, at the same time, he is clearly, like the figures discussed in Chapter 4, open to a kind of flexible teleology, in which formation unfolds toward some determinate ideal under the influences of external forces, strong enough at times, to change the nature of the ideal itself. Textual and circumstantial evidence suggests that Goethe's encounter with Kielmeyer's theory of compensation, though it preceded their actual relationship by several years, had an important impact on the way that Goethe thought about comparative morphology. Evidently, the analogy of the polyp proved handy in a variety of situations, functioning as a kind of metaphorical catch-all that is only possible after a cultural saturation point has been reached. The ease with which Goethe alludes to polyps resulted from his familiarity with recent scientific research, including the "canon" of polyp research in particular. Thus, as the chapter shows, by virtue of the author's personal and intellectual encounters with the products of polyp-culture, Goethe himself can be considered a kind of late-eighteenth century "polyp-thinker."

2. “die Tänze der Infusionsthiergen”²²⁸

From 1785 to 1786, Goethe met regularly with his friends Charlotte von Stein (1742–1827) and Karl Ludwig von Knebel (1744–1834) to conduct experiments in his garden house on the Ilm. These “Mikroskopenfreunde”²²⁹ prepared infusions according to directions in *Auserlesene mikroskopische Entdeckungen bey den Pflanzen, Blumen und Blüthen, Insekten und andern Merkwürdigkeiten* (Selected Microscopic Discoveries Concerning Plants, Flowers and Blossoms, Insects, and Other Curiosities, 1777) by Freiherr Wilhelm Friedrich Gleichen-Russwurm (1717–1783). They would then gather around the aquatic microscope—Goethe owned four—to observe their creations.²³⁰ Under the lens, the biotic soup of beer, bread, and other materials that they had concocted revealed little worlds of “Infusions tiergen von der schönsten Sorte”²³¹ and of every shape, too: some round, some bell-shaped, and some “die sich den Polypen nahen.”²³²

It is difficult to say whether Goethe, Stein, and Knebel, in the course of their experiments, ever examined or experimented on polyps—in addition to polyp-shaped microorganisms. On the one hand, Goethe makes no mention of such experiments. Given that his experimental notebooks are rather thorough, the absence of any reference to polyp experiments

²²⁸ Letter to Charlotte von Stein of 27 June 1785 (*Briefe*, 6.I:70).

²²⁹ Wilhelm Friedrich Gleichen-Russwurm, *Auserlesene mikroskopische Entdeckungen bey den Pflanzen, Blumen und Bluethen, Insekten und andern Merkwürdigkeiten* (Nürnberg: Adam W. Winterschmidt, 1777), 155.

²³⁰ Ludwig Otto, “Goethe’s Four Microscopes in Weimar,” *Journal of Microscopy* 106, no. 1 (1976): 71–83.

²³¹ *Briefe*, 6.I:179.

²³² *Briefe*, 6.I:179.

suggests that none ever took place.²³³ On the other, the formal analogy of infusoria and polyps implies an ability to differentiate actual and merely apparent polyps. That degree of knowledge would have to have come from indirect experience through books and scientific literature, if not direct experience via scientific observation and experimentation.

At the very least, it is obvious from other documents of the period that the milieu of hobbyist microscopists was saturated with polyp-enthusiasts. As discussed in Chapter 2, Ratcliff has shown that the polyp and the microscope were mutually indebted to one another for their popularity. Hence, whole chapters on polyps feature in many eighteenth-century microscopy handbooks, both those that targeted scientific and lay audiences. Likewise, not a few articles in German magazines of the period printed directions on how to gather polyp specimens and repeat the Hydra experiment with ease.

While it is hard to say whether Goethe himself conducted experiments on polyps, a number of his associates evidently did. Goethe maintained a correspondence with Georg Christoph Lichtenberg (1742–1799), who in 1773 published an article in the *Hannoverisches Magazin* describing how one might sever polyps *even* with a pair of “einf Zoll langen ziemlich verrosteten Papierscheere.”²³⁴ Similarly, in addition to engaging with his works, Goethe knew personally and corresponded with Blumenbach, who, as discussed in Chapter 4, attributes the origin of the concept of the *Bildungstrieb* to a pleasant afternoon spent dissecting polyps among

²³³ Whether or not the hobbyist microscopists collected any animals for use in their own experiments, they likely would have had many occasions to observe polyps in the wild, since the calm, clean waters of the Ilm, which their homes in Weimar all abutted, were the perfect environment for polyps.

²³⁴ In this article, he describes how he reproduced an experiment described on page 505 of Rösels’s *Insecten-Belustigung*. He also succeeds in splicing two different polyp species, one brown and one green, together. Georg Christoph Lichtenberg, “Einige Versuche mit Polypen,” *Hannoverisches Magazin* 11, no. 5 (1773): 74.

friends. And, as a letter from Knebel to Goethe of 1 July 1810 indicates, this kind of casual entertainment-experimentation with polyps would continue into the following century.

Jetzt hat sich ein anderer Zweig der Naturgeschichte bei uns hervorgethan und zwar durch Hrn. v. Ende, der die Insektologie mit Passion liebt und verfolgt. Unsre stehenden Wasser und Teiche müssen ihm täglich neuen Vorrath von dergleichen Geschöpfen liefern, und die Polypen sind bei uns an der Tagesordnung. Dazu werden nun alle Bücher, Mikroskope und dergleichen Instrumente herbeigeschleppt, und er findet mehrere sich beeifernde Freunde dazu—worunter unser Ferber der vorzüglichsten.²³⁵

Thus, one may conclude from the evidence, that even fifty years after Trembley's first descriptions of the animal had been published, when the initial excitement would have subsided, the freshwater polyp still occupied a singular position in the cultural imaginary.

Despite the fact that it is unclear whether Goethe experimented with polyps himself, it is notable that in his notes and letters he refers to them almost as frequently as other literary authors whose experimentation with polyps is documented. Lichtenberg, who published an article on his polyp-experiments, mentions them a handful of times in his *Südelbücher*. And the Romantic Jean Paul (1763–1825), who evidently reproduced Lichtenberg's work, likewise refers to polyps in a handful of writings.²³⁶ One might speculate from these examples that numerous allusions to

²³⁵ Johann Wolfgang von Goethe and Karl Ludwig von Knebel, *Briefwechsel zwischen Goethe und Knebel* (Leipzig: F. A. Brockhaus, 1851), 2:5.

²³⁶ Polyps are mentioned remarkably often in the novel *Titan* (1800–1803). The character Schoppe concludes a comical monologue with a recapitulation of recent polyp-science: “[...] reibe, sag' ich oft, diesen Federbuschpolypenstamm mit Rösel zu Brei—stülp ihn um wie einen Handschuh—schneide den Polypen wie Lichtenberg geschicht mit einem Haare entzwei—stecke wie Trembley mehrer abgeschnittene Glieder in einander und verleibe wie andere Naturforscher, Reichsstädte, Abteien, kleine Länder größern ein oder umgekehrt— —und schaue nach einigen Tagen darnach: wahrhaftig, herrlich und ganz genesen sitzt dein Polype wieder dort, oder ich will nicht Schoppe heißen.” A future version of this project will dedicate more attention to this remarkably rich passage, which reflects the transformation of the polyp into a complex geo-political metaphor. Jean Paul, *Titan* (1800; 2nd ed., Berlin: Verlag von G. Reimer, 1846), 1:33.

polyps over the course of several years would indicate some direct experience of their nature. At the very least, it raises questions about when, why, and in what context a literary author might allude to the little animal.

If Lichtenberg and Jean Paul provide a paradigm for the emergence of a polyp sensibility, then, in the absence of more explicit documentation of engagement with polyp science, what is required in Goethe's case are two things: first, evidence that he engaged with polyp literature, and second, evidence that this engagement had a detectable impact on the manner in which he wrote—especially about polyps. The following subsections therefore deal with only a handful of examples, before discussing how Goethe's use of polyp-analogies may have been affected by those readings.

3.1. Goethe & the Age of Polyp Science

The scholarship on Goethe's studies in natural science is extensive—in 1984, Dorothea Kuhn estimated that more than 5,000 titles on Goethe and natural science had been published,²³⁷ and the number has almost certainly ballooned with the recent surge in interest in ecological humanities.²³⁸ The present section examines the already well-documented archive of texts with which Goethe engaged in order to demonstrate the presence of the polyp as a kind of *roter Faden* throughout.²³⁹ It therefore serves two purposes: providing a summary of developments in

²³⁷ Dorothea Kuhn, "Goethe's Relationship to the Theories of Development of His Time," *Journal of Social and Biological Structures* 7, no. 4 (1984): 307–315, here 307.

²³⁸ See for example: Eva Geulen and Claude Haas, eds., *Formen des Ganzen*, vol. 1 (Göttingen: Wallstein Verlag, 2022); Emanuele Coccia, *Metamorphoses*, trans. Robin Mackay (Cambridge, UK: Polity Press, 2021).

²³⁹ Some key texts, such as the French and German editions of Trembley's *Mémoires*, are absent from the bibliography, but as the preceding chapters have shown, by the 1770s and 1780s, when Goethe first took a more serious interest in questions of natural history, the French, German, and

Goethe's views on the biological sciences and providing a firm evidentiary ground for the interpretation of his references to polyps in the following subsection.²⁴⁰

Kuhn's article on Goethe's responses to the evolutionary thought of his day, mentioned above, already cites several of the key players in the history of polyp-science. The article focuses on how Goethe's engagement with the work of other European scientists and philosophers contributed to the development of his unique views on the science of morphology. As a student in Strasbourg and Leipzig, Goethe encountered, with great disappointment, the mechanistic materialism of the French Baron d'Holbach (1723–1789). Thus, in his study of the natural sciences, he sought a more systematically meaningful explanation for the whole artifice of nature, one based on the inherent connectedness of all organized life.

As a young student, Goethe engaged with the works of Linnaeus and Buffon, whose respective, oppositional viewpoints on the interpretation of the products of nature have been thematized throughout the dissertation. As Kuhn notes, the *Fundamenta Botanica* was one of the few books that Goethe brought with him on his journey to Italy; it was the predecessor to the *Philosophia Botanica* discussed in Chapter 1, which Goethe likewise kept in his private library in Weimar. He marveled at Linnaeus's analogical system, even as he simultaneously appreciated the anti-systematist Buffon's extensive descriptions in his *Histoire Naturelle*. In *Dichtung und Wahrheit* (Poetry and Truth, 1811–1833), he in fact traces Buffon's influence back to his early childhood, even before he had taken an interest in the formal study of nature.²⁴¹ The influence of

Swiss intellectual cultures with which Goethe engaged had fully metabolized the idea of the polyp as a key to understanding the fundamental structure of nature.

²⁴⁰ Most of the authors discussed in the following have already been discussed in this dissertation—where that is not the case, a brief explanatory footnote follows for the purposes of orientation.

²⁴¹ See Johann Wolfgang von Goethe, *Sämtliche Werke nach Epochen seines Schaffens*, *Münchener Ausgabe*, ed. Karl Richter (München: C. Hanser, 1985), 16:280. All German citations

both Linnaeus and Buffon illustrates the fundamental tension between *Dauer* and *Wechsel* in Goethe's view of nature, his desire to apprehend the system of nature *without* obscuring the liveliness and variety of its products.

Of similar importance to Linnaeus and Buffon, in Kuhn's account, are the works of Albrecht von Haller (1708–1777) and Bonnet, whose descending and ascending conceptions of the ladder of nature on the one hand, and preformationist views on the other, fueled Goethe's pursuit of morphological constants. Whereas Haller treated the human being as the origin from which all other natural forms emerged in diminished form, as discussed in Chapter 4, Bonnet described the organizations of nature as developing from the least to most complex forms—from the polyp and the worm to the seraphim. Goethe could not abide the preformationism of either Haller or Bonnet, but Bonnet's concept of the gradation of nature, for which the polyp provided key evidence, appealed to him.

For Goethe, the discourses on theories of generation between Blumenbach, Herder, and Kant provided an explanation of the analogical symphony of nature that did not resort to untenable concepts of preformationism. The notion of the *Bildungstrieb*, the idea of a single harmonious law underlying the biological process of beings as different as the polyp and the human being, challenged the notion of a meaningful, metaphysical difference between human beings and animals. For Herder, this led to the conception of nature as a spectrum of ever more perfect beings, up to and including the human animal, who by nature employs reason to perfect himself. Through his engagement with these ideas and his independent pursuit of proof that human beings, like other mammals, had an intermaxillary bone, Goethe ultimately sought to

of Goethe's literary works are from the widely available *Münchener Ausgabe*. Subsequent citations as *MA* with volume and page number(s).

prove that the human being is “aufs nächste mit den Thieren verwandt”—just as Trembley had done with the polyp a half-century before.²⁴²

Some key figures and texts in the history of polyp science are absent in Kuhn’s account, but no less relevant as traces of polyp-thinking in Goethe’s own archive. For example, Blumenbach’s *Handbuch der Naturgeschichte* and Maupertuis’ *Venus physique* appear in the catalog of Goethe’s private library and of books that he borrowed from the library in Weimar. Likewise, Goethe evidently engaged with Diderot’s “Le Rêve de d’Alembert.”²⁴³ In the introduction to *Zur Morphologie*, Goethe prefaces the reprint of his seminal essay “Versuch die Metamorphose der Pflanzen zu erklären” (The Metamorphosis of Plants, 1790) with some scattered reflections on the scientific landscape during the 1780s and 1790s, when the essay was first published.

Die damalige Zeit jedoch war dunkler als man sich es jetzt vorstellen kann. Man behauptete zum Beispiel, es hänge nur vom Menschen ab, bequem auf allen Vieren zu gehen, und Bären, wenn sie sich eine Zeit lang aufrechte hielten, könnten zu Menschen werden. Der verwegene Diderot wagte gewisse Vorschläge, wie man ziegenfüßige Faune hervorbringen könne, um solche in Livrée, zu besonderm Staat und Auszeichnung, den Großen und Reichen auf die Kutsche zu stiften.²⁴⁴

²⁴² Letter to Knebel of 17 November 1784

²⁴³ In 1805, at Schiller’s encouragement, Goethe translated Diderot’s *Le neveu de rameau* (written between 1761 and 1774), in which the polyp’s physiological malleability functions as a metaphor for ideal verse: “Der thierische Schrei der Leidenschaft hat die Reihe zu bezeichnen, die uns frommt. Diese Ausdrücke müssen über einander gedrängt sein, die Phrase muß kurz sein, der Sinn abgeschnitten, schwebend, damit der Muster über das Ganze sowohl wie über die Theile herrsche, ein Wort auslasse oder wiederhole, eins hinzufüge, das ihm fehlt, das Gedicht wenden und umwenden könne wie einen Polypen, ohne das Gedicht zu zerstören” Johann Wolfgang von Goethe, *Goethes Werke* (Weimar: Hermann Böhlau Nachfolger, 1887), I,45:123. Subsequent citations as *WA* with part, volume, and page number(s).

