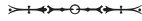


APPENDIX

THE GENETIC METHOD



Goethe was deeply interested in scientific method, realizing as he did that the answers one gets from inquiries into nature depend to a large extent on how one poses the questions. In his botanical work, he was of course concerned primarily with the “how” of vegetation and therefore investigated not only the diversity of physical forms but also the underlying unity from which they emerge. In a sketch of his distinctive approach to this type of investigation, written in the mid-1790s, he presents what he calls the “genetic method.” The term *genetic* here refers not to the science of genes, but rather to seeking the origin or genesis of things. He describes this method as follows:

If I look at the created object, inquire into its creation, and follow this process back as far as I can, I will find a series of steps. Since these are not actually seen together before me, I must visualize them in my memory so that they form a certain ideal whole.

At first I will tend to think in terms of steps, but nature leaves no gaps, and thus, in the end, I will have to see this progression of uninterrupted activity as a whole. I can do so by dissolving the particular without destroying the impression itself.¹

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Goethe believed that by practicing this method one could learn to consciously move back and forth between the region of relatively fixed and finished forms to the deeper realm of formative process. In the spirit of Spinoza, he was proposing that nature can be conceived in two ways—as creative power and as created product, or, in Spinoza’s terminology, as *Natura naturans* (“nature naturing”) and as *Natura naturata* (“nature natured”). And he worked to complement empiricism with imagination in order to see nature complete and unified as both creator and creation. As he suggests in his poem on the metamorphosis of plants, when faced with the daunting profusion of botanical forms, the way to uncover the simplicity of the “secret law” is to “gaze on them as they grow.”

How does the genetic method work in practice? While Goethe saw this method as applicable to the overall metamorphosis of a plant, it is easier to see in a subset of that larger process—the sequence of changing leaf forms sequentially displayed on the stems of many plants. The images included here show six such leaf sequences, depicted in the order in which the leaves appear together on the stem. Consider the leaves of *Sidalcea malviflora*. The four leaves represent steps in the metamorphic process. To descend via these diverse steps to the implicit wholeness at their source, one needs first to give close attention to the particular forms themselves. Beginning with the bottommost leaf on the right, we study its features intently—visually inspecting the rounded shape, the relative regularity of the scalloped edge, and the structure of the veins. Moving to the next leaf, on the left, we find the overall roundness somewhat modified by the appearance of small incisions that were only hinted at in the previous leaf. Proceeding on to the third and fourth leaves, we can see the formative process articulated more fully. The leaves become larger and less rounded, the incisions grow into definite divisions, but the original plan is still evident in the pattern of the veins. Thus there is a sameness in the midst of the differences.

