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CHAD WELLMON

## Goethe's Morphology of Knowledge, or the Overgrowth of Nomenclature<sup>1</sup>

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**D**AS PUBLIKUM STUTZTE."<sup>2</sup> That was how Goethe described the reception of his *Versuch die Metamorphose der Pflanzen zu erklären* almost thirty years after its initial publication in 1790. How could a poet of such renown deviate "von seinem Wege" and devote so much time and energy to plants (*Morphologie* 752)? The reading public was astonished that Goethe had given more than passing attention to science, a completely alien field. But Goethe had not only ventured into the plant realm, he had wagered a sweeping theory about nature itself. Goethe the poet had pretences of becoming Goethe the scientist.

In the decades following the publication of his *Essay*, Goethe wrote an ever expanding apology for his work in natural science—"Der Verfasser teilt die Geschichte seiner Botanischen Studien mit"—in which he rebutted the fundamental assumption of what he considered to be a particularly modern ethos of knowledge:

[D]enn nach seinem [the public's] Wunsch sich gut und gleichförmig bedient zu sehen, verlangt es an jeden daß er in seinem Fache bleibe and dieses Ansinnen hat auch guten Grund: denn wer das Vortreffliche leisten will, welches nach allen Seiten hin unendlich ist, soll es nicht, wie Gott und die Natur wohl tun dürfen, auf mancherlei Wegen versuchen. Daher will man daß ein Talent das sich in einem gewissen Feld hervortrat, dessen Art und Weise allgemein anerkannt und beliebt ist, aus seinem Kreise sich nicht entfernte, oder wohl gar in einen weit abgelegenen hinüberspringe. Wagt es einer, so weiß man ihm keinen Dank, ja man gewährt ihm, wenn er auch recht macht, keinen besonderen Beifall.

(*Morphologie* 417)

Goethe's suggestion that two seemingly disparate fields of inquiry, natural science and poetry, could be related lay completely "außer dem Gesichtskreise der Zeit" (*Morphologie* 458). As scientists became increasingly conscious of the disciplines in which they worked, science was pluralized, and the sciences began to operate in their own closed-off circles. Modes of inquiry and ways of knowing isolated themselves into increasingly specialized spheres of knowledge.

For Goethe, the increasing specialization of knowledge was a distinctive feature of a modern age that had come to overestimate itself based on "der

großen Masse Stoffes, den sie umfasst.”<sup>3</sup> By breaking knowledge down into discrete fields, or what Goethe refers to as disciplines [*Fächer*], the modern age was able to accumulate, process and manage more information. The modern age’s aggregative ethos of knowledge, then, was facilitated by the specialization of knowledge. What Thomas Pfau refers to as modernity’s “accumulative mode of inquiry”—its aggregative tendency that Goethe points out here—is bound to that mode of methodical analysis as introduced by Bacon, Newton and Descartes.<sup>4</sup>

The modern age’s isolation both of various ways of knowing and of distinct modes of inquiry—its basic assumption that a poet cannot be a scientist—fails to take advantage of what Goethe considers a human ability not just to accumulate but to deal with and control such masses of material. The human being, he suggests, can supplement what has been sundered [*das Zerissene*] and connect what has become distant [*das Entfernte*] (*Morphologie* 571). In a modern age that fragments, isolates and obfuscates the relationship of all knowledge, Goethe encourages a reflection on how the production of new knowledge is inseparable from its organization and what Goethe terms its *Überlieferung*. He frames the modern age as the age of mediation. We must conceive of modernity as an archive [*Archiv*] of past ways of knowing (*FL* 516). But such an archive would facilitate not a specialized form of research intent on recovering overlooked materials that are in themselves significant (Pfau 951); instead, it would advance a mode of inquiry for undoing our own habitual modes of thought. A “Geschichte des Denkens und Begreifens” can extricate us from the assumptions that tether our normal modes of thought (*Morphologie* 786). For Goethe, the archive of modernity, or modernity as archive, figures not an accumulative notion of knowledge but an ethical one. It figures how individuals can relate their own modes of inquiry to historical forms of knowledge. According to this archival notion, knowledge is more than mere “discoveries and opinions” [*Entdeckungen und Meinungen*]. Knowledge is produced and organized “durch Menschen” (*Morphologie* 477). To know is not to accumulate facts and information but to relate human beings to other human beings, nature and knowledge itself. The analytical, specializing impulse of modernity, implies Goethe, did just the opposite.

For Goethe, eighteenth-century natural science and Linnaean taxonomy in particular exemplified the accumulative character of the modern knowledge ethos. Natural science managed the increasing consciousness of the variability of nature through increasingly complex taxonomic systems. While Linnaeus’s *Systema naturae* was not the first systematic attempt to organize the plant realm, its emphasis on efficiency belies its particularly modern impulse. In the following sections, I consider Goethe’s critique of this modern ethos of knowledge by focusing on his reformulation of Linnaean taxonomy. His broader critique of eighteenth-century botany involves a fundamental shift in what it meant to know a natural object and an expansion of the traditional interest in the variability of nature to an interest in the variability of the observation of nature. Goethe projects, as Lorraine Daston puts it, the variability of nature “inward.”<sup>5</sup> The sources of the variability and diversity of nature become—to use a post-Kantian idiom—subjective as well as objective. The experience of what Wolf Lepenies has referred to as the eighteenth

century's *Wissenszuwachs*, or the overabundance of knowledge shifts, from the pressure of too many things to too many thoughts about things.<sup>6</sup>

Frederick Amrine has demonstrated that Goethe's morphology project makes possible a metamorphosis of the scientist. Building upon this observation, I argue that Goethe's response to this eighteenth-century information overload extends beyond his morphology of plants to a morphology of knowledge itself.<sup>7</sup> A function of his broader critique of modernity's aggregative ethos, Goethe's morphology of knowledge,<sup>8</sup> like a morphology of plants, is interested less in cataloguing the totality of knowledge than in articulating the relationship of knowledge to its own production. In the first two sections that follow, I outline how Goethe's revision of Linnaean taxonomy began as a morphology of plants but became a much broader morphology of knowledge. In the third section, I consider the transcendental character of Goethe's project and the place of experience and experimentation within it. Finally, I suggest that Goethe's morphology of knowledge is ultimately an account of how scientists attend to particular objects and the history of knowledge itself—that is, a morphology of knowledge is an account of paying attention [*Aufmerksamkeit*] to both the object perceived and the perceiving subject.

### I. Order, from Taxonomy to Morphology

In "The Author Shares the History of His Botanical Studies,"<sup>9</sup> Goethe recounts his botanical *Bildung*, an education that paralleled the development of eighteenth-century botany as a discipline. As Goethe makes clear, to study plants in the late eighteenth century was to engage in Linnaean methods, practices and assumptions. The ubiquity of Linnaean practices throughout Europe and the world, via European sea travel, also ushered in the expansion of Linnaean conceptions of order well beyond the gardens of Uppsala. Goethe encountered both these conceptions of order and the practices through which they were cultivated in his numerous interactions with Linnaeus's German acolytes. A personal letter from Linnaeus to the Dietrich family, for example, transformed a family of herb collectors and apothecaries, into, as Goethe put it, botanical aristocracy (*Morphologie* 738). The young Friedrich Gottlieb Dietrich was regarded as something of a Linnaean Wunderkind, whose mastery of Linnaean taxonomy was manifest in a "glückliche[m] Gedächtnis" that stored the names of innumerable plants (even if, as Goethe notes, his intonation of the Latin was a bit off.) Goethe insisted that even though the dividing and counting that characterized Linnaean taxonomy did not come naturally to him, the names impressed themselves on his memory, like impressions on wax.

This botanical *ars memoria* constituted the broader discipline of botany as Goethe came to know it. While grounded in Linnaeus's taxonomic advances, its dominance as a method for ordering the plant realm was facilitated by the increasing availability of texts that literally contained the system. The popularity of the Linnaean system rested on both its efficient facilitation of the collection, description and naming of plants, and the dissemination of itself as a taxonomic system. The naming of plants—and not Linnaeus's more theoretical questions about the distinction between *natural* and *artificial* systems or the fixity of species—constituted Linnaean taxonomy for most in

the eighteenth century. Linnaean taxonomy was something you carried with you, a miniature grid that anyone could lay over nature.

It was also a method of alleviation. It reduced the pressure of the increasing number of plants that had only become visible to the scientific eye with the emergence of botany as a science. It was designed to make the objective variability of nature—the variety of plants—navigable. On his way to Italy in 1786 just after leaving the familiar plants of Germany, Goethe experiences his own botanical overload. He is quickly relieved, however, when he remembers that he had brought his *Linnaeus* with him: “Nun habe ich zwar meinen Linné bei mir und seine Terminologie wohl eingepägt.”<sup>10</sup> Taxonomy, order, was something you stuffed in your backpack.