²⁴⁴ *MA*, 12:19.

The goat-coachmen to which Goethe refers appear in the last of the three dialogues.²⁴⁵ They are one of so many fantastic images that emerge from d'Alembert's meditation on the processes that govern the organization of matter. If no first cause exists to determine *a priori* the formation of matter, there is no limit to the forms that organized life might take. Much like Bordeu's dream of "human-polyps" on Jupiter or Saturn, the goatmen represent the uncanny potentialities that emerge from the idea of human control over the basic material reality that underlies biological and cultural life.

The polyp is a strange constant in the history of Goethe's engagement with contemporary science. Each of the figures mentioned comments on the animal, sometimes briefly, sometimes extensively. And secondary literature on the period usually makes obligatory reference to polyp science. Kuhn, too, mentions the animal once in her survey of the scientific landscape of the late-eighteenth century, alluding to Blumenbach's argument that the animal disproved the theory of preformationism.²⁴⁶ She does not have more to say about the polyp, and understandably so, for the animal floats through the works of the scientists and philosophers she cites as a malleable point of reference—something rearticulated time and again toward entirely different ends.

Hence, it was just as common to view the polyp as proof positive of preformationism, as Buffon

²⁴⁵ This passage in Goethe's preface stands out for a number of reasons. First, obviously, it shows that Goethe was familiar with Diderot's dialogue. As discussed in Chapter 3, Goethe's patron, the Duke Karl August, subscribed to the *Correspondance Littéraire* and evidently shared editions of the literary newsletter with his beneficiary. Second, to return briefly to the question of circulation, Goethe speaks of Diderot as though he expects that his readers to be familiar with the dialogue. He does not name the work in question. Perhaps that is because by 1810, almost thirty years after reading Diderot's dialogue, he has forgotten the title. Perhaps he assumes the public will not know or remember the text in question. Or perhaps it is precisely because no title is necessary to conjure the memory of Diderot's controversial dialogue. Perhaps the disturbing conclusions that French materialists drew about material reality based on the analogy of the polyp left an indelible mark on German cultural memory.

²⁴⁶ Kuhn, "Goethe's Relationship to the Theories of Development of His Time," 310.

did, or as the reverse. That is to say that Goethe, in his engagement with each of these authors, would have engaged with a different head of the hydra of polyp-analogies.

3.2. Goethe & Kiemeier

Scholars have only recently begun to appreciate Kiemeier's contributions to analogical practices in natural history. In the handful of essays and monographs published in the last two decades, Kiemeier has emerged as one representative of "polyp-thinking" during the late-eighteenth century. Azadpour and Whistler provide a relatively broad definition of "polyp-thinking," which encompasses the many different ways in which Trembley's experiment was "transposed analogically to promote or proscribe forms of thinking."²⁴⁷ They draw attention to the ways Kiemeier employed the image of the polyp not only to represent the "plasticity" of nature's physical manifestations, but also of the human mind (*Geist*). Kiemeier stands alongside Blumenbach, Kant, and Herder as a significant importer of "polyp-thinking" from Francophone science into the German speaking lands during the late eighteenth century.

Given the enthusiastic reception of Kiemeier's lecture, it is not surprising that less than a year after its publication, in 1793 or 1794, Goethe alludes to it in a letter to Herder: "Da du den Kiemeier vornimmst wird dir nicht zuwider seyn beykommende tabellarische Übersicht der Abhandlung die ich schreiben möchte durchzugehen."²⁴⁸ It is hard to say at first blush what

²⁴⁷ Their expanded definition: "1. as an anomalous object in nature, demanding attention owing to its specific, if far-reaching scientific, metaphysical and theological implications; 2. as a template for the broader workings of the natural world—that is, as a heuristic for better describing natural structures and processes; 3. as an epistemic virtue (or vice) with respect to both thinking in general and philosophical practice in particular" (Azadpour and Whistler, "Polyp-Thinking," 148–149).

²⁴⁸ *Briefe*, 9.I:214.

the reference to Kielmeyer actually means about the scholar's influence on Goethe's thinking. As mentioned above, scholars have only recently begun to reevaluate Kielmeyer's significance as a biologist.²⁴⁹ To date, there exists only one attempt to characterize the conceptual ties between the two natural scientists, and though that text by Gabrielle Bersier contains some strong arguments that Goethe's thinking changed after his engagement with Kielmeyer, it also contains several serious errors.²⁵⁰ It is worthwhile, then, in order to establish Goethe's inheritance of "polyp-thinking" from Kielmeyer, to trace out their relationship in detail.

Goethe evidently "took on" Kielmeyer's lecture during the same period that Herder did, and he still had a copy of it in his private library at the end of his life. However, the extent to which his reading influenced the "tabellarische Übersicht" to which he refers—or any of his other works—is more complicated. It is unclear which essay Goethe meant, though the sketch "Rekapitulation: Von weißen, schwarzen, grauen Körpern und Flächen" has been suggested as a possibility,²⁵¹ on the grounds that Goethe had recently sent the same text to Lichtenberg for his opinion as well. That outline eventually formed the conclusion to Goethe's "Versuch die

²⁴⁹ Joanna Raisbeck names him, along with Haller, Blumenbach, and Girtaner, as one important figure in theorization of the concept of a *Lebenskraft* (life force). Joanna Raisbeck, "Lebenskraft (Vital Force)," *Goethe-Lexicon of Philosophical Concepts* 1, no. 2 (2021). Gabrielle Bersier argues that Goethe's reflections on Kielmeyer's work continued throughout his lifetime, and that Kielmeyer left a not insignificant mark on Goethe's thinking about comparative anatomy and his understanding of human biology and anatomy as a whole. Gabrielle Bersier, "Visualizing Carl Friedrich Kielmeyer's Organic Forces: Goethe's Morphology on the Threshold of Evolution," *Monatshefte* XCVII, no. 1 (2005): 18–32.

²⁵⁰ Bersier's comparison of Kielmeyer's lecture with Goethe's 1795 writings on osteology is convincing, however, there are a lot of errors of interpretation in that article. There is no reason why there couldn't be a connection between Kielmeyer and both the *Farbenlehre* and *Osteologie*.

²⁵¹ Bersier suggests that Goethe is speaking of a plan to sketch out Kielmeyer's physiological categories, but there is no evidence of the existence of such a table or a corresponding essay.

Elemente der Farbenlehre zu entdecken.” Problematically, though, because the subject matter of the “Rekapitulation” text does not strongly correspond with the subject matter of Kielmeyer’s “Versuch,” it is not immediately obvious why Goethe would expect Herder to consider his work on color theory with Kielmeyer’s analogical methodology in mind. Goethe’s reference to Kielmeyer may therefore be mostly coincidental, merely a sign of the fact that Goethe wanted to take advantage of Herder’s attention while he was in a reading-mood.

There is stronger evidence for Kielmeyer’s influence in Goethe’s preparatory notes for his essay “Erster Entwurf einer allgemeinen Einleitung in die vergleichende Anatomie, ausgehend von der Osteologie” of January 1795. In a note entitled, “Anwendung verschiedener Principien auf den Typus, dessen Bildung und Abänderung,” Goethe plans first to outline his “[Princip] Des Gebens und Nehmens” and then to pursue the: “Princip im allgemeinsten passend (S. *Kielmeyer*) im besonderen hier [...]”²⁵² The association of a principle “Des Gebens und Nehmens” with the originator of the law of compensation clearly shows Goethe’s awareness of the significance of Kielmeyer’s particular brand of analogical Newtonianism for his own work. Given the publication date of the finished essay, the preparatory materials referring to Kielmeyer would have to have been written some time in 1794. Even if the “Anwendung” note is *not* the “tabellarische Übersicht” Goethe sent to Herder, it nevertheless clearly corroborates Goethe’s interest in Kielmeyer in the context of his morphological writing.

In the subsequent years, Kielmeyer became a regular if not constant figure in Goethe’s intellectual and social sphere. The two men met in 1797 and would continue to cross paths for the rest of Goethe’s life. Sometime after the turn of the nineteenth century, though it is not clear precisely when, Goethe began working on an essay entitled “Allgemeine Morphologie,” which

²⁵² *WA*, II,8:312.

he never completed. The surviving notes make mention of the “Bemühungen verschiedener Männer, deren als Beförderer der Morphologie zu gedenken ist.”²⁵³ These men include Petrus Camper (1722–1789), Blumenbach, Samuel Thomas von Sömmering (1755–1830), Kiemeyer, Félix Vicq-d’Azyr (1748–1794), Cuvier, and “Neuester Engländer.” According to the note: “Man kann annehmen daß alle diejenigen, welche in der comparirten Anatomie gearbeitet haben, auf die Morphologie los arbeiteten, sie mehr oder weniger vorbereiteten und veranlaßten.” In no uncertain terms, Goethe here asserts that Kiemeyer is one of a handful of scientists who made indispensable contributions to the study of morphology.²⁵⁴

What the circumstantial evidence suggests is that Kiemeyer’s work had a quiet but distinct impact on Goethe’s writing upon which few but the author himself have remarked. Though there are some inaccuracies in Bersier’s essay on Kiemeyer and Goethe, the critic nevertheless convincingly demonstrates that:²⁵⁵

In the pre-Kiemeyer phase that culminated in Goethe’s discovery of the human intermaxillar bone, the focus of his attention rests on finding visible traces of a homology between human and animal bone structure. The search for a general design or a “Bauprinzip” is derived from direct observation of structural features common to all the vertebrates. In the post-Kiemeyer essays on comparative anatomy, the attention shifts from a structural to a morphological viewpoint, from

²⁵³ *WA*, II,12:245.

²⁵⁴ According to the paratext, this note is “[...] eine Skizze, die ihre Ausführung wahrscheinlich in der Anfang des Jahrhunderts von Goethe vorbereiteten, aber nicht zu Stande gekommenen ‘Allgemeinen Morphologie’ hätte finden sollen” (*WA*, II,12:241).

²⁵⁵ Bersier’s article includes a few errors in interpretation, and therefore both overstates and understates the case for Kiemeyer’s influence on Goethe. Nevertheless, it also sheds important critical light on the significance of Goethe’s first, textual encounter with Kiemeyer in 1793/1794, which helped to push him toward analogical Newtonianism and his own formulation of morphology. Thus, though it is a problematic source, it is also an important one, being the only article on the topic of Kiemeyer and Goethe—which, ultimately, is not so surprising, given the fact that the study of Kiemeyer’s contributions to the history of science is only a decade old.

the apparent bone shape to the inner physiological functions revealed through anatomical forms.²⁵⁶

Goethe's characterization of his own intellectual development is more accurate, insofar as he does not reduce the evolution of his morphology to the simple binary pre- or post-Kiellmeyer. But it is clear from the analysis of his notes on morphology, that the natural scientist directly contributed to Goethe's work.

4. The Polyp's Wake

Goethe employs the term "polypenartig" frequently throughout his notebooks and letters. Similar formulations appear, as cited above, in his letter to von Stein of May 1786 as in his letter to Schiller of 1799. It also appears a third time, in preparatory notes for the essay *Versuch die Metamorphose der Pflanzen zu erklären*²⁵⁷—which Goethe most likely composed sometime in the late 1780s, around or after his microscopy work with von Stein and Knebel. There, Goethe describes the emergence of buds during the first stages of plant germination as "polypenartig."²⁵⁸ The repeated use of this uncommon phrase demands further analysis.

The affix "-artig" is roughly synonymous with the English "-like" or "-esque." When combined with another adjective, the affix "-artig" modifies an essential feature of the object it describes: someone who is "gutartig" or "böartig" is good or bad *by nature*. Thus, "-artig" evokes the concept of "Art," in the sense of the nature of a thing. Combined with an adjective, "-

²⁵⁶ Bersier, "Visualizing Carl Friedrich Kiellmeyer's Organic Forces," 23.

²⁵⁷ It is unclear when exactly these notes were written, but they would have to have been composed sometime in the late 1780s, before the publication of the essay but after Goethe's year of experimentation with von Knebel and von Stein.

²⁵⁸ *WA*, II,13:33.

artig” can also evoke “Arten” in the sense of kinds of things, for example: “gleichartig” and “verschiedenartig” distinguish between categories of objects. Thus, there is a static quality to the attribute that the adjectival compound evokes. When combined with a substantive, however, the scope of the affix expands to include appearances and behaviors. Hence, “artig” is most frequently combined with plants, animals, and various materials. That is to say, most commonly, “artig” has an essential analogical function that permits the comparison of any two material objects along virtually any axis of material expression.

Goethe’s usage of the adjective “polypenartig” and synonyms fits this latter paradigm, insofar as he does not programmatically compare any one sort of thing with the polyp, nor does he programmatically allude to any one feature of its biology. Rather, “polypenartig” evidently comes in handy for describing a multitude of things. Affairs that are “polypenartig” seem to multiply infinitely; budding plants resemble budding polyps; and some infusoria simply look quite a lot like polyps. All of these things can be “polypenartig,” and all in a slightly different sense—sometimes behavioral, sometimes morphological, and sometimes formal.

What these examples suggest is that there is a certain determinative force behind the image of the polyp: that it has become a tool for organizing knowledge of material reality. In the same sense that Trembley invoked the *polypus* in order to make sense of the freshwater polyp’s peculiar animality, Goethe here invokes the freshwater polyp in order to make sense of many different kinds of things. Thus, the semiotic process that began well before either Trembley or van Leeuwenhoek had ever seen a freshwater polyp—wherein bodily growths, microscopic creatures, and various marine animals were all absorbed by the image of the *polypus*—ultimately results in a contextual sprawl. The freshwater polyp overtakes the marine polyp and then extends its tentacles into new and different domains, reshaping them in its own image.