Appendix

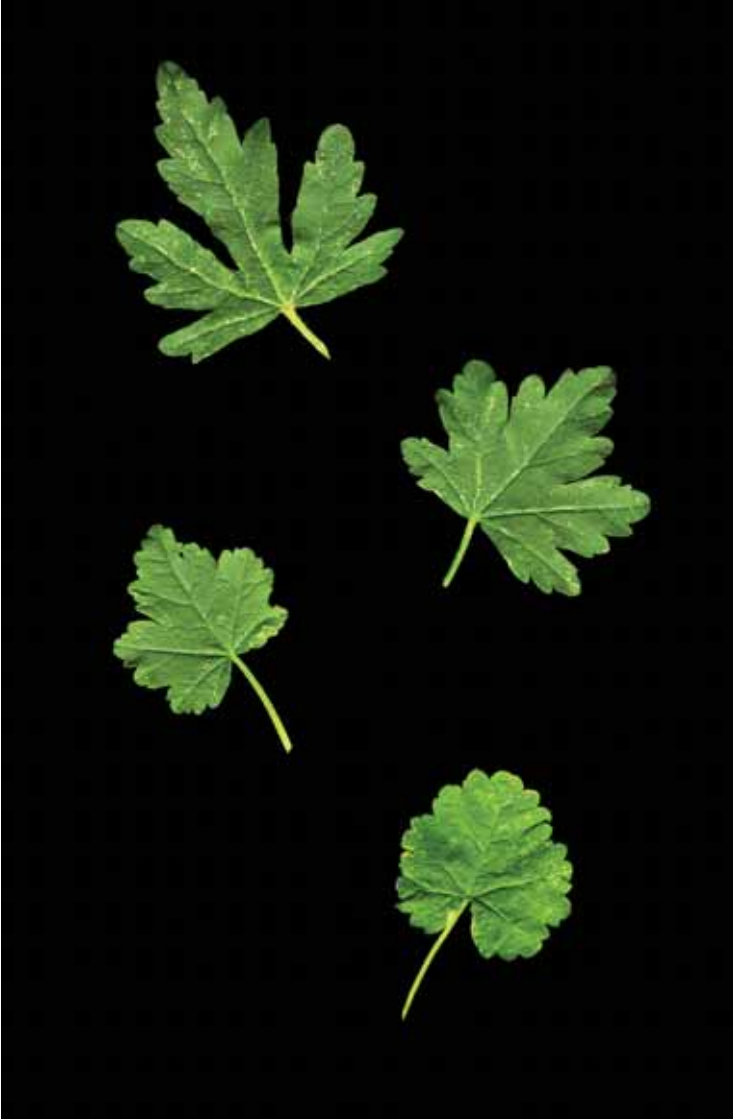


IMAGE 55: Leaf sequence in *Sidalcea malviflora*

Appendix

While in the case of *Sidalcea* we saw the leaf forms move from simple to complex, with *Delphinium astolat* the ascending movement is from complex to simple. We can nevertheless see evidence of the same formative principles working, though in different directions, in these two illustrations, as we can as well in the remaining four specimens.

Botanist Jochen Bockemühl has identified four basic movements in the spatial, archetypal dynamics of leaf formation—stemming, spreading, articulating, and shooting, as shown in figure 21. Together these movements constitute a logic of development in the metamorphosis of leaves, with the forces of intensification and polarity evident throughout.²

Looking past the leaf sequences depicted here to the overall metamorphosis of these plants, the vegetative leafy phase soon gives way to the reproductive, with varying degrees of contraction coming into play as the process moves from the stem leaves to the calyx and beyond.

The second part of the genetic method requires what Goethe called “exact sensory imagination.” We initially see the different leaves as discrete steps in a process, but since “nature leaves no gaps,” we need to consolidate these steps in order to apprehend nature’s continuous inner workings. Reviewing the sequence of leaves, we then attentively internalize these visual forms as memory images. With these forms firmly in mind, we move in imagination through the sequence, transforming the first into the second, the second into the third, and so on, following the process forward and backward, forward and backward, as nature has also done. We thus implicate each explicit form—each momentary pause in the process—with those before and after, like the flow of notes in a musical performance. By focusing on the relationship between the leaf forms, exact sensory imagination involves setting one’s mind in corresponding

Appendix



IMAGE 56: Leaf sequence in *Delphinium astolat*

Appendix

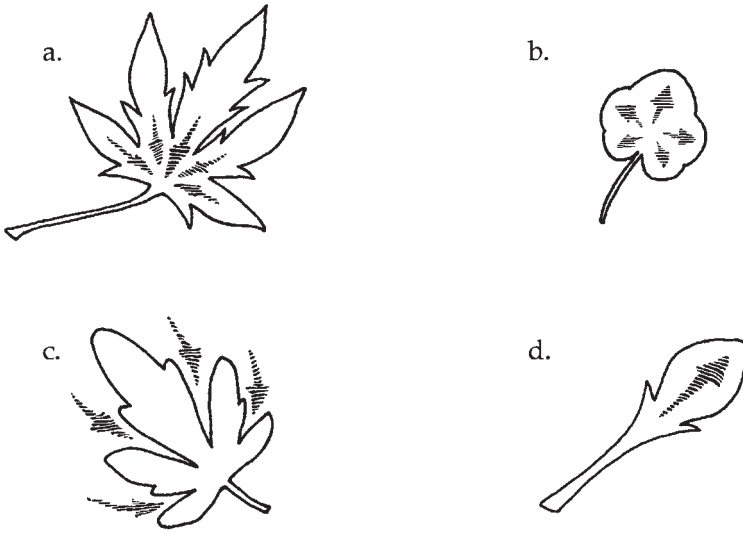


FIGURE 21: Dynamics of leaf formation (a) stemming, (b) spreading, (c) articulating, (d) shooting

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motion, so that the selfsame living idea that has expressed itself in the metamorphosis of the plant comes to life and visibility in the mind as well. What was successive in one's empirical experience then becomes simultaneous in the intuitively perceived idea—*Proteus in potentia*. Instead of an onlooking subject knowing an alien object, this is knowledge through participation, or even identification, of observer and observed—knowing things from the inside. As Goethe said, “our spirit stands in harmony with those simpler powers that lie deep within nature; and it is able to represent them to itself just as purely as the objects of the visible world are formed in a clear eye.”³