In and around Weimar, Goethe encountered a range of Linnaean-era taxonomists. He refers to Hoffrat Büttner, who had brought his collection of plants from Göttingen to Jena, as a “lebendige Bibliothek” (*Morphologie* 740). Büttner could not only store but retrieve with remarkable speed and agility a range of information about his collection. For the most skilled of eighteenth-century botanists, order was more than just something you stuffed in your backpack—order was maintained in the mind. The botanical genius was the person, not necessarily a scientist, who had so internalized the system that he could immediately order a plant in its proper place in the system. Whatever their particular complaints with Linnaeus’s system, all of these Linnaean acolytes—from what we might today consider the yeoman collector to the professional scientist—managed the variability of nature by reducing it to something more manageable. Their work was characterized above by a drive to stabilize and make the flow of knowledge and information more efficient by delimitating categories. It was marked by a gradual but insistent separating and distinguishing of plants. Linnaean taxonomy responded to the perceived overabundance of plant specimen by refining its taxonomic categories.

Goethe infuses his account of eighteenth-century botany with comments about how the science organized knowledge. For Goethe, the “Krise” that botany as a discipline [*Fach*] found itself in at the time made this relationship of science and the organization of knowledge even more explicit (*Morphologie* 744). He writes that he was fortunate to have found the discipline in such a “crisis,” because at such moments the imbedded structures and assumptions of particular scientific disciplines become visible. Prefiguring Thomas Kuhn on scientific crises and Michel Foucault on similar events in the human sciences, Goethe saw that crises mark those situations where disciplinary assumptions are no longer taken for granted and advances in theory and method are most likely.<sup>11</sup>

In the 1770s and 1780s, Linnaean taxonomy was coming under increasing criticism from Comte de Buffon. Buffon argued that Linnaeus’s taxonomic tables were merely storage devices that subordinated the more foundational task of natural science—the study of the interrelation of natural forces and natural historical change—to the classification of nature according to taxonomic schemes.<sup>12</sup> Linnaeus simply catalogued nature. Goethe credits Jean-Jacques Rousseau, however, with not only having introduced him to the broader discipline of botany but having promised “a method less opposed to the senses” [*weniger den Sinnen entrückte Methode*] (*Morphologie* 742).<sup>13</sup>

Despite the “crisis” in botany, Goethe remained impressed by the “Umsicht” and “Wirksamkeit” of a taxonomic science that made interactions with nature more efficient (*Morphologie* 744). These systematic efficiencies were made possible through a complex cultivation and dissemination of particular practices. In gardens, botanical collections and academies in Uppsala and around Europe, would-be botanists were trained in Linnaean methods of observation, which made visible what had to be perceived in order to organize plants. The assumptions and methods of Linnaean nomenclature and taxonomy were cultivated and distributed as a particular way of actually doing science through communities of scientific practice.<sup>14</sup> In this sense, Linnaeus described the goal of taxonomy as enabling the “use” of a botanical system.<sup>15</sup>

While Goethe embraced this practice-oriented notion of accounting for scientific knowledge, he also suggests how such an orientation toward scientific work can result in a certain epistemic inertia. It can lead to the ossification of methodological and theoretical assumptions, hence the benefit of so-called disciplinary crises. From Goethe’s perspective, the crisis (I shall discuss the epistemological paradox of this claim about crisis below) of the discipline made it possible to question the Linnaean assumptions:

Ich hatte mich ihm und seiner Lehre mit völligem Zutrauen hingegeben; demungeachtet musste ich nach und nach empfinden, dass mich auf dem bezeichneten eingeschlagenen Wege manches, wo nicht irremachte, doch zurückhielt. (*Morphologie* 744)

In order to understand the guiding assumptions of Linnaean taxonomy, Goethe encourages his reader to imagine him, Goethe, as a young poet, who sought to form his words “unmittelbar an den jedesmaligen Gegenständen, um ihnen einigermaßen genugzutun” (*Morphologie* 744–45). With a barely concealed irony, Goethe highlights one of the fundamental aims of Linnaean taxonomy: a certain appropriateness or affinity of language with natural objects. The goal of the botanist was to craft his names and terms as though there were no distance, no space between language and nature. As we have already noted, this aspiration for affinity and immediacy was facilitated by a strict limitation of what could be seen or observed in the first place. The plant realm was always to be brought *ins Engere*. As Foucault puts it with respect to Linnaeus: “To observe . . . is to be content with seeing—with seeing a few things systematically.”<sup>16</sup>

The assumed affinity of language and natural objects, however, was also predicated upon a more fundamental assumption: all *genera* were natural—created by God—and thus fixed. Linnaeus writes that the botanist could learn “to read” features “inscribed” into plants—that is, the botanist could learn to read the language that God had inscribed into nature itself (*Genera* 566). The affinity between language and natural objects was grounded in the guarantee of a divine inscription. In his *Genera plantarum*, Linnaeus details his taxonomic method. He reduces plants to their organs of fructification, which he then describes according to four features: number, shape, situation (relative position of a part with respect to another part) and proportion (relative size of a part to other parts). Linnaeus’s taxonomy trains the

botanist to see only these four features of the reproductive organs, organs that were illustrated so famously in *Systema naturae* (1736). He insists that these organs and their features are “obvious” to all (*Genera* 569). To learn how to organize and, thus, to know plants was to learn how to see and then count them

Goethe goes on to describe how a Linnaean botanist would work:

Ein solcher sollte nun eine fertige Terminologie ins Gedächtnis aufnehmen, eine gewisse Anzahl Wörter und Beiwörter bereit haben, damit er, wenn ihm irgendeine Gestalt vorkäme, eine geschickte Auswahl treffend, sie zu charakteristischer Bezeichnung anzuwenden und zu ordnen wisse. (*Morphologie* 477)

The impulse of Linnaean taxonomy was to place particular specimen in an already articulated order. The particular natural object was subordinated to the typological system of order. Such a procedure, continues Goethe, always struck him as though one were building a mosaic, in which one completed piece is placed next to another, “um aus tausend Einzelheiten endlich den Schein eines Bildes hervorzubringen” (*Morphologie* 745). And it was the production of such an apparent unity that Goethe found “widerlich.”

Goethe, however, did not simply reject Linnaean taxonomy out of hand. In fact, as I have detailed, Goethe narrates a growing consciousness of botany as a discipline. Underlying his botanical *Bildung*, then, was an education in the organization and transmission of scientific knowledge. He never denied the accomplishments of Linnaean taxonomy and remained impressed by Linnaeus’s simplification of botanical nomenclature (binomial nomenclature replaced much more unwieldy polynomial and non-unified nomenclatures). Through words Linnaeus made plants’ external characteristics more familiar and, thus, the possibility of naming and orienting oneself in the variety of nature more efficient. If to know is to name, then Linnaean taxonomy and nomenclature facilitated the more efficient production and dissemination of knowledge.

As he narrates it, Goethe began to doubt not the practical efficiency of taxonomy but the affinity of language and natural objects that it assumed. The “Versatilität der Organe” or the “Wechselhafte der Pflanzengestalten,” he claimed, cast this affinity into doubt (*Morphologie* 747). How could the comparison of plants’ organs ground taxonomic distinctions if these very distinctions were themselves always changing? Linnaeus’s organization of scientific knowledge about plants was a function not only of a strict delineation of a plant’s organs but a freezing of them in time. The guiding images of Linnaean taxonomy are static charts illustrating reproductive organs that do not seem to change. To order plants was to analyze their apparently distinct and static parts: to compare petals, stamens, apexes, pistils, and fruits and, then, to classify them according to the four features discussed above. Once Goethe “discovered” [*entdeckte*], however, that over the course of a plant’s life stems gradually developed from roundish, to notched, then finally to pinnate [*gefiederte*] leaves that then contracted, grew smaller, grew small scales and then just disappeared, the limitations of Linnaean taxonomy became apparent. He could no longer distinguish between particular organs or draw a “Grenzlinie” at all (*Morphologie* 745).

Organizing the plant realm according to strict delineations between organs became increasingly difficult once the organs or parts themselves were perceived to be constantly changing and developing into one another. The once “stable” categories became increasingly “artificial.” The strict delineation of fixed genera—the task of Linnaean taxonomy—and the ordering of species under them became futile, a futility exacerbated by the separation and splitting up of different genera [*Geschlechter*] and the disappearance of entire classes even. For Goethe, once an observer begins to see the variability of plant forms, she can recognize the fluidity of taxonomic distinctions: “das Geschlecht kann sich zur Art, die Art zur Varietät, und diese wieder durch andere Bedingungen ins Unendliche sich verändern” (*Morphologie* 748). Just as plant organs vary so too do botanical categories that once seemed fixed.