At least with respect to matters of natural history, Goethe also appears to have attributed this sort of power to the image of the polyp himself. Goethe's papers include notes taken by Charlotte Schiller (1766–1826) on a discussion with Goethe that took place after a lecture he gave on his theory of "Chemische Farben": "Bey den Pflanzen sind die Ramificationen am Tage, die Insekten gränzen durch den Polypen an die Pflanzen, u. man möchte sagen daß das thierische Leben da zuerst sichtbar wird."²⁵⁹ Here, Goethe invokes Bonnet's model of the ladder of being, in which the polyp represents the gradations of all forms of life. He goes on to argue that research of this kind into even the smallest elements of animal life is essential to the human organism's project of self-discovery. The analogy, here, is not between the polyp and the human directly, but between the polyp and the very structure of life. But it is by way of *that* analogy that the human being comes to know himself.

5. Conclusion

Locating Goethe's thought within the intellectual landscape of eighteenth-century polyp-science casts into relief the ambivalent position that the author occupied with respect to matters of growth and formation. Goethe is no materialist and clearly rejects the principle of radical formal transformation that Diderot identifies with the polyp. The polyp-human analogy therefore cannot mean, for Goethe, any essential communicability between the polyp and the human as *forms* of life. And yet, he does explicitly allow that understanding the polyp's peculiar position within the ladder of being can provide insight into the structure of animal life broadly. The artist-scientist cannot abide the elision of difference that Diderot's materialism implies, but he *does* see in the

²⁵⁹ Johann Wolfgang von Goethe, *Begegnungen und Gespräche*, ed. Ernst Grumach and Renate Grumach (Berlin: W. de Gruyter, 1965), 6:56.

polyp's body the possibility of translating between these fundamentally different forms of life. The polyp-human analogy therefore represents not a synonym but a synecdoche within a single metaphysical language—the polyp illuminates the structure of nature, which is perfected in the form of the human being.

There is, of course, a risk of exaggerating Goethe's significance within the milieu of eighteenth-century "polyp-thinkers": Goethe's work does not fit the paradigm of Diderot, for example, for whom the metaphor of the polyp bore substantial weight. He does not devote so much as a paragraph to the puzzling creature in his published works, let alone the many pages he would compose on the human intermaxillary bone or the critique of Newton's color theory. And, as previously noted, there is no documentation in Goethe's papers of his engaging directly in experiments with polyps.

Yet, as his engagement with the long tradition of polyp-science indicates, Goethe still swam in the same pond as the curious polyp and the great polyp-thinkers. The artist-scientist sought, like his contemporaries, to uncover the analogies of organization from the microscopic to the societal that might prove most serviceable to the gradual perfection of human life on earth. The "plant-animal" functions for him as it did for many others as an emblem of the analogical processes that produced the manifold forms of life. Hence, while, in Goethe's case, "polyp-thinking" may not quite reflect thought *about polyps*, there is plentiful evidence of scientific and creative thinking *in the polyp's wake*.

VI: The Law of Compensation in *Wilhelm Meisters Lehrjahre*

1. Introduction

Strangely, for a novel singularly concerned with development and flourishing, penned by an author thoroughly educated in the biological sciences, *Wilhelm Meisters Lehrjahre* (Wilhelm Meister's Apprenticeship, 1795/96) tends to marginalize the physical processes required for the generation of life. On the one hand, the processes of cultural formation occupy a central role in the text, and surrogate mothers like Aurelia, Therese, Natalie, and eventually Mignon abound. On the other, as feminist scholars have noted, the woman's physical, biological contribution to reproduction is often relegated to implication and euphemism.²⁶⁰ The reader witnesses only the very beginning of Mariane's pregnancy, while the remaining months of gestation and her death in childbirth remain hidden. Felix appears in Wilhelm's world as if by spontaneous generation. Thus, ironically, a novel partially influenced by concepts of *Bildung*—concepts developed through the study of biology and natural history—often obscures the biological facts that underpin the processes of formation.

This hidden origin would seem to create a problematic gap in the novel's thematization of *Bildung*. The mutual relationship between physical and ideal development is interrupted, and crucial steps in the generation of life are withheld, not to be offered up as topics of reflection. This is a quite different approach from Thomas Mann's *Der Zauberberg* (The Magic Mountain, 1924), for example, which features an entire chapter dedicated to Hans Castorp's cogitations on

²⁶⁰ See for example: Elisabeth Krimmer, "Mama's Baby, Papa's Maybe: Paternity and Bildung in Goethe's 'Wilhelm Meisters Lehrjahre,'" *The German Quarterly* (Cherry Hill) 77, no. 3 (2004): 257–277; Ian Duncan, "Against the Bildungsroman," *Modern Language Quarterly* 80, no. 1 (2019): 13–19.

sexual reproduction as a physical, that is biological and chemical, process.²⁶¹ However, this general absence suggests that for Goethe, there are some features of the development of life that are too secret or too sacred to be offered up to the creative, constructive gaze of the artist and the reader.

One brief scene stands out as an exception that proves the rule. At the start of Book 4, Wilhelm's acting troupe is in the middle of their preparations to leave the melancholic Count's castle. Bored, Philine begins to dance with Laertes in order to pass the time. While they dance, Madame Melina who is several months pregnant enters the room. Philine, who dislikes Madame Melina, is struck with demonic inspiration: She is "[...] boshaft genug, sie [Madame Melina] gleichfalls zum Tanze einzuladen, und sie dadurch an die Mißgestalt zu erinnern, in welche sie durch ihre Schwangerschaft versetzt war."²⁶² The dance should accentuate the way Madame Melina's protruding belly creates a "vordere Wackelfalte des verkürzten Rocks [...], die immer voraus spaziert, wenn sie sich bewegt."²⁶³ For Philine, pregnancy is represented as something ugly, burdensome, and graceless.

Through this joke, Philine voices an immature and mean-spirited imitation of the aesthetics of autonomy (*Autonomieästhetik*) of the late eighteenth century.²⁶⁴ If the unburdened

²⁶¹ See the chapter "Forschungen" in Thomas Mann, *Der Zauberberg: Roman* (Frankfurt am Main: Fischer Taschenbuch Verlag, 2013), 370–395.

²⁶² *MA*, 5:201.

²⁶³ *MA*, 5:201.

²⁶⁴ In his seminal essay *Gedanken über die Nachahmung der griechischen Werke in der Malerey und Bildhauerkunst* (1755), Johann Joachim Winckelmann (1717–1768) lauds Greek statuary as a model for the modern artist, because of the portrayal of strong, lean bodies. The Greeks knew nothing of the excesses of modernity and were not burdened by flabbiness or blemishes; the beautiful contour of their marbles reflected a life suffused with beauty. Ugliness, according to such aesthetic precepts, describes the line that has pulled, stretched, or burdened into an extreme and therefore unpleasant shape. Johann Joachim Winckelmann, *Gedanken über die Nachahmung*

form signifies freedom, then the pregnant body epitomizes the condition of unfreedom. The gestating fetus adds mass to the human form and augments the curvature of the body. The woman's body protrudes and swells, far exceeding the gentle curvature that impressed the *Kunstrichter* of the period, and disturbing to the artist's eye the natural perfection of the bare human form. The swollen curvature of the belly represents the mutual dependence of mother and child. Neither the pregnant mother nor the fetus is in a position to act freely in any conventional sense of the word. The unborn child, not yet formed, possesses no will of its own. Not until the moment of birth is it truly viable, and even then, it will require constant care and attention from its mother. Likewise, the mother is bound by nature and social bonds to eat, sleep, dress, and live only for this new life. She is also weighed down by the weight of the baby, the weight that she gains in order to protect and nourish it, so that she may not be able to do many of the things she ordinarily might. And she does all of this at great danger to herself, for if gestation and birth do not go smoothly, she may very well die. In short, the excessive curvature of the mother's swollen belly itself signifies the mutual dependence of mother and child.²⁶⁵

Obviously, the frivolous Philine speaks from a place of meanness, rather than an interest in aesthetic theory or empathy for other women. Nevertheless, this desire to remind Madame Melina of her misshapen, even monstrous ("Mißgestalt") body reflects her own desire for freedom—an immature concept of freedom, to be sure, but freedom nonetheless. It is her prerogative, she feels, to dance gracefully with Laertes, to be free from the dangers of

der griechischen Werke in der Malerei und Bildhauerkunst (Stuttgart: G. J. Göschen'sche Verlagshandlung, 1885), especially 10–11.

²⁶⁵ Philine's joke notably also exploits the fact that dance is associated with fertility more than any other type of performance, but it rarely celebrates pregnancy itself. Dance signals readiness for procreation by simulating the movements and intimacy of sex, but it celebrates pregnancy and birth much less commonly.

motherhood, to be liberated even from the ordinary burdens of friendship. Madame Melina, by contrast, has accepted the bonds of matrimony and motherhood, and to Philine, this is a very ugly thing.

In the continuation of the dance scene, Philine dreams of a solution to the burden of childbirth, a way of securing bodily autonomy against the exigencies of nature: “Es wäre doch immer hübscher, [...] wenn man die Kinder von den Bäumen schüttelte.”²⁶⁶ Philine dreams of decoupling childbirth from womanhood completely. So that she may retain her activity—increasingly associated with masculinity at the end of the eighteenth century²⁶⁷—she dreams of taking advantage of the passivity of vegetable reproduction. The massive tree, undisturbed by the force of gravity, being rooted to the ground, can easily bear the weight of one, three, five, even seven new children, freeing human women to pursue other activities. Physically displacing the burden of childbirth creates the space for an agility in embodied, perhaps even social, existence.

There is something polypoid about Philine’s dream of the baby tree—ultimately a plant-animal of unprecedented magnitude. Live birth for the polyp is a remarkably easy process: the “mother” polyp can reproduce sexually, but does not have to; the ability to bud means no mate is required to produce young. If food is plentiful, the environment hospitable, healthy polyps begin to bud almost immediately. It takes only a matter of days for the new polyp to sprout and form, and during that time, the mother is hardly impeded in its activities at all. The new life extends as a line, maintaining its own gentle contour, lending the animal an arboreal beauty, signifying the apparent freedom, the ease of asexual reproduction. As soon as the new polyp has separated, it is

²⁶⁶ *MA*, 5:202.

²⁶⁷ Thomas Walter Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge, MA: Harvard University Press, 1992), 6.

completely independent and able to move, hunt, and reproduce on its own. All that is denied to the pregnant human female comes to the plant-animal, the polyp, with ease. In the same vein as Dr. Bordeu's *polypes-humaines* in "Le Rêve de d'Alembert," generation on the model of the polyp seems to offer access to otherwise unattainable possibilities.

Yet Philine's meanness in this scene and her thoughtlessness throughout the novel should warn the reader to be suspicious of her daydreaming. It is an alchemical fantasy, like Dr. Bordeu's *polypes-humaines*, like Wagner's attempt to birth the Homunculus in *Faust II*—an attempt to substitute the womb with a laboratory.²⁶⁸ As Goethe's criticism of the "verwegene" Diderot and his portrayal of the Homunculus' death make clear, the levity of the scene belies the author's distaste for the very proposition.

Thus, returning to the question of why birth and gestation remain mostly hidden in *Wilhelm Meisters Lehrjahre*, the above reading of the polypoid image of the baby tree suggests that the answer is that, for Goethe, there must be limits to the impulse to transform reality according to even the noblest ideals. To put a finer point on it, it is not the logic of the polyp but of the *hydra* that underlies Philine, Wagner, and Dr. Bordeu's perspectives on generation: a relationship of power of the human being over the material of life. Yet, as is demonstrated in the following, Goethe's *polyp-humanism* critiques this dream as human arrogance and folly, seeking instead a conception of the impression of the human intellect on the material of nature in a manner that does not violate the internal character of the thing.

The present chapter argues that Goethe's novel rejects the hydroid impulse to sculpt humanity according to an Enlightened ideal and instead develops a polyp-humanist conception of

²⁶⁸ See the chapter by Wendy C. Nielsen, "Homunculus and the Search for Immortality in Goethe's *Faust*," in *Motherless Creations: Fictions of Artificial Life, 1650–1890* (New York: Routledge, 2022), 73–89.

formation based in the development of individual character with the beneficent support of a loving community. The first part of the chapter focuses on the bleak reality of *Bildung* as it is portrayed in the novel, through specific considerations of the two children, Mignon and Felix. The contrast between the children's fates casts into relief a necessary feature of Kierkegaardian compensation from Goethe's polyp-humanist perspective: namely, that the pursuit of balance cannot entail the suppression of the essential character of the individual, but only the development of countervailing forces that support and sustain life. The tragedy of Mignon and the comedy of Felix is that attempts at compensation in the novel—even by Natalie, the embodiment of gentle compensation—make precisely this error: in hydroid manner, they aim to subject the children heteronomously to social modes of being that are incongruous with their own inner character.

The second part of the chapter considers Mignon's egg dance in Book 2 of the novel as an allegory of Goethe's polyp-humanist views on human development. It is argued that elements of the context, setting, props, choreography, and social dimensions in this scene map symbolically onto different alchemical, biological, and anthropological concepts regarding the origin and development of human life. Through these different intellectual registers, Goethe's ekphrastic allegory expresses his particular brand of polyp-humanism: one concerned foremost with the formation of the individual through the reciprocal forces of character and compensation toward a telos of pure potentiality. This reading sheds light on the contrast between the ideal and reality of *Bildung* in the novel, and thereby demonstrates that ultimately, *Wilhelm Meisters Lehrjahre* is a tale of *Bildung ex negativo*, one that programmatically disturbs the ideal course of development in order to shed light on its individual functions.