Goethe thought that moving from fixed forms to formative process—from parts to whole—requires shifting mental gears. He called the two cognitive faculties involved in this effort “understanding,” which is the rational thinking that is the common instrument of conventional science, and “reason,” the intuitive perception that sustains the poetic sensibility. Both of these mental modes play important roles in science and in life, but they do not provide equal access to the heart, or mind, of nature:

The Understanding will not reach her; man must be capable of elevating himself to the highest Reason, to come into contact with the Divinity, which manifests itself in the primitive phenomena (*Urphänomenen*), which dwells behind them, and from which they proceed.

The Divinity works in the living, not in the dead; in the becoming and changing, not in the become and the fixed. Therefore Reason, with its tendency toward the Divine, has only to do with the becoming, the living; but Understanding with the become, the already fixed, that it may make use of it.⁴

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The genetic method encompasses both understanding and reason, attempting to unite the two for their mutual benefit—joining science and poetry—and Goethe criticized the one-sided emphasis of contemporary science on understanding alone, which served to limit its inquiries to merely the material surfaces of the natural world. He derived these two terms from Immanuel Kant’s *Verstand* and *Vernunft* respectively. Kant, however, who influenced Goethe in many ways, felt that intuitive perception—*Vernunft*—was impossible to achieve. Goethe, on the other hand, boldly believed that “through an intuitive perception of eternally creative nature we may become worthy of participating spiritually in its creative processes.”⁵ The genetic method holds out the hope not only of revealing some deeper secrets of nature but also of releasing new powers of mind. Germany’s greatest post-scientist therefore, was fully aware, and unabashedly hopeful, that perceiving the essence of metamorphosis will likely involve a beneficial metamorphosis in the essence of the perceiver.

NOTES

1. Goethe, “Studies for a Physiology of Plants,” in *Scientific Studies*, edited and translated by Douglas Miller (New York: Suhrkamp, 1988), 75.
2. Jochen Bockemühl, “Transformations in the Foliage Leaves of Higher Plants,” in *Goethe’s Way of Science*, edited by David Seamon and Arthur Zajonc (Albany: SUNY Press, 1998), 115–128.
3. Goethe, quoted in Richards, *The Romantic Conception of Life*, (Chicago: University of Chicago Press, 2002), 377 n. 152.
4. Goethe, *Conversations with Eckermann* (San Francisco: North Point Press, 1984), 238 (13 Feb. 1829).
5. Goethe, “Judgement through Intuitive Perception,” in *Scientific Studies*, 31.

Appendix

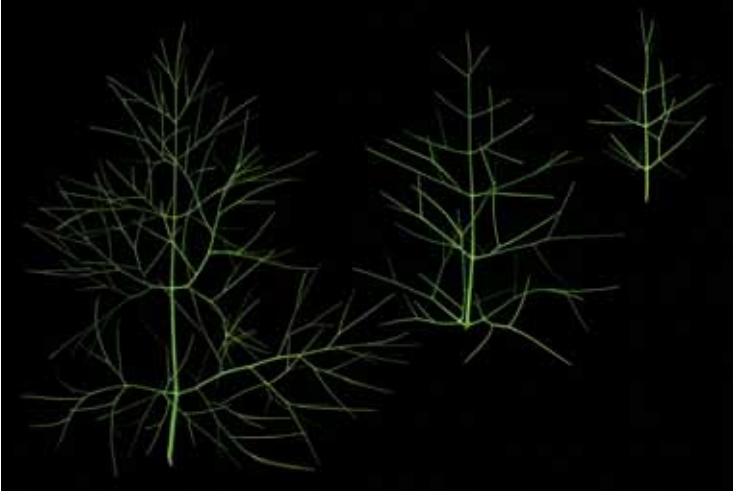


IMAGE 57: Ascending leaf structure in fennel (*Foeniculum vulgare*). This is one of the leaf sequences Goethe became fascinated with during his Italian journey.



IMAGE 58: Sequence of ascending leaf forms in wall lettuce (*Lactuca muralis*), from left to right.

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IMAGE 59: Ascending leaf sequence in *Scabiosa columbaria*

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IMAGE 60: Leaf sequence in creeping buttercup (*Ranunculus repens*)