Goethe’s narration of these moments of discovery is as central to his broader morphology as are the scientific insights that seem to follow. There is, claims Goethe, a “geheime Verwandtschaft” of parts by which certain external parts transform into different external parts. Such a “secret relation” would fundamentally challenge a Linnaean concept of order—it would undermine its methods of distinction. But the very claim of a “secret relationship” would also seem to obfuscate scientific knowledge by making it secret. Goethe often describes such decisive moments of insight as moments of unmediated, even violent, clarity: “Hier drang sich nun dem unmittelbaren Anschauen gewaltig auf” (*Morphologie* 746); other times he describes such insights as a “Gewahrwerden” (*Morphologie* 749). But these moments, however unmediated Goethe’s description of them might appear, are always carefully framed as historical—that is, Goethe always narrates them into the broader context of his botanical studies. He frames every moment of scientific discovery as part of a gradual *process*, as emerging out of a broader context of knowledge. Every insight has a story, a context, a narrative.

The repeated inter-textual references to his trip to Italy, for example, (where, he claims, in Sicily the “die ursprüngliche Identität” of all plant parts first occurred to him) are supplements to the narrative that he establishes in this essay (*Morphologie* 748). These moments of insight can only be narrated after the fact. Similarly, the crisis of botany can only be observed and identified as a significant moment—as a moment of decision between different possibilities—only after the moment has past. The crisis of botany only becomes such a moment of crisis through an act of narration, whereby Goethe ascribes the moment significance by outlining the different options that botany had at that moment. The declaration of crisis establishes its own conditions of possibility; it is a necessarily reflective act. For Goethe, his entry into a discipline in crisis was a distinct advantage. But from what perspective could Goethe, who was new to the discipline, recognize this crisis?<sup>17</sup>

In terms of the internal logic of eighteenth-century natural science, Goethe’s claims about the metamorphosis of plant organs were also a function of a distinct increase in specimens and information. “Neue Gegenstände in auffallender Mannigfaltigkeit” led to an infinite multiplication of taxonomic categories (*Morphologie* 746). The instability of these taxonomic categories challenged one of Linnaeus’s most basic assumptions, namely, that genera were the work of nature, i.e. they were *natural* categories. As James L. Larson



argues, the *naturalness* of Linnaean genera rested upon assumptions about the principle activity of plants, namely fructification. For Linnaeus, when the elements of this formative activity, the reproductive process, are analyzed and given form, they evidence the hand of God. The primary function of these “natural” elements of the system, then, was to safeguard the genus.<sup>18</sup> And because plant genera were assumed to be *natural*, their number was thought to be fixed. The taxonomist did not create genera; he merely read them out of nature: Linnaeus’s dictum captures this claim: “It is the genus that gives the characters, and not the characters that make the genus.” Higher categories like classes, in contrast, were considered to be artificial.<sup>19</sup> The influx of plant specimens into Europe, however, threatened the categorical stability of the genus. Linnaeus’s “apostles,” as he referred to them, collected over 5,900 plants and 4,378 animals.<sup>20</sup> The increase in species exerted enormous pressure on generic stability. This pressure was evident in the various editions of *Systema naturae*: the first edition had 549 species; the tenth edition had 4387; the eleventh had 5897 and the final edition had over 7000. As new species were discovered, not only were new genera established but old genera were sub-divided.<sup>21</sup> As Charles Godfrey puts it, Linnaeus faced the “first bioinformatics crisis: the problem of organizing information about the increasing number of species that were being discovered in the eighteenth century, and he developed solutions using the best technology available at the time.”<sup>22</sup>

Goethe’s morphology is, in a sense, a direct response to a taxonomy that had become increasingly self-referential. In the face of taxonomic instability, Linnaean taxonomy simply expanded and refined its already established categories. In Goethe’s morphology, however, we can observe a shift from a logic of class and category concepts based on particular features to one of relations of elements of plants over time. While Linnaeus had assumed that the task of taxonomy was theoretically finite, since the botanist had named the things that God had put on the earth, Goethe regards it as an infinite task. Morphology would not name natural objects but develop insight [*Einsicht*] into the relationship of their “Wesen und Wirken” and thus, perhaps, offer a concept of order more commensurate to a nature now seen to be dynamic and always changing:

Betrachten wir aber alle Gestalten, besonders die organischen, so finden wir, dass nirgend ein Bestehendes, nirgend ein Ruhendes, ein Abgeschlossenes vorkommt, sondern dass vielmehr alles in einer steten Bewegung schwanke. Daher unsere Sprache das Wort Bildung sowohl von dem Hervorgebrachten, als von dem Hervorgebrachtwerdenden gehörig genug zu brauchen pfllegt. (*Morphologie* 392)

For Goethe, *Bildung* corresponds to the manner in which nature changes in time. He advances his conception over against Linnaeus’s description of the natural world in an organizational chart. He rejects Linnaean taxonomy because it treats nature as if it were a static collection of species, a collection that could be captured in a single glance.

If Linnaeus framed his taxonomy as a method for dealing with the “many objects that the great Creator [had] placed before man,” then Goethe framed

his morphology as a method for dealing with how these objects developed and changed over time (*Genera*, 564). In this sense, Goethe refers to his morphology as the “lebendige Anschauen der Natur” wherein the observer herself would be just as “beweglich” as that which is observed (*Morphologie* 748). Through such a method, perception could be enlivened [*auf eine höhere Weise belebt werden*]. Goethe intimates a concept of order according to which not only the object of observation changes and moves but also the subject of observation. Both the observer and that which is observed changes, transforms and develops. Goethe’s claim that perception [*Anschauung*] itself could change or enlivened is based on the prior assumption that perception and understanding [*Verstand*] are always related.<sup>23</sup>

For Linnaeus and for the broader Linnaean tradition, nature manifested a divine order that was discrete and fixed; therefore, Linnaean taxonomy assumed an analogy between logical and natural forms. The concepts of order that under-girded eighteenth-century natural sciences mirrored the assumed order of nature: fixed, discrete and unchanging. Goethe did not necessarily challenge the assumption of analogy; instead, he challenged the character of the order assumed to undergird this analogy. As he points out, even during Linnaeus’s lifetime taxonomic categories were not stable: “man [hatte] manche Geschlechter in sich getrennt und zersplittert, ja sogar Klassen aufgehoben” (*Morphologie* 745). Given such taxonomic instabilities, it seemed that even the most “expert and acute” [*genialste, scharfsichtigste*] observer could not order nature (*Morphologie* 745). The dissolution, differentiation and subsequent proliferation of genera—the only *real* or *natural* Linnaean categories—exposed an apparent gap between the human being and nature.<sup>24</sup> The prior assumption of a static nature, then, combined with taxonomic instability had revealed a chasm between the human being and nature and made Goethe “doubtful” that these older concepts of order were adequate to a nature that he saw as increasingly dynamic.

Faced with such instabilities and apparent gaps, Linnaeus and his followers conducted themselves, writes Goethe, as “Gesetzgeber” more concerned about what should be than what is (*Morphologie* 413). Unconcerned with nature itself, they subordinated their scientific work to a cosmological task: to ascertain “wie so viele unbändige, von hausaus grenzlose Wesen zusammen einigermaßen bestehen können” (*Morphologie* 413). Linnaeus and his followers were interested in providing a universal and continuous grid for all of nature, a taxonomic mechanism into which all things could be fluidly placed. Linnaean taxonomy aimed to make it possible for a single observer to “look out upon and order” [*überschauen und ordnen*] everything (*Morphologie* 412). Goethe, in contrast, was interested less in such a commanding gaze—one is reminded of the encyclopedic gaze of Diderot and D’Alembert that was facilitated by a *map du monde*—and more in the “Erscheinungen des Wandels und Umwandels organischer Geschöpfe” (*Morphologie* 413).

For Goethe, then, the question about the unity of nature was not, in itself, wrong. It had just been poorly framed. It assumed that the order of nature was fixed or static. It assumed an external, fixed order bequeathed by a divine creator—an order simply to be articulated simply through a language that was ultimately inscribed in nature itself. The language of natural order was

a language of numbers (the number of organs). In contrast, Goethe emphasized the development of organs over space and time. For Goethe, then, Linnaean taxonomy suffered from a basic epistemological fallacy: it assumed that knowledge and order were a function of a strict distinction between observer and observed. It assumed a concept of order according to which the human being was simply tracing the edicts given by the divine lawgiver.