2.1. Bildung in Neglect

In Book 8 of *Wilhelm Meisters Lehrjahre*, the figure Natalie explains her philosophy of education to Wilhelm:

Ich erinnere mich von Jugend an kaum eines lebhaftern Eindrucks, als daß ich überall die Bedürfnisse der Menschen sah, und ein unüberwindliches Verlangen empfand sie auszugleichen. [...] meine angenehmste Empfindung war und ist es noch, wenn sich mir ein Mangel, ein Bedürfnis in der Welt darstellte, sogleich im Geiste einen Ersatz, ein Mittel, eine Hülfe aufzufinden. Sah ich einen Armen in Lumpen, so fielen mir die überflüssigen Kleider ein, die ich in den Schränken der Meinigen hatte hängen sehen; sah ich Kinder, die sich ohne Sorgfalt und ohne Pflege verzehrten, so erinnerte ich mich dieser oder jener Frau, der ich, bei Reichthum und Bequemlichkeit, Langeweile abgemerkt hatte; sah ich viele Menschen in einem engen Raume eingesperrt, so dachte ich, sie müßten in die großen Zimmer mancher Häuser und Paläste einquartiert werden.²⁶⁹

What Natalie describes in this passage is the drive toward social compensation that, according to Kierkegaard, is both essentially human and necessary for the further flourishing of the human species. Her instinct to correct imbalances in the world is just that: instinct. The concept of what, in a given situation, will provide the best corrective comes to her “ganz natürlich, ohne die mindeste Reflexion.” It exists in her evidently prior to any learning or cultivation. In seeking, wherever she goes, to provide others with what they need, she approaches the world as the embodiment of Nature’s own corrective force. The law of compensation acts through Natalie so to speak, ensuring that lack is met with abundance and excess is always tempered, so that every individual is prepared to confront life with the best possible chance at self-actualization.

It comes as little surprise that Natalie’s pedagogical instincts rhyme with Kierkegaard’s representation of compensation in the domain of social affairs. There is a clear concordance across Goethe’s life and works regarding the concept of balanced personal development. The theme of balance or balancing forces in the context of growth is present throughout Goethe’s

²⁶⁹ *MA*, 5:528.

work. In one aphorism Goethe asserts: “Wir können einem Widerspruch in uns selbst nicht entgehen; wir müssen ihn auszugleichen suchen.”²⁷⁰ It is also, by Goethe’s own accord, a theme of his life. In a conversation with Eckermann of 11 April 1827, he compares himself with Gotthold Ephraim Lessing (1729–1781): unlike the brilliant polemicist, “[...] ich habe mich nie auf Widersprüche eingelassen, die Zweifel habe ich in meinem Innern *auszugleichen* gesucht [...]”.²⁷¹ The pursuit of equilibrium is not merely the subject of Goethe’s works, it is the essence of his artistry.

Since Goethe engaged with Kilmeyer’s ideas in roughly the same period in which he returned to the material first developed in *Wilhelm Meisters theatralische Sendung* (Wilhelm Meister’s Theatrical Mission, 1777–1785), it is worth considering how the author deals with the concept of compensation in his *Bildungsroman Wilhelm Meisters Lehrjahre*. By the time Goethe read the published version of Kilmeyer’s lecture “Ueber die Verhältnisse der organischen Kräfte,” sometime in 1793, he had decided to return to the *Wilhelm Meister* material but had not yet begun writing in earnest.²⁷² He would not start *Wilhelm Meisters Lehrjahre* until signing a contract with the publisher Johann Friedrich Unger in May 1794. The essay on osteology—which Bersier argues evidences a clear shift in Goethe’s thought toward a Kilmeyerian morphology—appeared eight months later, at the same time that Goethe was completing the second half of the novel. Based on this chronology, Goethe contemplated Kilmeyer’s theses at the same time that he penned his novel.

²⁷⁰ *MA*, 17:780.

²⁷¹ *MA*, 19:223.

²⁷² Besides his official responsibilities in Weimar, the tumult of the French invasion of Mainz and his work on botany and zoology, which would have included his engagement with Kilmeyer, had kept him from his literary pursuits.

Surprisingly, though, the two children who receive the most care, the direct objects of social modes of compensation, are ever resistant to it. The narrator points out that both children seem particularly resistant to any molding by other figures. In the earliest books of the novel, Mignon rejects all attempts at heteronomous formation of her character. She refuses to wear dresses and succeeds despite the wishes of the doctor and her travelling companions. She performs her idiosyncrasies more or less as she likes, does not go to the theater or perform, no matter how much her companions or the impresario Serlo beg of her or wish.

Felix, too, is unwieldy, becoming increasingly more poorly behaved as the narrative progresses. In Book 5, Chapter 1, the narrator provides a brief description of his behavioral aberrations.

Der Knabe gefiel sich in gewissen Eigenheiten, die man auch Unarten zu nennen pflegt, und die sie ihm keinesweges nachzusehen gedachte. Er trank, zum Beispiel, lieber aus der Flasche als aus dem Glase, und offenbar schmeckten ihm die Speisen aus der Schüssel besser als von dem Teller. Eine solche Unschicklichkeit wurde nicht übersehen, und wenn er nun gar die Thüre aufließ oder zuschlug, und, wenn ihm etwas befohlen wurde, entweder nicht von der Stelle wich oder ungestüm davon rannte, so mußte er eine große Lection anhören, ohne daß er darauf je einige Besserung hätte spüren lassen.²⁷³

Felix ignores compensatory gestures from his elders, generally preferring to behave just as he pleases. Yet his resistance to molding reflects not so much stridency as casual independence. He is simply not particularly interested in what the other members of his community have to say. As such, though he misbehaves, it does not lead to meaningful conflict. In fact, it is his habit of drinking directly from the bottle that saves his life in Book 8. Felix thus represents the integrity of the individual as an independent balancing force, against collective wisdom.

²⁷³ *MA*, 5:281.

Notably, Felix does receive compensatory care from Mignon, but not from his own father. And indeed, given the children's shared inability or lack of interest in participation in traditional social mores, it is no wonder that they are immediately attracted to each other as playmates, as mother and child. The education that Mignon provides, and evidently, to which Felix is attracted, is a curriculum of song and geography, poetry and sunlight:

[...] Felix hätte sich ganz allein gesehen, wäre nicht Mignon auch ihm als ein liebevoller Schutzgeist erschienen. Auf das artigste unterhielten sich beide Kinder mit einander; sie lehrte ihm kleine Lieder, und er, der ein sehr gutes Gedächtniß hatte, recitirte sie oft zur Verwunderung der Zuhörer. Auch wollte sie ihm die Landkarten erklären, mit denen sie sich noch immer sehr abgab, wobei sie jedoch nicht mit der besten Methode verfuhr. Denn eigentlich schien sie bei den Ländern kein besonderes Interesse zu haben, als ob sie kalt oder warm seien. Von den Weltpolen, von dem schrecklichen Eise daselbst, und von der zunehmenden Wärme, je mehr man sich von ihnen entfernte, wußte sie sehr gut Rechenschaft zu geben.²⁷⁴

These children either reject, are immune to, or were denied external cultivation—which is not to say that external forces do not affect the ways in which they form their own characters, but that there is a high degree of spontaneity in the direction of these changes. Having been left to their own devices, they have developed idiosyncratic characters that are more or less problematic.

At first blush, then, the situation looks bleak for the educational reality of both of these children. Even if nature itself is the origin of the instinct toward social compensation, that does not guarantee the successful *Bildung* of a human being, because compensation is socially determined and therefore subject to the imperfect, arbitrary priorities of human beings. The law of compensation dictates that human beings will strive to compensate for the deficits and surfeits that they perceive, but it cannot guarantee correct judgment about those deficiencies or the compensatory measures that may be required.

²⁷⁴ *MA*, 5:281–282.

Over the course of the novel, Goethe employs Mignon and Felix as experimental subjects, whose uneven experiences of compensatory forces of nurturing and education interrupt their development as human beings. On the one hand, the stridency of Mignon's essential character produces her prodigious talent; it also resists all attempts at assimilation so that she remains, until the end, as unsuited to the world as it is to her. Conversely, it is Felix's great felicity that he seems to refuse formation, for he survives more than one run-in with death, precisely because he rejects instruction. The different fates of Mignon and Felix are really two sides of the same coin. The same mechanisms of *Bildung* and compensation are at work in both cases, but there is always a brutal indifference on the part of Nature about who wins and who loses in the struggle to grow and flourish. In Mignon's case, the incongruity of internal and external *Bildung* produces—in the biological terms of the eighteenth century—monstrous effects, while in Felix, they create a condition of lively rambunctiousness and a feeling of endless possibility. What makes Mignon a monster is what makes Felix a lucky, happy little boy.

2.2. Was ist das für ein Wurm?

While there are no polyps in *Wilhelm Meisters Lehrjahre*, there are two moments of organismic analogy that occur in the eighth and final book that relate directly to the theme of polyp-humanism. On separate occasions, the narrator compares Wilhelm's biological son Felix and adopted daughter Mignon with worms. This commonality is notable because in these selfsame passages, Wilhelm reflects with guilt on his failure and, indeed, inability to adequately cultivate these children. In other words, these worm metaphors are interesting because they appear precisely at moments when the narrative is most focused on the theme of the reciprocal

relationship between self-directed and externally guided compensation. More specifically, in each case, the worm represents the organism untouched by or beyond external formation.

In Book 8, Werner visits Lothario on matters of business, not knowing that his childhood friend Wilhelm is there. While Werner and Wilhelm are speaking with each other, Felix, whose identity is still a mystery to Werner, enters the room:

Felix war indessen in die Stube gekommen, und hatte sich, als man auf ihn nicht achtete, auf's Canapee gelegt, und war eingeschlafen. Was ist das für ein Wurm? fragte Werner. Wilhelm hatte in dem Augenblicke den Muth nicht, die Wahrheit zu sagen, noch Lust, eine doch immer zweideutige Geschichte einem Manne zu erzählen, der von Natur nichts weniger als gläubig war.²⁷⁵

Felix enters the room as symbol of all the ways in which Wilhelm's life path has diverged from Werner's, for this moment in the text follows directly upon Werner's descriptions of his own domestic situation, the happiness of his wife and sons. By contrast, as Felix's very existence verifies, Wilhelm is the father of a motherless child, whom he has also neglected for much of the novel.

In this context, the worm signifies a condition of abandonment, as in the text of Psalm 22: "My God, my God, why have you forsaken me? [...] To you they [our ancestors] cried, and were saved; in you they trusted, and were not put to shame. But I am a worm, and not human."²⁷⁶ The worm is the creature that falls outside of the sphere of paternal love. Likewise, while Wilhelm loves his child, he has been unable to or uninterested in caring for him the way that a father ought. Yet unlike the miserable speaker in the biblical text, Felix, as his name suggests, is happy and serene in his unnurtured condition. He does not "cry" for salvation, for help, or for anything,

²⁷⁵ *MA*, 5:503.

²⁷⁶ Michael David Coogan et al., eds., *The New Oxford Annotated Bible* (Oxford & New York: Oxford University Press, 2018), Psalm 22:1–6.

but is quite content with his situation. In other words, though he lacks what Werner's children have, he expresses no anxious desire, no longing for a life of simple domesticity.

The counterpoint to Felix's vermicular repose, a moment of calm and self-assurance, is the scene of Mignon's most violent epileptic fit after telling Natalie that she witnessed Philine and Wilhelm spending the night together:

Das gute Geschöpf, so erzählte mir Natalie, war kaum auf diesem Punkte seiner Erzählung, oder vielmehr seiner Antworten auf meine steigenden Fragen, als es auf einmal vor mir niederstürzte, und, mit der Hand am Busen, über den wiederkehrenden Schmerz jener schrecklichen Nacht sich beklagte. Es wand sich wie ein Wurm an der Erde, und ich mußte alle meine Fassung zusammen nehmen, um die Mittel, die mir für Geist und Körper unter diesen Umständen bekannt waren, zu denken und anzuwenden.²⁷⁷

Here, the squirming, pathetic girl, at this point in the novel practically a woman, suffers precisely because, for her, the nodes of the domestically family unit are constantly confused. Not only is she a product of incest, has she been denied connection to her mother and father, but this past has also confused her understanding of filial and romantic love. Her bond with Wilhelm is both too strong and too brittle to abide competitors. Quite unlike Felix, Mignon senses that she is the proverbial worm, forsaken by the biological and adopted fathers who ought to have cared for her.

The comparison of these two brief but narratively significant vermicular moments casts the similarities and differences between the two children into striking relief. In a concrete sense, the worm is invoked differently in the two scenes. In the first, the phrase "Was ist das für ein Wurm?" does not directly refer to the organism, but might be translated roughly as "Who does that creature belong to?" It is not a direct attribution of any specific vermicular quality to Felix. By contrast, the phrase "Es wand sich wie ein Wurm an der Erde" provides a vivid image of a writhing, suffering, pathetic creature. It at once invokes the biblical connotation of the worm as

²⁷⁷ *MA*, 5:526.

essentially “low” and “pathetic,” with a concrete image of the physicality of the worm. In other words, the image of the worm sticks to Mignon in a concrete, even biological sense.

2.3. The Monstrous Mignon

In fact, throughout the novel, there is something much more vermicular, much more polypoid, about the characterization of Mignon than the characterization of Felix, as evidenced, for example, by the novel’s treatment of matters of gender and behavior. No one in the novel seems troubled in the least by Felix’s gender expression. The boy does not exhibit any obvious femininity, but indeed, is altogether boyish. In fact, the problems with his *Bildung* discussed in the previous section would seem even to indicate a natural and healthy course of growth. Some of the descriptions of the boy call to mind Goethe’s descriptions of his own youth in *Dichtung und Wahrheit*—the story about the young Goethe throwing crockery out the window to entertain the neighborhood boys likewise reflects a healthy drive toward self-expression.²⁷⁸ Thus, while Felix’s behavior is problematic in some ways, the product of imperfect *Bildung*, it also functions as a sign of the boy’s health. That is, precisely because he is a motherless, fatherless child, he learns to resist all forms of heteronomy.

By contrast, there is a tendency not so much to de-sex Mignon, but to confuse the matter of her biological sex in a way that makes her seem more like an animal. For example, the narrator reserves the use of the genderless term “Geschöpf” for Mignon, with only a handful of exceptions,²⁷⁹ which places the unusual child within the metaphorical field of plant-animals like

²⁷⁸ *MA*, 16:14.

²⁷⁹ One exception is Mariane (*MA*, 5:15, 25, 34, 111, 112, 479). However, the term is employed to describe Mignon more than twice as often (*MA*, 5:90, 102, 113, 130, 192, 193, 223, 332, 356, 506, 524, 526, 545, 547, 579, 586, 587).

the polyp and the worm. Sometimes she is described as a girl, sometimes she is described as boyish. But most importantly, she is quite explicitly described as “zwitterhaft.”²⁸⁰ Mignon does not grow and change quite like a girl, nor does she grow and change quite like a human being. That is, like the hermaphroditic worm, she intrinsically tends to grow and evolve in ways that would seem problematic according to the morphological plan of the human being.