This point of distinction between a Linnaean botany and Goethe's morphology came down to what Goethe referred to, perhaps ironically, as a "naturgemäße Methode" (*Morphologie* 442).<sup>25</sup> The metamorphosis of a plant, however, could never be directly experienced, or experienced as serially as Goethe described it. His "true-to-nature method" was not just simple mimesis. It was, and Goethe was very conscious of this fact, highly technological, artificial even. It was a product of human labor or scientific practice. The development of natural organisms could be known not through some naïve notion of empirical proximity but only through highly stylized, deliberate and historically developed scientific practices. Goethe himself writes that his scientific knowledge was achieved not through a "momentane Inspiration, noch unvermutet und auf einmal" but a "folgerechtes Bemühen" (*Morphologie* 752). Linnaeus claimed that his method read off the divine order, but this reading, as we have seen, was a hard earned act, an act that would eventually reveal not a transcendent realm of forms but a reality that was simply imperceptible to the untrained eye. His method was itself "true-to-nature" but in a different sense. Linnaeus focused on certain features and ignored others that were deemed irrelevant by the botanist. Only thus could the true natural categories, genera be revealed. While Goethe also strove for a true-to-nature method, his object of study was not reducible to a single type as was Linnaeus's. Linnaeus reduced his ideal specimens not to actual plants but to illustrations. For Goethe, as Daston puts it, "the typical is rarely, if ever, embodied in a single individual" (Daston [n. 5] 69). The difference in the two methods, both in their own terms true-to-nature, was in what they sought to be true to: Linnaeus a static nature, Goethe a dynamic nature.

But what method could be appropriate to a nature now understood to be dynamic and always changing? Goethe formulates its imperative thus:

Daß mein Denken sich von den Gegenständen nicht sondere, daß die Elemente der Gegenstände, die Anschauungen in dasselbe eingehen und von ihm auf das innigste durchdrungen werden, daß mein Anschauen selbst ein Denken, mein Denken ein Anschauen sei. (*Morphologie*, 595)

For Goethe, a true-to-nature method would require that the observer's concepts become as dynamic as nature itself. If a scientist wishes to have a "lebendiges Anschauen der Natur," a perception that can develop and metamorphosize just like the natural objects that it observes, then it too must become "mobile and flexible" [*beweglich und bildsam*] (*Morphologie* 392). The observer's concepts must themselves become part of the same *natural* process of development and change. Like Linnaeus, Goethe refers to a nature, but one that is always in flux.

Goethe's morphology addresses precisely this imperative for dynamic concepts.<sup>26</sup> Two "demands" [*Forderungen*], he writes, arise in us when we

observe nature.<sup>27</sup> First, we must attain complete knowledge of the phenomena and second we must make them our own through reflection [*durch Nachdenken aneignen*].

Wenn wir einen Gegenstand in allen seinen Teilen übersehen, recht fassen und ihn im Geiste wieder hervorbringen können, so dürfen wir sagen, dass wir ihn im eigentlichen und im höhern Sinne anschauen. . . . Und so führt uns das Besondere immer zum Allgemeinen, das Allgemeine zum Besonderen. (*Naturlehre*, 142)

The first step—to grasp the object correctly—involves repeated observation of empirical phenomena through the serialization of particular observations. We become familiar with the object by placing singular observations side-by-side in a continuous series. When observing a plant, for example, the scientist must produce a series of observations about the life of the plant from its origins as a seed to flower. The goal here is to produce a continuous series of observations that can then be considered as constituting a whole.

The second step—to bring the object forth in the observer's mind—involves making the object our own [*aneignen*] and then re-producing it in our own mind. This is the imperative of morphology that seems so at-odds with traditionally conceived science. Förster suggests that we imagine that a scientist wants to draw a plant. First, she would draw a stalk, then add leaves to one then to the other side. Finally, she might draw flowers as though to bring the entire illustration together. The plant can only be illustrated part-by-part. The entire plant (the completed illustration) would be a product of an aggregative method of simply attaching parts. This is the aggregative method undergirding Linnaean taxonomy. Plants are known—named and classified—according to concepts that isolate individual organs. The problem with this method is that a plant grows in all of its parts at the same time. Its development is, in fact, not aggregative.

Neither a discursive rationality nor a sense-based empiricism can perceive organic development, because both see only particular points. Discursive thought tends to generalities at the cost of concrete particulars, while sense perception only sees the concrete particular and not the whole. In order to conceive of a plant's development, then, our own thinking must itself become “mobile and flexible.” The individual parts of a plant cannot simply be added to one another; instead, they must be perceived as they continuously develop in relationship to one another. We must observe the transition [*Übergang*] of one form to another. We must observe how certain outer parts develop into the form of neighboring parts. We must observe and learn how nature develops one part out of another. But since these transitions, these developments are not immediately visible, how can they be observed? As we noted above, they must be re-produced [*wieder hervorgebracht*] in the observer's own mind—that is, the observer must observe her own individual observations. In *The Metamorphosis of Plants*, where Goethe attempts to account for the steps of a plant's development, he gives, however, not a list of disconnected observations but a second-order account—the observation of his own attempts to observe the growth of a plant. In order to account for the eventual flowering of the plant, he relates every individual observation

to another. Because the observer cannot observe the transitions from form to form, he must think them by observing his own cognitive reproduction of the various steps of an organ's development, otherwise, each step will remain isolated. The observer must engage in a reflective thinking of the plant's development; he can only think development by reflecting on his own discursive thought process.

Because all of a plant's parts stand in a "necessary relationship," this process must happen with all parts at once (*Morphologie* 155). The observer cannot merely think of the whole or individual parts but must think the development of the parts as a whole all at once. As Förster puts it: "Der Gedanke eines gleichzeitigen Ganzen von Teilen und der einer Abfolge von Veränderungen der Teile muss ein einzelner, selbst lebendiger Gedanke werden" (Förster [n. 26] 185). Discursive and intuitive thinking must be united. The *Typus*, or the universal form that guides this process, then, is not a taxonomic category but a *Bild* that emerges and reemerges from the interaction of experience and ideas: "Die Erfahrung muß uns vorerst die Teile lehren. . . . Die Idee muß über dem Ganzen walten und auf eine genetische Weise das allgemeine Bild abziehen" (*Morphologie* 230). The observer must think the developmental processes that remain imperceptible to the untrained eye. And she can only do that by reflecting on her own processes of observation. As Amrine points out, Goethe summarizes this 'method' elsewhere in the context of his color theory: it moves from "mere looking" [*das bloße Anblicken*] to "observation" [*Beobachten*] to "reflection" [*Sinnen*] to "connecting" [*Vernüpfen*]. Each step, however, must be accompanied by "consciousness, self-knowledge, freedom . . . with irony" [*Bewußtsein, Selbstkenntnis, Freiheit . . . mit Ironie*] (Amrine 205; *FL* 14). The cognitive miming of natural processes is achieved through constant reflection, through irony.

## II. Goethe's Morphology of Knowledge

For Goethe, morphology would account for the consistent but unpredictable emergence of new organic forms and shapes of organisms. By admitting the possibility of anomalous forms of unity and order, conceptions of order beyond Linnaean taxonomy, it could account for what Goethe referred to as nature's "infinitely free exercise of life" [*Lebenstätigkeit*] (*Morphologie* 413). Goethe, however, did not limit this *Lebenstätigkeit* to natural objects. In fact, he insists that his morphology

ruht auf der Überzeugung dass alles was sei sich auch andeuten und zeigen müsse. Von den ersten physischen und chemischen Elementen an, bis zur geistigen Äußerung des Menschen lassen wir diesen Grundsatz gelten. Wir wenden uns gleich zu dem was Gestalt hat. (*Morphologie* 349)

Morphology's objects of study are not just natural things like plants but the mental manifestations and expressions of the human being as well. Goethe extends the claims of morphology—the claims of metamorphosis—to both natural and mental objects. Morphology would account for the increasing differentiation not only of plants, but also of knowledge itself. The variability of nature is projected inward through the extension of morphological claims

to mental expressions. The sources of variability and change become, to use a more contemporary idiom, subjective as well as objective. The question that Goethe makes possible is thus: to what extent are the formal and systemic attempts to understand the differentiation of nature analogous with the self-differentiation of sciences and knowledge systems? To what extent can Goethe's interest in a law [*Gesetz*] that might account for the *Bildung und Umbildung* of natural forms be understood as a question about the *Bildung* and *Umbildung* of disciplines and sciences, of *Wissenschaft* itself? Goethe claims that like the natural objects that it organizes, scientific knowledge changes and expands. It too manifests a fundamental dynamism. Just as nature is constantly generating new forms so too does *Wissenschaft* generate new forms.

Goethe's implied expansion of morphology from natural organisms to scientific knowledge is a direct challenge to a modern ethos of knowledge that, as he put it above, isolates and splits, fragments and specializes. Goethe reconfigures the entire conception of how scientific knowledge changes: knowledge does not simply expand in an aggregative manner to more and ever divergent domains (through the discovery of new species or the opening of new domains of knowledge through the expansion into new disciplines). Goethe's fundamental suggestion is that knowledge always develops in relation to itself. The expansion of knowledge is now characterized not as accumulation or progress but as an organic change over time. Scientific knowledge must now account for the variability not only of an objective nature but of subjective claims about nature. Modern age scientific knowledge is characterized not by too many objects of knowledge but by too many ways of thinking, too many theories, too many concepts, by competing epistemological claims. Goethe's response to this surfeit of knowledge is to relate them through a morphology of knowledge. Instead of categorizing the variability of scientific knowledge according to identical elements, he proposes, just as he did with plants, to serialize them according to similarities.

Understood in this light, then, the limitations of Linnaean taxonomy, from Goethe's perspective, are not that such a system cannot expand (think of the explosion in genera and species) but that it cannot grow in a *natural* way—that is, its patterns of growth are aggregative not organic. It is not so much that Linnaeus's nomenclature was not true-to-nature but that his system was designed to account for a nature that does not change. Under Goethe's more dynamic view of nature and scientific knowledge itself, Linnaean taxonomic methods and categories cannot account for the development of natural objects, scientific categories and order itself. Goethe's conception of order, as Dorothea von Mücke puts it, would achieve more than simply adding “bits and pieces to an already existing and growing catalog of all the different varieties in nature in a cumulative fashion.”<sup>28</sup> It would, rather, exhibit the very principles of organic change that he perceived in nature.

The inverse of Goethe's interest in the laws of metamorphosis—in the laws of change and development—is an interest in the production, dissemination and ethics of scientific knowledge. As Goethe writes in his *Materialien zur Geschichte der Farbenlehre*, with the “rush” [*Zudrang*] of an infinite number of objects the questions concerning the metamorphosis of natural

objects and their organization becomes almost indistinguishable (*FL* 973). The pressure of things, the overabundance of natural objects is a function of the pressures and instabilities of knowledge structures. For Linnaeus, the plenitude of the natural world required a stable and stabilizing taxonomy that would always confirm the stability of a natural world. For Goethe, the plenitude and dynamism of nature required a science that—like the objects that it studied—would change, transform and itself develop.

In the sense that morphology concerns the development of natural objects and science itself, Goethe considers metamorphosis “*der Schlüssel zu allen Zeichen der Natur*” (*Morphologie* 349). These signs, however, were not the fixed signs of the *Buch der Natur*; the logos of God impressed upon nature that organized Linnaeus taxonomy. Morphology is the key to a cadre of ever-changing signs. In two incomplete sets of notes, Goethe enumerates a range of these different sciences and their relationship to morphology: natural history [*Naturgeschichte*] (knowledge of natural objects according to their *Habitus*); *Naturlehre* (knowledge of forces); anatomy (knowledge of natural objects according to their inner and outer parts without a consideration of the living whole); chemistry; zoology; psychology; morphology; and finally, physiology (*Morphologie* 363–64). Morphology is, first of all, a study of form in both the parts and the whole, including how forms deviate from and correspond to one another. As a supplemental science [*Hilfswissenschaft*] to physiology, however, it is the study of the organic whole through the “power of the mind.” It rests [*ruht*] on *Naturgeschichte* but also on anatomy and, especially, zoology. It conceives of itself as subordinate to physiology along with all the other supplemental sciences.

As a new science, then, morphology does not have a different object. Like all these other sciences, its object, broadly speaking, is life. Its scientific particularity, however,—what makes it distinct from other sciences—is its view [*Ansicht*] and method. The possibility of morphology as a particular science rests on the continued recognition and delineation of distinctions between it and all other sciences. This disciplinary distinction, however, is also a function of what it borrows from other sciences. From chemistry, for example, it learns how different organs process the same materials differently—that is, this borrowing is not effaced or forgotten once the new science emerges (*Morphologie* 361). Morphology

muss sich als eine besondere Wissenschaft erst legitimieren, indem sie das, was bei anderen gelegentlich und zufällig abgehandelt ist, zu ihrem Hauptgegenstande macht, indem sie das, was dort zerstreut ist, sammelt, und einen neuen Standort feststellt, woraus die natürlichen Dinge sich mit Leichtigkeit und Bequemlichkeit betrachten lassen. Sie hat den grossen Vorteil dass sie aus Elementen besteht, die allgemein anerkannt sind dass sie mit keiner Lehre im Widerstreite steht, dass sie nichts wegzuräumen braucht um sich Platz zu verschaffen. . . . (*Morphologie* 369)

Morphology organizes itself as a particular science not by creating new objects of study but by operating at the borders and re-organizing the limits of already existing sciences. This borrowing and inter-action between sciences is science itself.

### III. Morphology, a Transcendental Science?

As I noted at the beginning of this essay, for Goethe, the modern age overestimates itself because of the “great mass of material” that it encompasses. Modernity has reduced knowledge to the aggregation, accumulation and management of so much stuff, be it plants, concepts, observations or knowledge in general. Goethe’s morphology, then, might just be the quintessential science of another modernity, a modernity that could overcome the fragmentation of modern science. Only a science of change can account for the development of scientific forms and scientific order: the sciences, writes Goethe, “haben sich bewunderswürdig erweitert, aber keinesweges in einem stetigen Gange, auch nicht einmal stufenweise, sondern durch Auf- und Absteigen, durch Vor- und Rückwärtswandeln in grader Linie, oder in der Spirale” (*FL* 623). Goethe figures the movement of the sciences through the exact metaphor that he uses to describe the development of organisms: the spiral. The object of morphology is not just the development or *Bildung* of natural objects but science itself. The spiral tendency functions as a filter for knowledge itself by making knowledge comprehensible [*fajßlich*] (*Morphologie* 780). Morphology blurs the distinction between objects of knowledge and the processes of knowledge. Morphology is not merely a science of natural things but a science of science.<sup>29</sup> Does this mean that Goethe’s morphology is ultimately a transcendental science in the Kantian sense? Though this may seem to be the case, there is an important distinction.

For Kant, transcendental philosophy considers the conditions of possibility of knowledge prior to experience. A transcendental philosophy “guards against error” and “reins in reason” by showing that all experience or representation of an object is fundamentally governed by self-legislated rules. Experience, for Kant, is a product of reason. For Goethe, however, reason, in part at least, is a function of experience. Goethe’s morphology, as a science of science, may have a transcendental import but it draws its critical force from a very different notion of experience. Goethe’s transcendental science, unlike Kant’s transcendental philosophy, is—however complex this relationship might appear in a post-Kantian world—bound up with experience.

“There is no doubt,” writes Kant in the introduction to the *Kritik der reinen Vernunft*, that “all our cognition begins with experience” [*alle unsere Erkenntnis mit der Erfahrung anfangt, daran ist gar kein Zweifel*] (B1).<sup>30</sup> Demonstrating his philosophical distance from a Humean skepticism, Kant continues and claims that even if knowledge begins with experience it does not originate from experience.<sup>31</sup> Like Hume, Kant was suspicious of the unchecked use of a priori ideas. Unlike Hume, however, and in an effort to mollify Hume’s radical skepticism, Kant argued that a priori principles underlay our experience:

Denn es könnte wohl sein, daß selbst unsere Erfahrungserkenntnis ein Zusammengesetztes aus dem sei, was wir durch Eindrücke empfangen, und dem, aus unser eigenes Erkenntnisvermögen (durch sinnliche Eindrücke bloß veranlaßt) aus sich selbst hergibt. (B1)



It was, of course, in the same *Kritik* that Kant undertook the task of disentangling the sensible, experiential elements of cognition from the a priori elements and considering the possibility of cognitions prior to experience, or what he called pure cognitions. Kant set out to articulate the a priori principles that ground experience. In this sense, then, key elements of cognitive experience are necessary and universal (Jay [n. 31] 70–71).

While Goethe never explicitly offers what I have referred to above as a concept of experience, he does address Kant's underlying assumptions, namely the former's claim that the "cognition of every, at least human, understanding is a cognition through concepts, not intuitive but discursive" (A68/B93). There is, assumes Kant, only a discursive reason, a reason that operates through concepts. As Goethe asks, however, has Kant not "limited" us to a "reflective, discursive power of judgment" [*reflektierende, discursive Urteilskraft*] (*Morphologie*, 447)? Might there not be another reason, a non-discursive reason? The distinctions between a Kantian and, if there is such a thing, Goethean notion of experience can be more easily discerned from Goethe's fictive dialogue "Der Sammler und die Seinigen":

- Ich: Zu jeder Erfahrung gehört ein Organ  
 Gast: Wohl ein besonderes?  
 I: kein besonderes, aber eine gewisse Eigenschaft muß es haben  
 G: Und die ware?  
 I: Es muß produzieren können.  
 G: Was produzieren?  
 I: Die Erfahrung! Es gibt keine Erfahrung, die nicht produziert, hervorgebracht, erschaffen wird.<sup>32</sup>

For Kant, cognitive experience is undergirded by necessary and universal a priori principals. It cannot be "created" or "produced" in the sense that Goethe suggests here.