There is a biological slant to the way the narrator describes Mignon’s talent: that is, there is a direct connection between her artistry and physicality, seemingly unmediated by her human intellectual capacities. Yet, as suggested above, this animalic aspect of Mignon’s character creates problems for her. For example, in Book 4, Chapter 16, it is evident that Mignon’s physical existence limits her integration into the theatrical society.

Man konnte auch hier wieder bemerken, daß bei einer großen Anstrengung sie nur schwer und mühsam begriff. So war auch ihre Handschrift, mit der sie sich viele Mühe gab. Sie sprach noch immer sehr gebrochen deutsch, und nur wenn sie den Mund zum Singen auftrat, wenn sie die Zither rührte, schien sie sich des einzigen Organs zu bedienen, wodurch sie ihr Innerstes aufschließen und mitteilen konnte.²⁸¹

Like the worm or the polyp, Mignon is all mouth: her movement within the little society is strictly delineated by the use of this one “Organ.” Most identifiably human behaviors like writing or speaking elude her, and it is *only* through art—playing the zither and dancing—that she is able to interface with the human world. In fact, one might argue that Mignon’s interests remain within the sphere of the animal. Language is a secondary feature in her singing, for example, since she otherwise has no preference or aptitude for speaking. Similarly, her interest in geography is marked by her attraction to warm climates and the sun, wherein she resembles plants and animals

²⁸⁰ In Book 3, Jarno expresses his disgust, “[...] wie Sie, um nur einigermaßen leben zu können, Ihr Herz an einen herumziehenden Bänkelsänger und an ein albernes zwitterhaftes Geschöpf hängen mußten” (*MA*, 5:192).

²⁸¹ *MA*, 5:261.

that foremost seek light—indeed, it was oft remarked by observers that the polyp was remarkably attracted to light sources as an indication of sustenance. Thus, Mignon’s difficult integration into her social world results from her *polypoid* nature.

This deviation from the normal human pattern of growth and change is described by Natalie upon Mignon’s death. In describing Mignon’s demise, Natalie employs the metaphor of the canker-worm that destroys the rose.

Mein guter Oheim hatte große Vorliebe zu diesem Werke des Alterthums. Er sagte manchmal: Nicht allein die ersten Blüthen fallen ab, die ihr da oben in jenen kleinen Räumen verwahren könnt, sondern auch Früchte, die am Zweige hängend uns noch lange die schönste Hoffnung geben, indeß ein heimlicher Wurm ihre frühere Reife und ihre Zerstörung vorbereitet. Ich fürchte, fuhr sie fort, er hat auf das liebe Mädchen geweissagt, das sich unserer Pflege nach und nach zu entziehen und zu dieser ruhigen Wohnung zu neigen scheint.²⁸²

From Natalie’s perspective, Mignon’s external beauty, her cultural capacities for dance and poetry, for example, were antagonized by this internal worm. Literally, Natalie refers to the physical sickness that plagues Mignon as physical defects inherited from the incestuous union of her parents. Thus, from the external perspective of the rational Enlightenment hegemony, the worm is that which destroys the human being.

However, Goethe portrays Mignon in a polypoid manner not in order to advance this rigid program of *Bildung*, but instead in order to invite the reader to make certain kinds of associations with this figure: associations of potentiality, experimentation, wonder, monstrousness, marvel, as well as animality, primitiveness, and development. This analogy between Mignon and the composite figure of the polyp turns the girl into a rather uncomfortable figure, one who represents an uncanny proximity to a sphere of existence beyond what the tools of rational Enlightenment may be able to grasp. In this sense, just as the polyp came to signify

²⁸² *MA*, 5:543–544.

the origin of all animal *Bildung*; as a polypoid figure, Mignon appears as a figure of pure *Bildung* prior to compensation. Hers is a story of a monstrous individual development without the social correctives that otherwise facilitate a more comfortable experience of growth. In her case, it is not that no attempts at cultivation, or compensation, are made, but that they are focused on the assimilation of this unique individual to a social environment in which she cannot thrive.

3.1. The Egg Dance

In Book 2, Chapter 8 of *Wilhelm Meisters Lehrjahre*, Mignon meets Wilhelm at his room and tells him that she has prepared a “Kunststück” for him.²⁸³ Wilhelm is not in the mood, but he ultimately relents to Mignon's wishes out of a feeling of compassion for the child. Mysteriously, Mignon disappears without a word, only to return a moment later with a carpet and a basket of eggs in hand. She unfurls the carpet with care and then arranges the eggs on top of it at predetermined distances from one another. Finally, she ties a blindfold around her eyes and begins a lively dance. Mignon performs a complex choreography of wild movements, creating fluid contours with her arms and legs, as she snaps the castanets. The eggs and the blindfold mean that she must perform this already complex dance with virtuosic precision. Surprisingly, she easily, instinctively, almost mechanically—as an “Uhrwerk”²⁸⁴: Sie berührte keines, ob sie Gleich mit allen Arten von Schritten, engen und weiten, ja sogar mit Sprüngen, und zuletzt halb kniend sich durch die Reihen durchwand.”²⁸⁵ Wilhelm is amazed by the spectacle “und war

²⁸³ *MA*, 5:113.

²⁸⁴ *MA*, 5:114.

²⁸⁵ *MA*, 5:114.

verwundert, wie in diesem Tanze sich ihr Charakter vorzüglich entwickelte.”²⁸⁶ At the end of the dance, Wilhelm embraces Mignon and promises to care for her. Aside from Wilhelm, the only other person present is the violinist who provides musical accompaniment.²⁸⁷

The Egg Dance scene, as it appears in Book 2 of *Wilhelm Meisters Lehrjahre*, represents an interesting confluence of different intellectual themes in Goethe’s life and work. An initial version of the scene appeared in Book 4 of Goethe’s *Wilhelm Meisters theatralische Sendung*—written between 12 November 1782 and 12 November 1783.²⁸⁸ This text emerged during an interesting period in Goethe’s biography. In the early 1780s, as a result of his work on the mines in Ilmenau, Goethe became increasingly interested in the natural sciences. The most intense phase of his alchemical practice lay behind him, but as Ronald D. Gray argues, Goethe brought these experiences to bear on his mineralogical and osteological research. When Goethe returned to the *Wilhelm*-material in 1794, he had spent a decade developing his ideas on botany and morphology, and, as discussed in Chapter 5, reading widely on various natural scientific topics. Thus, as argued in the following, the revised version of the Egg Dance Scene can be read as a repository of images and symbols metabolized from more than a decade of alchemical, biological, and anthropological study.

Some recodification of the signs and symbols in this scene must occur between the *Sendung* and *Lehrjahre*. For example, one of the most important differences between the

²⁸⁶ *MA*, 5:114.

²⁸⁷ *MA*, 5:113–115.

²⁸⁸ This is the same year in which Diderot’s “Le Rêve de d’Alembert” appeared in Germany, which Goethe evidently read. There is insufficient evidence that Goethe responds to Diderot in any concrete way in the *Sendung* or *Lehrjahre*, but as the present chapter shows, his views on generation reflected in the novel are consistent with his criticism of the “verwegene Diderot.”

1782/83 and 1794/95 versions of the Egg Dance is the framing of the performance. In the *Sendung*, the “Kunststück” follows upon a rehearsal. However, in the preceding chapter in the *Lehrjahre*, Wilhelm learns from the *Alte*, the impresario of the theater where Wilhelm met Mariane, that the actress was forced to leave the theater when it was no longer possible for her to conceal her pregnancy. For a time, the *Alte* supported Mariane financially, but when she stopped responding to his letters, he cut her off in anger. This information causes Wilhelm deep consternation, leading him to reflect on his responsibilities to his former love, the mother of his child, and to the child itself.²⁸⁹ Wilhelm carries these worries with him into the next chapter.

If, in the *Lehrjahre*, the thematic context for Mignon’s “Kunststück” is Wilhelm’s guilt for having failed in his duties as a lover and father, then this changes the meaning of the scene radically. In the context of the *Sendung*, a novel more centrally focused on the theater as an institution, the crux of the scene would seem to be Mignon’s idiosyncratic virtuosity. Yet in the *Lehrjahre*, the family drama sheds different light on the most prominent features of Mignon’s performance: its combination of courtship dances—the Spanish Fandango and the Germanic Egg Dance—the images of the eggs themselves, and the feeling of understanding that Wilhelm develops over the course of the dance become much more important. Thus, the text of 1795 is also a document of Goethe’s developing concept of *Bildung*—particularly, the tension between the alchemical impulse and biological and anthropological forces in the development of human individuals.

²⁸⁹ See *MA*, 5:111–113.

3.2. Alchemy

In one chapter of his extensive study on alchemical themes in Goethe's oeuvre, Gray focuses on the image of the hermaphrodite as a symbol of perfection in Goethe's prose works, including *Wilhelm Meisters Lehrjahre*. Hence, he is primarily interested in the representation of "Mannweiblichkeit" in the *Lehrjahre*, the figures like Natalie who represent the reconciliation of male and female parts, and therefore the perfection of the human species. Yet, notably, Gray argues Mignon self-evidently cannot represent perfection for Goethe. Given the fact that Gray dedicates less attention in his study to *Wilhelm Meisters Lehrjahre* than to other texts and that Mignon is the only character actually described as a hermaphrodite, it seems worthwhile to revisit the scene from the alchemical perspective.²⁹⁰

At the same time, as Gray also acknowledges, and as is evident from Goethe's other narratives of reconciliation, such perfection is an object of longing, something never to be achieved or realized in this realm. If that is the case, then realistically none of Goethe's many androgynous female characters, not even the "beautiful Amazon" Natalie, could genuinely represent the alchemical principle of perfection. This apparent contradiction in Gray's analysis invites further reflection on Goethe's approach to hermaphroditic perfection in *Wilhelm Meisters Lehrjahre*.

If Goethe regards perfection as unattainable, then characters marked by hermaphroditic features would necessarily gesture not toward the idea of perfection itself, but rather toward the difficult, human experience of striving toward an ultimately unattainable telos. Mignon may not appear in the text as a "perfect" being, but that is because she is the tragic embodiment of

²⁹⁰ Ronald Douglas Gray, *Goethe the Alchemist: A Study of Alchemical Symbolism in Goethe's Literary and Scientific Works* (Cambridge, UK: Cambridge University Press, 2010).

precisely the incongruencies of nature, necessity, and fate that foreclose transcendence to the human being. Hence, in his letter to Goethe of 2 July 1796, upon finishing the eighth book of the *Lehrjahre*, Schiller comments that the two tragic figures, Mignon and the Harper, function as comets who point at something beyond the world that Goethe has created.²⁹¹ Schiller's comment, combined with the fact that Mignon is the only character in the novel explicitly referred to as hermaphroditic, support the notion that Mignon does not need to *be perfect* in order to represent the pursuit of perfection.

Crucially, the interpretation of Mignon as alchemical hermaphrodite is incomplete if one disregards the most important set piece in her "Kunststück"—the egg. As a symbol of the origin of life, the egg has ties to the Orphic traditions that nurtured alchemical thought.²⁹² In Orphism, Chronos created the silver egg from which the hermaphroditic god Phanes (Φάνης; also Protogonos, Πρωτογόνος meaning 'Firstborn') hatched.²⁹³ All things in the universe come about through this hermaphroditic being. Correspondingly, in the alchemical tradition, the Philosopher's Egg is the vessel that the alchemist uses in order to create the Philosopher's Stone. The Philosopher's Stone is often represented as a hermaphrodite, since it is a combination of "male" sulfur and "female" quicksilver, or mercury. The stone has the power to "perfect

²⁹¹ "Wie ist es Ihnen gelungen, den großen so weit auseinander geworfenen Kreis und Schauplatz von Personen und Begebenheiten wieder so eng zusammen zu rücken. Es steht da wie ein schönes Planetensystem, alles gehört zusammen, und nur die italienischen Figuren knüpfen, wie Kometen-Gestalten und auch so schauerlich wie diese, das System an ein entferntes und größeres an" (Goethe, *MA*, 8.I:187–188).

²⁹² Goethe's own interest in Orphism, the musings in his "Urworte. Orphisch," and the importance of the question of the origin of life for the novel as a whole provide support for this reading.

²⁹³ Notably, the Orphic egg is frequently depicted with the serpentine primeval goddess Ananke wound around it; in some cases, as Jacob Bryant's print of 1774, Ananke is represented as a literal serpent.

imperfection in all things” and therefore also “to transmute base metals into pure gold and transform the earthly man into an illumined philosopher.”²⁹⁴ In alchemical iconography, the hermaphrodite is sometimes pictured with an egg in order to represent this process.²⁹⁵

If a hermaphroditic girl and several eggs are the two most important signifiers in the dance scene, then based on the above context, the alchemical significance of this scene is much more plausible. Further, if the scene depicts the union of the hermaphrodite and the egg, as the union of the philosopher’s stone and alchemical vessel, then that would imply that Wilhelm, the solitary audience of this magical spectacle, functions in the analogy as the alchemist, the imperfect “earthly man” who seeks to be transformed into an “illumined philosopher.” This, too, would make sense according to the classical lexicon of alchemical images: The creation of the stone required the symbolic marriage *and* death of its “parents,” mercury and sulfur. Thus, it was common to refer to the philosopher’s stone as the “orphan” and the alchemist as the “adopted father.” To the extent that the egg dance scene represents an instrumental step in Wilhelm’s adoption of Mignon, this paradigm would appear to fit this scene as well.

Based on this constellation of images and ideas, the Egg Dance scene figures Mignon as the strange and precious object of Wilhelm’s fixation who, at least he hopes, is in the position to facilitate his evolution from “earthly man” to “illumined philosopher.” Yet, here, one recalls again the notion that this path of perfection must always remain incomplete. Goethe’s personal experiences with alchemy from his early adulthood taught him, in a concrete sense, that the

²⁹⁴ Lyndy Abraham, *A Dictionary of Alchemical Imagery* (Cambridge: Cambridge University Press, 1998), 145.

²⁹⁵ The manuscript *Splendor Solis*, for example, depicts a two-headed hermaphrodite holding a mirrored shield in one hand and an egg in the other. See the reproduction in Plate IX of Solomon Trismosin, *Splendor Solis* (London: Kegan Paul, Trench, Trubner & Co., Ltd., 1920).

alchemical scene could lead only to disappointment. And so, it would seem that in the egg dance, alchemical imagery is invoked precisely in order to demonstrate to the reader that the bond between “orphan” and “adopted father” will not and cannot lead to the end that Wilhelm wishes.