We can better understand Goethe's claim that experience is produced [*produziert*] if we consider the connection between experience and experiment that he outlines in "Der Versuch als Vermittler zwischen Objekt und Subjekt" where he writes of an experience of a "higher kind." In this essay, Goethe initially uses *Erfahrung* to denote a particular, unique (perhaps even immediate) impression based on sense data but then expands it to denote an experience with temporal duration. He does this by tying the concept of experience directly to the experiment. He writes of experiment as a form of experience.

His first use of *Erfahrung* comes early in the essay:

Daß die Erfahrung, wie in allem was der Mensch unternimmt, so auch in der Naturlehre, von der ich gegenwärtig vorzüglich spreche, den größten Einfluß habe und haben sollte, wird niemand leugnen, so wenig als man den Seelenkräften, in welchen diese Erfahrungen aufgefaßt, zusammengenommen, geordnet und ausgebildet werden, ihre hohe und gleichsam schöpferisch unabhängige Kraft absprechen wird. Allein diese Erfahrungen zu machen und wie sie zu nutzen, wie unsere Kräfte auszubilden und zu brauchen, das kann weder so allgemein bekannt noch anerkannt sein. (*Naturlehre* 28)

Douglas Miller's translation of *Erfahrung* and *diese Erfahrungen* as "empirical evidence,"<sup>35</sup> while conceivable is indicative of how easily Goethe's expansion of the term can be concealed or overlooked. Experience as the singular *Erfahrung* in the first sentence is a collective noun denoting plural experiences or *Erfahrungen*. Here, *Erfahrungen* denote empirical data that are collected and ordered only after they are perceived. A few paragraphs later, Goethe confirms this meaning when he writes of "each individual experience" [*jede einzelne Erfahrung*]. Experience is a singular, empirical data point; Goethe even uses *Data* as a synonym for "an individual experience" [*eine einzelne Erfahrung*] at one point in the essay (*Naturlehre* 32). When a scientist repeats [*wiederholt*] *Erfahrungen* or reproduces *Phänomene*, Goethe calls them "an experiment" [*ein Versuch*] (*Naturlehre* 29). An experiment is a collection of singular distinct *Erfahrungen*. An experiment gains its "worth" [*Wert*], however, only in combination with other experiments—that is, only through "continued repetition" [*öftere Wiederholung*] can an experiment, itself a collection of singular *Erfahrungen*, prove anything (*Naturlehre* 31). The error [*Fehler*] of so much scientific work, insists Goethe, is the tendency to connect distinct *Erfahrungen* or experiments "without mediation" [*unmittelbar*] (*Naturlehre* 33), to make connections through the power of judgment [*Urteilsthraft*] alone. The use of an experiment must be "mediated" [*mittelbar*].

The only way for a scientist to establish connections between seemingly isolated *Erfahrungen* or phenomena is through the "Vermannigfaltigung eines jeden einzelnen Versuches." The scientist must work "indefatigably" through the manifold permutations and forms of a particular experiment (*Naturlehre* 35). The scientist must first conduct a series [*Reihe*] of experiments and, second, serialize them, i.e. consider them as one continuous and complete series of experiments. Studied in this manner—a method that I laid out above as the first step in the practice of morphology—these serialized experiments can represent "einen Versuch, nur eine Erfahrung" (*Naturlehre* 34). The serialization and subsequent reflection on singular experiments and *Erfahrungen*, writes Goethe, produces an "Erfahrung von einer höhern Art." In this sense, an experience is produced and not simply given, as is Kant's cognitive experience, through universal and necessary principles. Goethe compares the meticulous care [*Bedächtlichkeit*] required to connect so many singular things in a continuous series to that of a mathematician, who exposes and recapitulates every step of a mathematical proof that is already present in its entirety. So too must a scientist proceed in his work towards an experience of a higher kind.

Goethe has shifted from a discussion of *Erfahrungen* as singular data points to a discussion of *Erfahrung* as a form of temporal duration. Experience of the latter sort is built on relations between singular experiences over time. For Goethe, nature is only knowable through the work of experience, but this experience is not a naïve sensationalism. It is a hard won experience over time. "Wenn man also fragt wie ist Idee und Erfahrung am besten zu verbinden? So würde ich antworten: praktisch!" (*Morphologie* 713)—through a technology of experimentation (a set of historically determined but never fully articulated set of practices). The question of what

nature *is*, in a metaphysical sense, does not seem to interest Goethe. His view of nature is like his view of scientific knowledge: both are fundamentally temporal phenomena, phenomena that are defined in terms of repeated and repeatable encounters.

What Goethe does share with Kant is a conception of experience, or for Goethe experiment, that is not only spatial but temporal. For both Kant and Goethe, experience (cognitive experience for Kant and experience of a higher kind for Goethe) is tied to temporal duration. In this sense, Goethe's true-to-nature method is motivated less by a traditional correspondence model of truth and more by a relational model, a model according to which experience involves discerning regularities and relationships in apparently random sense data over time. Goethe, however, rejects Kant's claim that such experience can only be guaranteed by necessary and universal principles particular to cognitive experience. Goethe's morphological method can, as Förster notes, be discursively accounted for but not discursively reproduced (Förster [n. 26] 334). The major difference between Kant and Goethe's notion of experience is that Goethe insists that concepts, that thinking itself, be made more agile [*beweglicher*]. Concepts and experience should develop in accord with the development of natural objects.

Goethe's revised notion of the experiment points to his broader contention that science always involves the history of science. To experiment is to work through and with the history of a particular experiment, to work through the ways other scientists and groups of scientists have explored "alle Seiten und Modifikationen einer einzigen Erfahrung" (*Naturlehre* 35). To do science is, as Goethe says in reference to the experiment, to "follow every experiment through its variation" [*Vermannigfaltigung eines jeden einzelnen Versuches*]. Repeated over time an experiment becomes a qualitatively different type of experience. It becomes a framework for considering the relationship of scientific practices over time. Goethe has redefined experience and experiment as a practice through which individual scientists engage each other, established scientific knowledge, and, ultimately, nature itself. Accordingly, scientific knowledge is not the articulation of doctrines and isolated facts but the reflective practice of doing scientific work.<sup>34</sup>

It is in this sense that Goethe says that the human being is the "greatest and most exact scientific instrument that there is."<sup>35</sup> Science is a practice that is always tied to the individual scientist. The greatest "failure" [*Unheil*] of modern science is that it has separated the experiment from the human being; its methods and instruments are "artificial" [*künstliche*] because they are radically a-historical (*Naturlehre* 29). They are designed and conducted without a context of practice. Artificial experiments are those that tie scientific knowledge to a reason without a history, without a context. Like nature, science is a complex web of relationships and joints and not simply question of the "accumulation of brute facts" by individual isolated scientists (Amrine 193). Scientific knowledge emerges out of relationships and historical contexts. As Dorothea von Mücke puts it, it is a function of "how the environment at a given time happens to interact" with knowledge.<sup>36</sup>

The interaction of scientific knowledge with its contemporary and historical contexts, however, is haunted:

Leider besteht der ganze Hintergrund der Geschichte der Wissenschaft bis auf den heutigen Tag aus lauter solchen beweglichen, in einander fließenden und sich doch nicht vereinigenden Gespenstern, die den Blick dergestalt verwirren, dass man die hervortretenden, wahrhaft würdigen Gestalt kaum recht scharf ins Auge fassen kann. (FL 616)

Contemporary sciences are always haunted by the specters of past practices that cannot be fully reconciled with the contingent forms of scientific practice, which remain, even for the reflective, historical scientist, “out of focus” [*unscharf*]. They can never be fully articulated. Their assumptions, claims and ramifications will remain to a certain degree blurred, because contemporary scientific knowledge and practice is always an admixture of past practices. The construction of the history of a science is never complete.<sup>37</sup>

Goethe gives the clearest statement of the spectral nature of scientific knowledge in his “Materialien zur Geschichte der Farbenlehre.” The development of scientific knowledge grows not in a steady forward movement, a linear progression, but rather through an “Auf- und Absteigen” or a “Vor- und Rückwärtswandeln,” a movement, as noted above, that Goethe figures as a spiral. Knowledge is a repetition of the same but different. As Goethe writes elsewhere, the shape of this development insures that science will ultimately repeat “all true insights and all mistakes” [*alle wahren Ansichten und alle Irrtümer*] (*Morphologie* 475). Because the monuments of previous times, the documents of this history are “revered like gods, literally accepted” [*göttlich verehrt, buchstäblich aufgenommen*], paradigms of science become embedded and opaque. The history of scientific knowledge is a spectral past of methods, hypotheses, theories, confusions, controversies and “changes in opinion” [*Meinungswechsel*] (FL 622). Past methods are never truly absent but never fully present. They hover between a scientific present and past.