All of this—the alchemical significance of the scene—would provide a reasonable enough reading of the dance as it appears in the *theatralische Sendung*. However, it is in the context of the *Lehrjahre*, in which the discussion of *Bildung* is expanded, that the fragments of the idea of the “orphan” and the “philosopher” achieve a more complete signification. For the context that is added both before and after the performance provides insight into how the bond with Mignon would, in theory, provide Wilhelm with a path to transformation, and why, ultimately, this transformation must fail.

3.3. Biology

One crucial change in the 1795/96 version of the text, is the explicit identification of the dance that Mignon performs as a Spanish courtship dance, the fandango.²⁹⁶ The fact that Goethe chooses to emphasize this detail in the revised version of the text is notable for a number of reasons. For one, given that the egg dance itself is likely inspired by a Germanic fertility ritual of the “cold north,” its combination with a performance tradition from the “warm south” contributes to the theme of the impossibility of perfection. As noted before, the idea of irreconcilable (geographical) opposites frequently serves this function in Goethe’s writing.

²⁹⁶ In the *theatralische Sendung*, Wilhelm learns from Madame Melina that Mignon „[...] tanzte [...] den *Fandango* allerliebste und machte verschiedene andere Kunststücke mit vieler Geschicklichkeit und Anstand” (*MA*, II.2:128). However, the fact that her Egg dance is itself a Fandango is left for the reader to infer by recognizing Goethe’s description of her performance, which characteristically includes the snapping of castanets. The fact that Goethe moves this detail to the end of scene in the 1795/1796 version of the text, shows that it is necessary information for the interpretation of the scene.

This detail is interesting for another reason, though. The fandango was notorious in the eighteenth century as particularly sensuous, even “licentious.” Hence, dance historians frequently cite the description in volume 10 of *Histoire de ma vie* (composed between 1789–1798) by Giacomo Casanova (1725–1798), as an example of European perception of Spanish fandango:

Each couple danced face to face, never taking more than three steps, striking the castanets, which are held in the fingers, and accompanying the music with attitudes than which nothing more lascivious could possibly be seen. Those of the man indicated love crowned with success, those of the woman consent, ravishment, the ecstasy of pleasure. It seemed to me that no woman could refuse anything to a man with whom she had danced the fandango.²⁹⁷

It is unsurprising that the prolific lover Casanova immediately seeks a fandango teacher after witnessing such a performance. But that makes it appear that much more peculiar—indeed, inappropriate—that the child Mignon knows the music of this dance of seduction well enough to teach it to her accompanist, and the steps well enough to perform them blindfolded on a carpet covered with eggs.

By drawing the reader’s attention to the type of dance that Mignon performs, Goethe gives the reader reason to think more carefully about the peculiar choreography of the dance. For the absence of a human male as dance partner changes the meaning of the “Kunststück” completely. As a courtship dance, the fandango prescribes a determinate end: the male and female dancers form couples, marry, and procreate. Yet here, there is no other human dancer, but only a half-dozen most likely unfertilized eggs. Thus, if this courtship dance is to *lead to*

²⁹⁷ Giacomo Casanova, *History of My Life*, trans. Willard R. Trask (Baltimore, MD: Johns Hopkins University Press, 1997), 321. Although Casanova’s memoirs were not published until the nineteenth century, they were written at the close of the eighteenth century and accurately reflect the international perception of Spanish fandango at the time. See Thomas Baird et al., “Changing Places: Toward the Reconstruction of an Eighteenth Century Danced Fandango,” *Música Oral Del Sur*, no. 12 (2015): 619–665, especially 622–624.

something, it cannot be the coupling of eligible young men and women. And in that sense, this dance does not, in any straightforward sense, celebrate the ‘regular’ order of sexual reproduction—the union of an individual male and an individual female—but in fact, interrupts that sexual reproduction as an option altogether.

Instead, what the Egg Dance produces is something obviously unstable from a symbolic perspective. Mignon cannot dance *with* the eggs the way that she would dance with a human partner—as Casanova’s memoir makes clear, that would require the nearness and intimacy of two warm bodies. Instead, precisely the opposite principle of distance determines the success of the dance. The eggs are not a goal or a prize, but an obstacle. They are not there to be fertilized, but to be avoided at all costs: “Sie trat so scharf und so sicher zwischen die Eier hinein, bei den Eiern nieder, daß man jeden Augenblick dachte, sie müsse eins zertreten, oder bei schnellen Wendungen das andre fortschleudern.”²⁹⁸ The drama of the dance lies not in the synchronization of movement but in the potential that the dancer might do harm to her partner, the eggs. Only if *no contact* is made between the two “dance partners” does the performance succeed.

This principle of distance means that, ultimately, the egg dance conjures only half-developed concepts of human reproduction—eggs with no sperm, a not-yet marriageable girl with no partner. The imagery of reproduction is suspended in an in-between space of signification: The “Kunststück” could gesture toward the notion of pure potentiality, of transformative power associated with the philosopher’s stone. It could just as easily frame alchemical ambition as impossible, since the dancer, representing the stone, and the eggs, representing the alchemical vessel, ought never in the course of the dance to meet.

²⁹⁸ *MA*, 5:114.

The solution to this interpretive problem is the move, that for Goethe occurred in the ten years dividing the *Sendung* and the *Lehrjahre*, from the alchemical toward the biological interpretation. In his reading of the Egg Dance, Andreas Gailus draws attention to the uncanny ambiguity in the rendering of Mignon²⁹⁹—the way she executes this dance as though driven, internally, by a “Räderwerk”: “Unaufhaltsam, wie ein Uhrwerk, lief sie ihren Weg, und die sonderbare Musik gab dem immer wieder von vorne anfangenden und losrauschenden Tanze bei jeder Wiederholung einen neuen Stoß.”³⁰⁰ It is only because Mignon has completely internalized her choreography, made it second nature to herself, that she is able to execute her steps with machinic speed, efficiency, and lightness.

As Gailus notes, the automatic quality of the choreography makes the dancer seem not quite human. Arguably, that is because the human being is *not* the organizing principle of the egg dance at all. Rather, the dance offers a moment of insight into the mechanism of nature itself. It instantiates in the conflation of organic and mechanistic imagery, the egg and the clockwork, the confounding structure of the universe, as something both essentially free and determined. Thus, Mignon’s dance with the eggs interrupts the conventional logic of courtship in order to stage instead the idea of the generation of life rather than the physical processes that it typically requires.

In that sense, the dance also resists the alchemical worldview: the symbols of the egg, hermaphrodite, orphan, and father evoke the ideas of the origin of life, control over matter, the possibility of taking into one’s hands the *prima materia*, and molding the stuff of life as one

²⁹⁹ Andreas Gailus, “Metamorphoses of Form (Goethe),” in *Forms of Life: Aesthetics and Biopolitics in German Culture* (Ithaca, NY: Cornell University Press, 2020), 123–187.

³⁰⁰ *MA*, 5:114.

wills. The language of modern science, of a mechanistic, self-organizing nature, in which these symbols are couched, the principle of distance and rupture that organizes Mignon's choreography, indicate that the idea of access to and control over such origins must remain as elusive as ever. The scorn for the hydroid impulse to control that underlies Philine's wish for the baby, Diderot's dream of *polypes-humaines* appears here, too, in the biological recodification of alchemical symbols.

At the same time, in replacing the alchemical with the biological order of knowledge, Mignon's dance performs a similar function to the "Tänze der Infusionsthiergen" and polyps during the late eighteenth century. For Goethe and his contemporaries, the polyp came to represent the idea of the prototype of all life. An understanding and appreciation of the polyp functioned, analogically, as understanding and appreciation of the primordial functions of all life. Likewise, here, the marvelous Mignon, precisely because she has rejected and may even be innately inimical to human *Bildung*, is in a position to provide insight into the essential features of life. Her polypoid spectacle dramatizes the engagement with, and attunement to, the principle of life itself.

3.4. Anthropology

Mignon's dance discloses the secret of life—pursued by the alchemist and the biologist alike. Yet, remarkably, she offers only a moment of insight, after which such a connection to the secret origins of life is forever lost. For after this evening, Mignon will never perform the egg dance again, and insofar as it is *her dance*, or as she later insists, *Wilhelm's dance*, the egg dance itself will never *be performed* again. There is a metaphysical significance to this secret staging, in that it signifies the elusiveness of precisely those answers sought by all students of life. But there is

also a social, indeed anthropological significance to the secrecy of the egg dance.

Namely, secret-telling and secret-keeping entail a complicated negotiation of distance and proximity to other human beings. A secret can bring the teller and the keeper together, but it can also drive them apart. It can place a burden on both parties, too, who by virtue of the secret are made more dependent on the other. The secret-teller may worry that the secret-keeper may give in to indiscretion. The secret-keeper may find themselves tending toward distancing or disidentification, separating themselves from the truth, perhaps even separating themselves from others, as a way of resisting the urge to tell the secret. In so many ways, the secret confronts both parties with threats of betrayal and isolation, that they must develop trust and mutual regard if they are to survive their entanglement.

According to the logic of the secret, Mignon and Wilhelm both are and are not bound to each other, because Mignon's secret requires no committed action on the part of the secret keeper, Wilhelm. For Mignon shares a secret with Wilhelm that he *cannot* share, even if he wanted to. Quite literally, this is a private performance, involving only one dancer, Mignon, and one spectator, Wilhelm. There is another performer present, the violinist, but he functions as a mere mediator of the spectacle. Having only learned one part of the spectacle, the music to the fandango, the violinist is in no position to teach the choreography to any other dancer. Mignon will share her secret with Wilhelm, and it will remain his alone, a secret that he will never be able to reproduce for others. In other words, there is in this scenario a secret teller, Mignon, but no secret keeper.

This relational ambivalence is programmatic for Mignon and Wilhelm, who throughout the novel oscillate between conditions of greater and lesser intimacy—to disastrous effect for Mignon. At the close of the scene, the narrator explains how Wilhelm is overcome with paternal

affection: “Er empfand, was er schon für Mignon gefühlt, in diesem Augenblicke auf einmal. Er sehnte sich, dieses verlassene Wesen an Kindesstatt seinem Herzen einzuverleiben, es in seine Arme zu nehmen, und mit der Liebe eines Vaters Freude des Lebens in ihm zu erwecken.”³⁰¹ On the one hand, this would seem to be a positive consequence of the dance for both Mignon and Wilhelm. Mignon, by entrusting Wilhelm with knowledge of a sacred mystery, finds a father for herself, also gives Wilhelm the opportunity to care for her in the way that he has failed to care for his former lover and child.

And yet, as discussed earlier in this chapter, Wilhelm fails to care for Mignon just as he fails to care for Felix. In Chapter 12 of the same book—four chapters after the egg dance—Wilhelm is unable to respond to the child appropriately when she shows him her attempts at writing: “Wilhelm, dem die Aufmerksamkeit des Kindes, wenn er ruhigen Sinnes war, große Freude machte, achtete diesmal wenig auf das, was sie ihm zeigte; sie fühlte es, und betrückte sich darüber nur destomehr, als sie glaubte, diesmal ihre Sache recht gut gemacht zu haben.”³⁰² Notably, as a father and educator, Wilhelm compares quite unfavorably to Goethe’s own father, of whom Goethe writes in *Dichtung und Wahrheit*, “Mein Vater war überhaupt lehrhafter Natur [...]”.³⁰³ Even after the relationship between father and daughter is expressed out loud at the end of Book 2, Wilhelm continues to fail to offer Mignon the fatherly compensation that he has promised.

Thus, the egg dance not only stages the transition from an alchemical toward a biological view of nature, but also the sacred connection between biology and anthropology. Mignon is a

³⁰¹ *MA*, 5:114.

³⁰² *MA*, 5:133.

³⁰³ *MA*, 16:17.

sort of anthropological Philosopher's Stone, in that she offers Wilhelm, through her mysterious dance, the opportunity to achieve the fullest expression of his own humanity by fulfilling his biological and social duty to contribute to the cultivation of another human being. Perhaps the secret that she reveals is not, per se, the origins of life in an alchemical or biological sense, after all, but in an anthropological sense. She reveals to Wilhelm that the most mature, most meaningful contribution that he could make is *not* the composition of a play or the establishment of a successful theater troupe, but rather care for all of the beings, great and small, who populate his world. It is his tragedy, and Mignon's as well, that Wilhelm forgets what this marvelous girl reveals to him.

4. Conclusion

Wilhelm Meisters Lehrjahre impressed and offended the Romantic poet Friedrich von Hardenberg, known by his penname Novalis (1772–1801).³⁰⁴ Novalis belonged to the band of Jena Idealists who inaugurated the era of German Romanticism. Heavily influenced by Schiller's treatise "Über naïve und sentimentalische Dichtung" (On Naïve and Sentimental Poetry, 1795–1796) he, like the other Jena Romantics, viewed their age as one defined by disenchantment, brought about by scientific rationalism. The tools of reason and investigation alone would and could never produce the understanding that the Enlightenment philosophers sought. Not only that, but they threatened to destroy the sense of wonder and of the miraculous that suffused life with meaning. Poetry and art, though, by *reenchanting* nature through narrative, were uniquely capable of offering transcendental insight into the mysteries of being, thereby healing and

³⁰⁴ See Robert T. Ittner, "Novalis' Attitude toward 'Wilhelm Meister' with Reference to the Conception of His 'Heinrich von Ofterdingen,'" *The Journal of English and German Philology* 37, no. 4 (1936): 542–54.

transforming the modern world. Thus, the Romantic project of *Bildung* was synonymous with the religion of art, which exposed the modern reader to divine truth.