Goethe uses the same spectral language to describe the difficulty he has in accounting for his own scientific insights. Describing his encounter with the *Urpflanze* in Palermo, he writes:

Heute früh ging ich mit dem festen, ruhigen Vorsatz meine dichterischen Träume fortzusetzen nach dem öffentlichen Garten, allein, ehe ich mich versah, erhaschte mich ein anderes Gespenst, das mir schon diese Tage nachgeschlichen. . . . Im Angesicht so vielerlei neuen und erneuten Gebildes fiel mir die alte Grille wieder ein, ob ich nicht unter dieser Schar die Urpflanze entdecken könnte? (*Reise* 285–86)

Once again, he can only narrate these insights after he can account for their place in the broader narrative.

Goethe ties the spectral character of scientific knowledge to a transmission [*Überlieferung*] of knowledge that is never fully transparent: “Man soll sich, heißt es, nicht an das Wort halten, sondern an den Geist halten. Gewöhnlich aber vernichtet der Geist das Wort oder verwandelt es doch dergestalt, daß ihm von seiner frühern Art und Bedeutung wenig übrigbleibt” (FL 50). The transmission of scientific knowledge weighs like a “burden” [*Last*] on the individual scientist who stands in constant “struggle” [*Kämpfe*] with this process of transmission. This conflict of the individual between the

“unmediated experience” [*unmittelbaren Erfahrung*] of empirical observation and the “mediated transmission” [*mittelbaren Überlieferung*] of science as a historical practice constitutes science. And the individual scientist is the middle point of these two epistemic demands: the apparent immediacy of empirical observation and the historical conditions of every observation. Scientific work in the present is always burdened by past scientific work that is “piled up” [*aufgebäufte Vergangene*]. Scientific knowledge is produced not “through mere experience” [*durch bloße Erfahrung*] (FL 621) but through a constant confrontation with the “authority” [*Autorität*] of past theories, methods, controversies and assumptions. Scientific work that reflects on its own past, then, promises the type of “higher experience” that Goethe describes in his metamorphosis of plants. Only an “able individual who should collect, sort, edit and unify everything” [*tüchtigeres Individuum, das alles sammeln, sondern, redigieren, und vereinigen soll*] can produce scientific knowledge in the modern age (FL 615).

While the paradox inherent to Goethe’s scientific project—the paradox of a system that would be both static and dynamic, particular and universal—is not resolved by such a scientific practice, his morphology of knowledge changes the very terms of what it means to know. Such a project assumes that over time the distance between subject and object, scientist and nature will be reduced through the practice of experimentation, a practice that, as we have seen, involves not only particular work with particular experiments but the history of experimentation and thus the history of science itself. If we read Goethe’s science of science as transcendental in the strictly Kantian sense, then the subject-object divide would remain intact because such a transcendental philosophy assumes thought to be built upon two fundamentally distinct faculties: cognition through concepts and sensible intuitions, i.e. spontaneity of thinking versus the receptivity of sensible intuitions.

For Kant, the object of transcendental philosophy is human cognition itself and not the objects in nature. But, for Goethe, thinking is not reducible to cognition through concepts. There is another form of thought, a non-discursive form of thought through which the processes of cognition and the objects of cognition are brought forever closer in the practices of scientific knowledge. The work of science, as embodied in these practices, never ends. A natural process that we attempt to cognize as both simultaneous and sequential will always seem to plunge us into madness [*uns in eine Art Wahnsinn zu versetzen*] (*Morphologie* 449). The apparent chasm between experience and idea cannot be theoretically resolved without driving us mad. Theoretically speaking—that is, as an epistemological project—Goethe’s morphology of scientific knowledge is impossible. As a practical problem, however, these dichotomies (idea-experience, subject-object) can be addressed through the practice of scientific work. There is more, however.

Goethe also considers his morphology “eine höchst ehrwürdige, aber zugleich höchst gefährliche Gabe von oben. Sie führt ins Formlose; zerstört das Wissen, löst es auf. Sie ist gleich der vis centrifuga” (*Morphologie* 582). When understood as making claims not only about plants but knowledge as such, the broader imperative of morphology—by accounting for changing forms of knowledge—risks undoing established doctrine and institutionalized

scientific knowledge; it always threatens the apparent solidity and stability of knowledge, especially the stability of modernity's specialization and fragmentation of knowledge. Goethe is acutely aware of the consequences of tying scientific knowledge so closely to history—that is, he is aware of the theoretical and practical consequences of such a radical historization of science. Hence, it must always be practiced with irony and humility, with a knowledge of its own place in the history of science. “Die Geschichte der Wissenschaft sei die Wissenschaft selbst” (FL 13).

#### IV. Narrating Scientific Knowledge

In conclusion, we return to Goethe's history of his own studies in botany, where he brings his reflections on scientific knowledge to bear on shifting conceptions of taxonomic order. While his *Materialien zur Geschichte der Farbenlehre* provided a history of color theory through the practices and work of other scientists, his autobiographical history of his own botanical studies focuses on the reflective context of his own botanical discoveries and insights. In particular, his account emphasizes the importance of “attention” [*Aufmerksamkeit*] in the history of scientific knowledge. Goethe's history of his studies is just that, a history not of the particular facts or objects of knowledge but of his encounters with the practice of science, of how he attended not only to particular objects but to particular, historical claims and assumptions. It is an account of paying attention.

Goethe writes that in order to gauge how scientific knowledge developed, one must first determine:

Wer zuerst einem Gegenstand seine Aufmerksamkeit zugewendet, wie er sich dabei benommen, wo und zu welcher Zeit man zuerst gewisse Erscheinungen in Betracht gezogen, dergestalt daß von Gedanke zu Gedanken neue Ansichten sich hervorgetan, welche durch Anwendung allgemein bestätigt endlich die Epoche bezeichnen, worin wir das was wir eine Entdeckung, eine Erfindung nennen unbezweifelt zu Tage gekommen. (*Morphologie* 732)

The history of science is ultimately an account of attending to an object, of “wie die Phänomene nach und nach bekannt geworden” (FL 17). It is an account of an appearance, of how an object first appeared to an observer and a reflection on the development of the thoughts that ensue. The scientist attends to phenomena and the process of reflection from which they are inextricable by serializing his or her own thoughts. And it is this development—from appearance to idea and still more ideas—that Goethe suggests mimes organic forms' natural processes of development. Throughout his account of his studies, Goethe places various and seemingly unrelated thoughts, insights and claims into a relationship by placing them side-by-side. He narrates them. He establishes a relationship between seemingly distinct events by establishing a broader narrative frame. It is through this narrative frame that a reader can witness the moment when a discovery “comes to light.”

It is on the level of serialization and narration of perceptions and thoughts that Goethe's morphology of plants becomes a morphology of knowledge. Above I noted that the transition of one plant part to another can only be

observed if they are re-produced [*wieder hervorgebracht*] in the observer's own mind. This reflective process is precisely the one that Goethe employs in writing the history of his own studies. By narrating the individual steps and insights, Goethe gives a second order account of his scientific work, an account that narrates and, thus, relates the individual moments to a broader whole. However, instead of relating individual parts to an entire plant, Goethe relates individual thoughts or observations to a broader scientific history.

Goethe's repeated revisions of his text, then, are reflections on his own observations, i.e. attempts to relate distinct parts to a unified history of knowledge. His revisions highlight when, how and under what conditions he was "excited" [*erregt*] or "awakened" [*erwechte*], when he recognized [*erkennen*] another object, or when an object "drew his entire attention" [*zog meine ganze Aufmerksamkeit auf*] (*Morphologie* 747). Such moments of attention can only be brought into a causal relationship through narration after the fact. As such, narrative replaces discursive forms of thought as the ordering method best suited to deal with complex types of information. Goethe moves from a class or category based notion of order to one based on a serialized similarity through narrative.<sup>38</sup> The systematic identity or place of an object is determined not by its characteristics but from its relationship to other objects as established in the broader narrative of the system.

Goethe, however, also recognized the limits of this narrative miming of natural phenomena. It remains incomplete. Goethe concludes his essay conceding this fact:

Da es aber im Verfolg wissenschaftlichen Bestrebens, gleich schädlich ist, ausschließlich der Erfahrung als unbedingt der Idee zu gehorchen, so habe ich für meine Schuldigkeit gehalten das Ereignis, wie es mir begegnet, historisch treu, obgleich nicht in aller Ausführlichkeit, ersten Forschern darzulegen. (*Morphologie* 752)

The complexity of this event—the "event" of his entire botanical studies—will always exceed his narrative efforts. The "event" of Goethe's botanical insights and learning exceeds its own narrative, regardless of how many times he revises his essay, because he will never be able to fully narrate his insights and moments of attention. And since Goethe assumes an analogy between the processes of knowledge and those of nature, he extends this failure to the narration of nature itself. However analogous these processes might be, something always remains unknown. Nature exceeds our ability to theorize or narrate it. Thus, as Goethe writes elsewhere: "In natural science a categorical imperative is as necessary as in morals"—that is, we must replace Kant's moral "act as if" with "perceive nature as if."<sup>39</sup> We must observe nature *as if* there were no distinction between our experience of nature and our idea of it. What Kant demands for the moral realm, Goethe demands for the intellectual realm. Through the perception of an always productive nature, we might make ourselves worthy of an "intellectual participation in its productions" [*zur geistigen Teilnahme an ihren Produktionen*] (*Morphologie* 448). We can also re-read Goethe's response to the fragmented and specialized nature of modern knowledge into the provisional space of the *as if*. We can only study

nature and knowledge *as if* they were whole. Goethe the poet can work *as* Goethe the scientist.

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## NOTES

1. I would like to thank Fred Amrine for his contributions to this essay and his reading of an earlier draft. Special thanks go to Ben Bennett for his careful reading and all those relentless conversations in the hall.

2. *Schriften zur Morphologie*, ed. Dorothea Kuhn, vol. 24, *Sämtliche Werke: Briefe, Tagebücher und Gespräche* (Frankfurt am Main: Deutscher Klassiker Verlag, 1987) 417. Hereafter, all references to this volume will be indicated by *Morphologie*.

3. Johann Wolfgang Goethe, *Zur Farbenlehre*, ed. Manfred Wenzel vol. 23, *Sämtliche Werke: Briefe, Tagebücher und Gespräche* (Frankfurt am Main: Deutscher Klassiker Verlag, 1985) 614. Hereafter, cited as *FL*.

4. Thomas Pfau "The Philosophy of Shipwreck: Gnosticism, Skepticism, and Coleridge's Catastrophic Modernity." *MLN* 122 (2007): 955.

5. See Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007) 191–251.

6. See Wolf Lepenies, *Das Ende der Naturgeschichte* (Baden-Baden: Suhrkamp, 1978) 16–28.

7. Frederick Amrine, "The Metamorphosis of the Scientist," *Goethe Yearbook* 5 (1990): 187–212.

8. I borrow the phrase "morphology of knowledge" from Jonas Maatsch, *Naturgeschichte der Philosopheme* (Heidelberg: Universitätsverlag, 2008).

9. This essay was published in 1831 and was a revised version of his earlier "Geschichte meines botanischen Studiums" and "Entstehen des Aufsatzes über Metamorphose der Pflanzen," both of which appeared in the 1817 *Zur Morphologie*.

10. *Italienische Reise*, ed. Christoph Michel and Hans-Georg Dewitz, vol. 15, *Sämtliche Werke: Briefe, Tagebücher und Gespräche* (Frankfurt am Main: Deutscher Klassiker Verlag, 1993) 22.

11. See Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: U of Chicago P, 1996) 66–91. In terms of the so-called human sciences, Michel Foucault focuses *The Order of Things* (New York: Vintage Books, 1990) precisely on these moments of crisis and "immature sciences" in general as exemplifying an in-between stage.

12. For more on Buffon's criticisms, see Jacques Roger, *The Life Sciences in Eighteenth-Century French Thought*, trans. Robert Ellrich (Palo Alto: Stanford UP, 1997) 426–29.

13. See, for example, the seventh walk of Rousseau's *Reveries of the Solitary Walker* or his *Lettres élémentaires sur la Botanique* (Paris 1782).

14. See, for example, the account of how Linnaeus trained and sent his own students around the world to collect specimen and distribute his system in Wilfrid Blunt and Thomas Stern, *Linnaeus: The Complete Naturalist* (London: Frances Lincoln, 2004) 189–201.

15. Carl Linnaeus, "A Translation of Carl Linnaeus's introduction to *Genera plantarum* (1737)," trans. Staffan Müller-Wille and Karen Reeds, *Studies in History and*



*Philosophy of Biological and Biomedical Science* 38 (2007): 563–72, 570. Hereafter, cited as *Genera*.

16. Foucault, *The Order of Things*, 134.

17. As Frederick Amrine points out in a more contemporary idiom, this is precisely the problem with Kuhn's conceptualization of scientific paradigms. It is "just these revolutionary, 'extra-paradigmatic' moments about which Kuhn has nothing to say." Amrine, "Metamorphosis of the Scientist," 189.

18. James L. Larson, *Reason and Experience: The Representation of Natural Order* (Berkeley: U of California P, 1971) 73 and 87.

19. Ernst Mayr, *The Growth of Biological Thought* (Cambridge: Harvard UP, 1985) 175.

20. Muller-Wille, S. "Linnaeus's herbarium cabinetia: A Piece of Furniture and Its Function," *Endeavour* 30:60–64.

21. Ernst Mayr, *Systematics and the Origin of Species* (New York: Columbia UP 1982) 286.

22. Quoted in Marta Paterlini, "There Shall be Order: The Legacy of Linnaeus in the Age of Molecular Biology," *Science and Society* 8.9 (2007): 814–17.

23. Elsewhere Goethe makes clear that this was always his assumption. In *Einwirkung der neueren Philosophie*, he writes that the distinctions of Kant's transcendental philosophy—distinctions between mind-body and sensible-intelligible—had never really occurred to him: "ich hatte beide niemals gesondert" (*Morphologie* 443).

24. In an earlier version of this essay, Goethe writes that the observer "couldn't agree with nature" (*Morphologie* 412).

25. For more on the history of this concept, see Daston, *Objectivity*, 58–59.

26. The following discussion follows Eckhart Förster's "Die Bedeutung von 76, 77 der Kritik der Urteilskraft," *Zeitschrift für philosophische Forschung* 56 (2002): 169–90.

27. Johann Wolfgang Goethe, *Schriften zur Allgemeinen Naturlehre, Geologie und Mineralogie*, ed. Wolf von Engelhardt und Manfred, vol. 25, *Sämtliche Werke. Briefe, Tagebücher und Gespräche* Wenzel (Frankfurt am Main: Deutscher Klassiker Verlag, 1989) 142. Hereafter, cited as *Naturlehre*.

28. Dorothea von Mücke, "Goethe's Metamorphosis: Changing Forms in Nature, the Life Sciences, and Authorship," *Representations* 95 (2006): 27–52, here 40.

29. Here and in the sections that follow, I am following Amrine's insight that for Goethe the "ultimate aim of science is nothing other than the metamorphosis of the scientist" and extending it to the metamorphosis of knowledge itself. See Amrine (n. 7) 194.

30. All Kant citations are taken from the Akademie Ausgabe (Kants Gesammelte Schriften, ed. Königliche Preußische [later Deutsche] Akademie der Wissenschaften [Berlin: Walter de Gruyter, 1902-]) According to the convention of Kant scholarship, however, I refer to the pagination of the revised 1787 edition of KrV with a B and to that of the first edition with an A.

31. Martin Jay, *Songs of Experience: Modern American and European Variations on a Universal Theme* (Berkeley: U of California P, 2005) 70–71.

32. FA 18:676–738; Quoted in Amrine (n. 7) 206.

33. See "The Experiment as Mediator Between Object and Subject," in *Johann Wolfgang von Goethe: Scientific Studies*, trans. Douglas Miller (New York: Suhrkamp, 1988) 11.

34. I follow Amrine (n. 7) here, when he writes that “the freedom of the scientist rests upon the scientist remaining self-critical at every stage,” 224.
35. Letter from Goethe to Zelter on June 6, 1808. *Briefe, Tagebücher und Gespräche vom 10. Mai 1805 bis 6. Juni 1816*, ed. Rose Unterberger, vol. 6 (Frankfurt am Main: Deutscher Klassiker Verlag, 1993) 329.
36. Dorothea von Mücke, “Goethe’s Metamorphosis,” 40.
37. Goethe also puts it this way: “Wie man tappend hin und wieder schwankt, indem man sich das Wissen zueignen will, wie man in der Wissenschaft das hinterste fürs Vorderste das Unterste fürs Oberste zu nehmen geneigt ist . . .” (*FL*, 4).
38. When Wolf Lepenies (n. 6) writes more generally of an eighteenth-century *Verzeitlichung komplexer Informationsbestände* that opposed the more spatially-oriented methods of Linnaeus, he could just as well be describing Goethe’s morphology as a narrative project (18).
39. I owe this formulation and idea to Benjamin Bennett, *Beyond Theory* (Ithaca: Cornell UP, 1993) 39.