If the poet was, as Novalis believed, a “transcendental physician,” then Goethe had forsaken his Hippocratic oath by reducing the great work of *Bildung* to mere matters of adaptation and conformism in his novel—according to Novalis, “eine poetisierte bürgerliche und häusliche Geschichte.”³⁰⁵ In *Wilhelm Meisters Lehrjahre*, according to such an interpretation, *Bildung* falls solely within the purviews of the secretive *Turmgesellschaft*, which stands for the rationalizing principle of the Enlightenment, the pursuit of a well-ordered society. The *Turmgesellschaft* could never effectuate the Romantics’ longed-for state of aesthetic-religious transcendence, being entirely unsympathetic and unaccommodating to the miraculous in nature. Hence, Novalis laments that, because the teleological center of *Wilhelm Meisters Lehrjahre* is Wilhelm’s induction into the *Turmgesellschaft*, the novel dismisses the “Wunderbare [...] als Poesie und Schwärmerei.”³⁰⁶

In his study *Die Theorie des Romans* (The Theory of the Novel, 1916/1920), Georg Lukács (1885–1971) echoes Novalis in his interpretation of the novel, stating of Goethe’s rendering of the *Turmgesellschaft*: “Seine gestaltende Ironie, [...] kann hier nur das Wunderbare—seinen spielerischen, willkürlichen und für das Letzte unwesentlichen Charakter aufdeckend—entwerten [...]”³⁰⁷ The two figures in the novel who understand poetry and exaltation are Mignon and the Harper. They are the only characters through whom, at least for

³⁰⁵ Novalis, *Briefe und Werke in drei Bänden* (Berlin: Verlag Lambert Schneider, 1943), 3:279, fragment 934.

³⁰⁶ Novalis, *Briefe und Werke in drei Bänden*, 3:279, fragment 934.

³⁰⁷ György Lukács, *Die Theorie des Romans; ein geschichtsphilosophischer Versuch über die Formen der grossen Epik* (Berlin: P. Cassirer, 1920), 155.

Novalis, the possibility of transcendence enters into the fictional world. Yet Wilhelm's entry into the secret society hastens these characters' awful deaths. As Lukács puts it, the tragic effect of the *Turmgesellschaft* is that "[m]an muß ganze Reihen von Menschen, wegen ihrer Unfähigkeit zur Anpassung, untergehen [...] sehen [...]"³⁰⁸ From Novalis' perspective, by sacrificing "[d]as Wunderbare" for "prosaische[n] Stoff"—the miraculous for the prosaic—Goethe had betrayed the form by committing an act of "[k]ünstlerischer Atheismus."³⁰⁹

Novalis' assessment of Goethe's treatment of the miraculous ought to be taken with a grain of salt, at minimum because it is the expression of an artist making a name for himself.³¹⁰ But more importantly, the reception history of the miraculous Mignon,³¹¹ dating back to the novel's first appearance, is too rich to support the view that Goethe dismisses the "Wunderbare [...] als Poesie und Schwärmerei." No character from the novel has captivated the imaginations of subsequent generations quite like Mignon.

Ultimately, as this chapter has shown, Novalis and Lukács are right to identify the miraculous Mignon as one victim of the *Turmgesellschaft*'s Enlightenment program, but that is hardly evidence of Goethe's embarrassment about representing the totality of the world in narrative. Mignon's death is an expression of the same grief that can be found throughout his

³⁰⁸ Lukács, *Die Theorie des Romans*, 145.

³⁰⁹ Novalis, *Briefe und Werke in drei Bänden*, 3:279, fragment 934.

³¹⁰ See Harold Bloom, *The Anxiety of Influence: A Theory of Poetry*, 2nd ed. (New York: Oxford University Press, 1997).

³¹¹ See Terence Cave, *Mignon's Afterlives: Crossing Cultures from Goethe to the Twenty-First Century* (Oxford: Oxford University Press, 2011).

work at the impossibility of reconciliation.³¹² That grief does not permit Mignon to appear in the narrative as a straightforward miracle like Novalis' blue flower, but rather causes her to teeter on the boundary between the miracle and the monster. Mignon is the exemplum of the same tragic lesson as Schiller's Johanna and Mary Shelley's monster: the bitter paradox that those beings who bring us closest to insight and manifestation of the transcendent truths of the universe are—in the imperfect state of nature as it now exists—those most likely to suffer for the knowledge for which man has longed.

Beyond the fact that Mignon has bewitched generations of readers, there is also the fact that the novel itself frequently thematizes the miraculous, for example, in Goethe's descriptions of the girl's many ritualistic performances. As shown, Mignon's mysterious Egg Dance in Book 2 is tinged with an atmosphere of Gnosticism and Hermeticism, and the intimacy of the performance gives the impression that Wilhelm is being inducted into a sacred mystery. Her wild, improvised dance in Book 2, in which she appears as a "Maenade," likewise gives the impression of the Dionysian cult.³¹³ Through dance as well as through song, Mignon is a walking—or rather "hopping and skipping"—revelation.

³¹² Tellingly, only in Goethe's "Märchen" does anything like Novalis' transcendence come to fruition.

³¹³ In Book 12, during a party Mignon performs a dance diametrically opposite to her Egg Dance: "Mignon ward bis zur Wut lustig, und die Gesellschaft, so sehr sie Anfangs über den Scherz gelacht hatte, mußte zuletzt Einhalt tun. Aber wenig half das Zureden, denn nun sprang sie auf und raste die Schellentrommel in der Hand, um den Tisch herum. Ihre Haare flogen, und indem sie den Kopf zurück und alle ihre Glieder gleichsam in die Luft warf, schien sie einer Mänade ähnlich, deren wilde und beinah unmögliche Stellungen uns auf alten Monumenten noch oft in Erstaunen setzen" (*MA*, 5:327).

Coda

From February to March of 1830, the French *Académie des sciences* bore witness as the naturalists Georges Cuvier (1769–1832) and Étienne Geoffroy de Saint-Hilaire (1772–1844) reprised an old argument: whether the scientific understanding of nature required the fastidious observation of particulars or the divination of rules that governed the composition of the whole. Both men were shaped in their thinking by the past hundred years of scholarship and politics. It had been ninety-five years since Linnaeus published his *Systema Naturae*, articulating the first systematic description of nature based on the analogy of forms; ninety-four since Buffon published his shocking refutation of Linnaeus's artificial categories, defending the complexist belief that nature defied human categories; eighty-nine since Trembley's polyp had dealt another serious blow to the concept of an *a priori* hierarchy of nature. And forty-one years since Cuvier and Geoffroy's contemporaries had renounced complexism as the intellectual offspring of the *ancient regime* and embraced Linnaeus as the hero of revolutionary science.

This minor episode reflects the degree to which science in the age of the polyp was a matter of major cultural and political significance. Though friendly, Cuvier and Geoffroy diverged along the ideological lines drawn in the 1790s, during the revolution: the complexist Cuvier was a conservative and a royalist, while the systematist Geoffroy was a liberal and a republican. They had met during the revolution and survived the many changes to the scientific world that the establishment of the First Republic, the Terror, and the Empire would bring. Now they would witness yet another regime change: The stage for their debate, the *Académie des sciences*—formerly the *Académie royale des sciences*—was located less than a mile up the Seine from the Palais Bourbon, where on 17 March 1830, the Chamber of Deputies passed a motion of no confidence against Charles X. On 18 March, Charles dissolved the parliament. Four months

later, the July Revolution would begin and bring the short-lived Bourbon Monarchy to an end. Cuvier would go on to hold important positions in the government of the July Monarchy, while Geoffroy would join the liberal opposition that criticized the monarchist for endangering the progress of science.

Cuvier and Geoffroy's scientific dispute bore international significance as well. Within days of the event, the seventy-eight-year-old Goethe published a brief report on the debate between Geoffroy and Cuvier, in which he recounts this history in broad strokes and, ultimately, relates it to developments in German science—to which Cuvier and Geoffroy evidently had not attended. The complexist Cuvier, Goethe reports, "[...] arbeitet unermüdlich als Unterscheidender, das Vorliegende genau Beschreibender, und gewinnt sich eine Herrschaft über eine unermeßliche Breite."³¹⁴ He operates within the Buffonian tradition. The more Linnean Geoffroy, however, "[...] ist im stillen um die Analogien der Geschöpfe und ihre geheimnisvollen Verwandtschaften bemüht."³¹⁵ Goethe then proceeds to make the point that the analogical method has been the special province of German scientists, and that Geoffroy might profit from a closer investigation of their work. He estimates that in the last forty years, there have been at least fifty German scientists who have approached the study of anatomy from an analogical perspective, including Kiemeyer, Meckel, Oken, Spiel, and Tiedemann. None of their work seems much appreciated in the French-speaking world.³¹⁶

Though Goethe's report does not touch on the topic of the polyp or the dream of the republic directly, it does weave together the stories of several scientists firmly embedded in the

³¹⁴ *MA*, 18.II:509.

³¹⁵ *MA*, 18.II:509.

³¹⁶ Cuvier was a graduate of the Karlsschule and a student of Kiemeyer.

intertwined histories of science and politics, and very much influenced by Trembley's discovery. It is not as though the republican spirit of the age or the differing French and German approaches would not have been possible without the polyp: rather, the polyp was one construct among many that shaped the ways in which different parties viewed the political dreams and conflicts of the age. Trembley's discovery initiated a period of "polyp-thinking," which in turn led to the development of a "polyp-politics."

In the wake of Trembley's discovery, the human mind, if not the human body, came to be understood as a kind of polyp. For Bonnet, the power of reason generated chains of thoughts and ideas in the same manner that one polyp budded from another. Diderot viewed the society of human beings as a polypoid organization, a single organism at the level of cognition, operating as one to general novel ideas. In this golden age of reason, the concept of the mind as constitutionally free and flexible had obvious political significance. The polyp was synonymous with liberty itself: not only the idea that the pursuit of freedom was the telos of the human species, but also that the polypoid malleability of the material world made success not just thinkable, but possible. In the Age of Enlightenment, freedom and joy ought to multiply like Trembley's miraculous little creatures.

The elevation of the polyp to a symbol of liberty is bound up with two concurrent political histories: the French pursuit of popular sovereignty and German wariness of barbaric rationalism. The polyp's challenge to the Great Chain of Being contributed to freethinking umbrage with France's religious-political hierarchies, and hence, to the intellectual mood that ignited the Revolution in 1789. German intellectuals, horrified by the brutal and imperialist turn that the Revolution took, in turn dreamed of a political state constructed according to a polypoid ideal of organic internal harmony.

Conclusion: A Gallery of Monsters

Der Mensch begreift niemals, wie
anthropomorphisch er ist.

Johann Wolfgang von Goethe,
Über Kunst und Altertum (1823)

1. A Totally New World of Plastic Beauty

In the latter half of the nineteenth century, the field of mathematics saw the emergence of a shocking class of functions. At the time, mathematicians generally believed that all continuous functions were differentiable almost everywhere. Some functions might exhibit minor aberrations, or “pathological” behavior, but on the whole, one could expect regularity and predictability from the graph of any given continuous function. It was disconcerting, then, to learn of the existence of a number of counterexamples to these widely held assumptions about the behavior of continuous functions. In 1872, Karl Weierstrass (1815–1897) proved that in fact some continuous functions exist that are differentiable *nowhere*; his set of counterexamples, the so-called Weierstrass functions produce intimidating, jagged graphs, rather than the smooth and elegant lines one might typically expect.³¹⁷ This result disturbed even the world’s most renowned

³¹⁷ The Weierstrass function is the first known example of a function that is continuous everywhere and differentiable nowhere. Continuity and differentiability are both properties of “well-behaved” functions, the latter being strictly stronger than the former. While it was well-understood that functions could be continuous but fail to be differentiable at a discrete set of points, Weierstrass showed that continuity gave absolutely no assurance of differentiability in any form. My thanks to Robert Huben for advising me on the explanations of the mathematics in this section.

mathematicians.³¹⁸ Henri Poincaré (1854–1912) deemed Weierstrass’ result a “monster,”³¹⁹ while Charles Hermite (1822–1901) pronounced it a “lamentable scourge.”³²⁰

The discovery of these monsters ultimately led to the articulation of a new field of mathematical study. In 1982, Benoit Mandelbrot (1924–2010) published *The Fractal Geometry of Nature* (1983), the first systematic study of undifferentiable continuous forms.

Until I took up their study, the sets alluded to in the preceding sections were not important enough to denote them. However, as the classical monsters were defanged and harnessed through my efforts, and as many new ‘monsters’ began to arise, the need for a term became increasingly apparent.³²¹

Thus, Mandelbrot coined the neologism “fractal”—from the Latin *frangere*, to break—to refer to this new category of mathematical objects. The formal study of fractals demonstrated that even the most bizarre functions exhibit certain common properties. For example, the dimensions of all such functions are generalizable to irrational numbers. Through the application of modern mathematical tools and technology,³²² Mandelbrot was able to demonstrate regularity and predictability even in the most pathological functions.

³¹⁸ In contemporary parlance, these mathematical objects are not “well-behaved,” which is to say that they offend natural intuitions about how good mathematics ought to work.

³¹⁹ “Logic sometimes breeds monsters. For half a century there has been springing up a host of weird functions, which seem to strive to have as little resemblance as possible to honest functions that are of some use. No more continuity, or else continuity but no derivatives, etc.” Henri Poincaré, *Science and Method*, trans. Francis Maitland (London, Edinburgh, Dublin, & New York: Thomas Nelson and Sons, 1914), 125. Original French published in 1908.

³²⁰ “Je me détourne avec horreur et effroi de cette plaie lamentable des fonctions continues qui n’ont pas de dérivées.” Charles Hermite and Thomas Jan Stieltjes, *Correspondance d’Hermite et de Stieltjes* (Paris: Gauthier-Villars, Imprimeur-Libraire, 1905), 2:318.

³²¹ Benoit B. Mandelbrot, *The Fractal Geometry of Nature* (San Francisco: W. H. Freeman, 1983), 4. Subsequent citations as “*The Fractal Geometry of Nature*” with page number(s).

³²² Access to a computer meant that Mandelbrot could generate with relative ease intricate graphs otherwise so impractical as to be virtually impossible to render by hand.

The twentieth-century quest to subdue the monstrous fractal mirrors eighteenth-century scientific investigations into the nature of the freshwater polyp in several respects. As has been demonstrated in this dissertation, scientists and laypersons alike regarded the polyp as an “intractable” sort of creature.³²³ Many of Trembley’s contemporaries would have or even did apply the same terms to the polyp that Mandelbrot later would to the fractal. In the introduction to *The Fractal Geometry of Nature*, Mandelbrot subsumes to the category “fractal” all natural forms hitherto described as “*grainy, hydra-like, in between, pimply, pocky, ramified, seaweedy, strange, tangled, tortuous, wiggly, wispy, wrinkled [...]*.”³²⁴ Included in that list is one of the analogies that contributed most directly to the polyp’s notoriety in the middle of the eighteenth-century—that of the Hydra of Lerna.

This common lexicon foregrounds the behavior—specifically the *bad behavior*—of the objects of study in question. Mathematicians prefer what they call *well-behaved* functions, functions that do not deviate from the norms of the science. A function that refuses to *do* what is expected of it is deemed problematic, indeed, *pathological*. Likewise, as discussed in Chapter 2, the polyp struck the *incrédules* as a pathological, that is, monstrous aberration from the divine—so much so that they refused at first even to accept that the creature was real. The polyp appeared to *be* a plant, at the same time that it *behaved* like an animal; like the fractal, it frustrated received knowledge about the fundamental ordering of nature.

Similarities exist, too, in the way that the opposition of language, broadly construed, and natural objects is figured as a kind of battle. By evoking Poincaré and Hermite via the image of

³²³ See the chapter “‘Not without Some Repugnancy, and a Fluctuating Mind’: Trembley’s Polyp and the Practice of Eighteenth-Century Taxonomy” in Schwartz, *Worm Work*, 71–112.

³²⁴ Mandelbrot, *The Fractal Geometry of Nature*, 5.

“classical monsters,” Mandelbrot frames discovery as a battle between two fearsome agents. On one side of that battlefield, the problematic behavior of a confounding natural form; on the other, the wily human scientist prepared to subdue it. Victory would require the development of a mathematical language for describing analogies between things that, according to informal languages, could have no analogues. In “rigorous and vigorous quantitative fashion,” Mandelbrot masters the beast precisely through the invention of a powerful, new formal language. His triumph consists in the discovery of “a totally new world of plastic beauty” in a “gallery of monsters.”³²⁵ It is the neologism that makes the whole host of poorly behaved things traversable for the scientific intuition.

Trembley and subsequent natural historians and philosophers evoked terrifying monsters in their descriptions of the freshwater polyp like the ancient *poulpe* and the terrifying, many-headed Hydra of Lerna, respectively. The animal’s common and taxonomic names—Süßwasserpolyp and hydra—preserve the pitched idiom of that early period. In Trembley’s case and in the case of subsequent generations of scientists, this meant searching for analogies of form in other parts of nature’s products. In each case, the *existence* of an unfamiliar pattern demands that the scientist provide an accurate articulation of the law behind that pattern. Complex morphologies once seen as indescribable or even impossible were now recognized as having some regular order to them.

Rösel, for example, invokes the myth when he reproduces Trembley’s results. He even prints images of natural polyps—as yet unaltered by the scientist’s knife—alongside images of his “Wunderthiere,” as though Nature and the scientist are “creators” of equal status.

Blumenbach, who alludes to both Rösel and Trembley, draws the sectioning-experiment to the

³²⁵ Mandelbrot, *The Fractal Geometry of Nature*, 2.

forefront in his description of the *Bildungstrieb* as well. He focuses specifically on the idea of battles of the flesh: the polyp's wounded body shows that organismic healing follows the same principles, no matter what the species in question may be. Hence, the Latin term that Blumenbach coined for his concept of the *Bildungstrieb*, *nisus formativus*, denotes a "struggle for formation": life, even at the lowest levels of existence, is a laborious pursuit.

Thus, for the scientific communities of both centuries, the discoveries of the polyp and the fractal respectively generated the need for a renewed evaluation of the language of nature. The agency of nature—its ability to *behave* in ways that may or may not respect the desires of human beings—is precisely what produces the language of fractals, polyps, and hydralike things. Because this unique language is required to explain how such forms fit within the framework of existing knowledge, it also captures the discomfort of human scientists who have been caught off guard by the agency of non-human, natural things.

2. The Analogical Surplus

Because natural languages precede technical and formal ones in characterizing the peculiarities of nature, analogies play a central role in defining fields of scientific and mathematical research. Comparing certain geometric forms with other wiggly, wriggly, and hydralike things is what made the investigation of *fractals* possible. Similarly, the history of the polyp is a series of organismic comparisons, the reflection on positive and negative analogies between the polyp and the octopus, the Hydra of Lerna, the elephant, and the human being, as well as the machine, the plant, the worm, and the serpent. These many parts of the history of the polyp as a symbol are what contribute to its meaning for scientific purposes—one must conceive of an animal in a particular way first in order to think of the types of experiments that can be conducted with it.

More strikingly, as this dissertation has shown, the meanings of natural objects may even come to encompass the metaphorical fringes of analogies that no longer operate within the scientific or cultural consciousness. That is, what has been termed the analogical surplus sometimes seems to stick to objects being compared—despite the fact that this particular semiotic space goes beyond what is strictly plausible from an analytical perspective. Even when the initial analogy breaks down or is contested, similarities asserted between very different kinds of things may persist as a kind of cultural residue. Thus, the intractable, polypoid features of the analogy may themselves take on a life of their own.

Hence, for example, the polyp continued to be perceived as in some way “marvelous” until the end of the eighteenth century. Its defining features contradicted the rules hitherto gleaned about the constitution of an animal—and yet, the “little monster” did seem to be an animal. Animality of this particular and novel mode gave perceptible form to the laws by which *all things* come into, maintain, and change their being. Thus, the polyp was a miracle, because it drew back the curtain not only on *a* law of nature, but *the* law of nature. In Spinoza’s terminology, it demonstrated the concept of *natura naturans* (“nature naturing”): the active expression of the infinite substance, God, in infinitely many modes of being, *natura naturata* (“nature natured”). In Blumenbach’s update to that language, the polyp demonstrated the principle of the *nisus formativus*, the *Bildungstrieb*—formative drive. Thus, in short, for eighteenth-century scientists, the polyp was a marvelous particularity that evidenced the miraculousness of the whole of nature.

What this history suggests is that organismic analogies capture information about natural objects and their study that formal languages cannot. Moreover, they reflect the meanings that scientific objects come to have beyond the laboratory. The organismic analogy “hydraulic

things” described for Mandelbrot and Trembley natural objects that behaved in unexpected ways. Thus, this particular organismic analogy proved useful in making sense of the agency of natural forms. The polyp came increasingly to represent fundamental truths not of natural but human processes. In the wake of Trembley’s discovery, German scientists invoked the polyp in descriptions of many aspects of the human world. Blumenbach cited the regenerative capacities of the polyp and the human being in order to demonstrate the existence of what he called the *Bildungstrieb*. Kiehmeyer compared the cultivation of the human mind with the flexible organism of the freshwater polyp. And Schiller cited the polyp as an example of the principle of freedom inherent in all organizations from the microscopic to the socio-political.

As shown in Chapter 3, the desire to sand down the edges of analogies, to ban the analogical surplus from the realm of scientific significance, can lead to a much drier sense of the frontiers of research. In pursuit of a coherent system, German Neoplatonists endeavored to naturalize the polyp, to denude it of its status as a natural miracle, and therefore its potential to induct new ways of viewing and interpreting nature into the world. Simultaneously, as shown in Chapter 4, embracing the analogical surplus may open up a new world of possibilities. The analogy of the polyp and human being, as outlandish as it already appeared to many in the eighteenth century, nevertheless became an emblem of the human being’s innate capacity to transform his own reality.

The respective semiotic histories of fractals and polyps reveal the reciprocal relationship between natural languages, on the one hand, and technical and formal languages on the other. Mandelbrot does not endeavor to replace the natural language employed to describe fractal-like natural forms. Rather, his contribution strengthens the existing semiotic network of hydralike things by adding to it the formal language to describe these bizarre forms of nature. The

neologism “fractal” identifies the category under which wiggly and hydra-like things fall.

Similarly, as discussed in Chapter 1, formalizing the language of natural history does not mean that the images and associations related to natural beings need be erased. Linnaeus’s goal was to create a perfect abstract system for the categorization and description of nature, but even he did not always prioritize the formal requirements of taxonomy over the descriptive power of the analogy.

Thus, both mathematics and taxonomy strive to create a system among the various objects that human observation has, through intuition, grouped together as analogous. The mathematics of the fractal, for example, cannot make sensible to the student of nature why these forms are so peculiar. Rather, as Mandelbrot does, it is necessary to have recourse to both the mathematical, philosophical, and aesthetic tradition in order to explain *why* it is so unprecedented that even these jagged shapes exhibit an underlying regularity. Similarly, the descriptive work of the natural historian, the textual record, the images of the animal, and the way in which the animal is represented in the image—all of that involves more, contributes more to the meaning of the animal that is necessary to understanding that natural thing, that cannot be captured by a purely technical record of the organism. The images and metaphors that stick to the analogies that scientists use necessarily enliven the concept of the animal, which is obviously indispensable when speaking of a living being.

3. Polyp-Humanism & the Fractal Social Imaginary

This dissertation began with a reading of Brockes’s sentimental poem “Die Ameise” and a question about human attention—or inattention—to “small things.” The purpose of starting the project this way was to frame the argument, now almost complete, as a kind of experiment in

cultivating precisely the gaze that is absent from Brockes' short piece. On one level, the object throughout has been organismic analogies between polyps and octopuses, monsters, elephants, serpents, worms, and human beings. On another, though, the dissertation has strived not to treat these analogies entirely fairly, but to privilege the lens of the polyp in particular as a way of becoming reacquainted with an otherwise quite familiar story: that is, the story of the development, at the end of the eighteenth century, of an ethos of gradual progress toward an ultimate telos of universal happiness.

There are many ways of telling that story, of course, and all would necessarily focus on different features of the historical narrative. The lens of the polyp has required a broad-scoped investigation of mythology, taxonomy, aesthetics, biology, microscopy, anthropology, theology, and literature. That is the prerogative of small things, after all: they may go wherever they please with relative ease. And in pursuing the trail of the polyp, one becomes reacquainted with a still-interconnected disciplinary landscape: in which the various fields of the arts and sciences are not merely contiguous, but in fact, continuous; that is, a disciplinary landscape that resembles the "Polypennatur" of antiquity more than the "Uhrwerk" of modernity.

At the time that Schiller made that distinction, the siloing of the disciplines was already underway, and therefore, also, the alienation of human beings from the rest of the natural world. Disenchanted science struggles to find meaning in its objects. It must abstract from the substrate of objective reality the analogies that muddy the water of "clear and distinct ideas." What is lost as a result of the process of alienation is thus precisely the miraculous sense that the human being is not a clever but solitary ape, but in fact, that deep continuities exist between the metaphysical, biological, even cultural and social realities of humans and other animals. In other words, one loses sight of the fractal nature of all life and culture and is left only with fracture.

This dissertation, in attempting to look closely at the figure of the polyp in eighteenth century science, philosophy, and literature, has sought to recover precisely that fractal sense of the continuities of being that run through all living things. In doing so, it has identified the body of polyp-writing from the late eighteenth century as an entity of its own, as worthy of engagement as the real and fictional polyps and human beings that produced it. That is, in the idiom of Douglas Hofstadter's theory of "the vortex of I," the dissertation has treated the "bigger" and "smaller souls" as aesthetic and ethical equals in at least one important sense: that all necessarily contributed, like Brookes' ants, to the garden of polyp-humanism.³²⁶

In a concrete sense, the view of eighteenth-century humanism through the lens of "bigger" and "smaller," yet nevertheless equal souls is intrinsic to the period, and to its orientation toward animals like the polyp. Goethe's belief that the study of the smallest individual units of the natural world is essential to the human being's understanding of his own life is well documented. Goethe's descriptions of Geoffroy read like summaries of the views on natural history that he had cultivated over the previous sixty-five years of his career. Geoffroy "[...] hegt das Ganze im inner Sinne und lebt in der Überzeugung fort: das Einzelne könne daraus nach und nach entwickelt werden."³²⁷ In other words, the engagement with the polyp-human analogy created a fractal "public" grounded in a notion of self-similarity across levels of generation.

To describe polyp-humanism as a public is to do something with Niklas Luhmann's theory of the public sphere that the sociologist admittedly never intended. Luhmann uses the term "second-order observation" to describe the structure of the public sphere as constituted by

³²⁶ Douglas R. Hofstadter, *I Am a Strange Loop* (New York: BasicBooks, 2007).

³²⁷ *MA*, 18.II:509.

an instance of collective reciprocal observation. The public sphere is composed of individual observers observing other individual observers who, it is presupposed, are also engaged in observing the initial observers themselves. For Luhmann, this concept of second-order observation describes the specifically simultaneous, reciprocal, and knowing observation that defines discourse in the public sphere.³²⁸

In polyp-humanism, the observation of the polyp, as the smallest unit of this system recognition, ultimately serves the perfection of the human social experiment as a whole. Observation of the polyp produces insights into the nature of the physical reality, the marble out of which an Enlightened society is to arise. When the human being contemplates the nature of polyp-*Bildung*, it takes part in a feedback loop between patterns in the biological and cultural structures of human and animal life, through which a self that is neither exclusively human nor animal but an amalgamation of both, emerges—a “big soul.”

The moment of marvel that occurs between the scientist and the polyp could be considered part of the emergence of a public. The polyp, and even more specifically the isometry of polyp and human biology becomes instrumental in the construction of a multispecies imaginary. This implies that the emergence of the public sphere around 1800, generally considered part of the ideological turn from theological to humanistic-philosophical orders of public knowledge, was connected in a much more direct sense to the emergence of the field of biology around 1800. This was the emergence of polyp-humanism.

Applied to the network of self- and mutually-observing entities that make up nature, the natural public is articulated as a system of stacked consciousness similar to what Goethe

³²⁸ Niklas Luhmann, *Soziale Systeme: Grundriss einer allgemeinen Theorie* (Frankfurt am Main: Suhrkamp, 1984).

describes in his lecture on “Chemische Farben,” though expanded to more than just the human individual: as each increasingly complex concrescence of Nature’s self-directed curiosity emerges and directs its attention toward its surroundings, collecting impulses about what smaller individuals mean for their own natural existence, they also serve quite the same purpose for greater, more complex natural observers, and all ultimately serve the ultimate goal of Nature herself.

Reconceptualizing late eighteenth-century humanism as an essentially *polypoid* *humanism* allows the contemporary reader to conceive of eighteenth-century philosophy not, or at least not exclusively, as the origin of instrumental reason and the extractive, murderous logic of capitalism, but rather as the birthplace of a history that has not yet taken place.

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