



NATURALNESS IN THE MAKING: NATURALIZING NATURALNESS IN PLANT MORPHOLOGY

AUSTRALASIAN ASSOCIATION OF PHILOSOPHY
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Catherine Kendig



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WHAT IS NATURALNESS?

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natural

ADJECTIVE & ADVERB

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ADJECTIVE

I. Existing in, determined by, conforming to, or based on...

I.1. Existing or present by nature; inherent in the very...

I.2. Consistent with nature; normal, expected.

I.3. Having a real or physical existence.

I.4. † Based upon innate moral feeling; instinctively or...

I.5. Based on nature or the intrinsic properties of a thing.

I.6. Not unusual, exceptional, irregular, or miraculous...

I.7. Formed by nature; not subject to human intervention, not...

I.8. Scottish. Having innate abilities and gifts. Obsolete. rare.

I.9. Theology. Of a person: spiritually unenlightened...

I.10. Of thought, behaviour, or expression: having the ease or...

I.11. Unaltered, not enhanced.

ADJECTIVE

I. Existing in, determined by, conforming to, or based on nature.

I.1. Existing or present by nature; inherent in the very constitution of a person or thing; innate; not acquired or assumed.

Show quotations

“ Cite Historical thesaurus

I.2. Consistent with nature; normal, expected.

I.2.a. Ordinary; conforming to a usual or normal character (or †constitution).

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I.2.b. Of an emotion, reaction, event, etc.: naturally arising or resulting from, fully consonant with, or appropriate to the circumstances; predictable, understandable.

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I.2.c. Being such by the nature of things or force of circumstances; inevitably or obviously such.

Show quotations

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I.2.d. Normally or essentially connected with, relating to, or belonging to a person or thing; consonant with or inherent or proper to the nature or character of the person or thing.

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c1425-

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c1485-

5 Synthetic kinds

Kind-making in synthetic biology

Catherine Kendig and Bryan A. Bartley

Introduction

Synthetic biology may be defined broadly as the application of engineering principles to the design, construction, and analysis of biological systems.¹ The perspective that living systems can be engineered is made possible by modern biotechnologies like DNA sequencing, DNA synthesis, and genetic modification. For example, biological functions such as metabolism may now be genetically reengineered or reprogramed to produce new chemical compounds. Designing, modifying, and manufacturing new biomolecular ways draws upon analogies from engineering such as oscillators, and digital logic gates. These engineering models are then used to understand, rewrite, and build logical networks and modules. But is that all that the descriptive catalogue of bricolage and plug-and-play of the discipline? Do these descriptions impact science? Might these parts descriptions inform us of what we are? Attempting to answer these questions requires these biological parts as well as what role descriptions of them as the same sort of thing as and different from. Standard biological parts with known functions are repositories (Ham et al., 2012; Madsen et al., 2012). These can be selected from the catalogue and assembled to construct a system or pathway in a chassis microorganism. These parts repositories serve as a common resource to obtain physical samples of DNA associated with a function. Perhaps the best example of a biological parts repository is the Registry of Standard Biological Parts (regenerativebiology.org) significantly because it serves as a collaborative effort in the International Genetically Engineered Machine (iGEM) competition. In 2008, the Registry has grown from approximately 100 parts as determined by a recent programmatic search of the literature into collections, some labeled with engineering terms (e.g., promoter, repressor) and some labeled with biological terms (e.g., protein, enzyme).

14 Metaphysical Presuppositions about Species Stability Problematic and Unavoidable

Catherine Kendig

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Y STABILITY?

Species as stable cohesive units presupposes what the Biological Species Concept (BSC) presupposes – the nature of this stability, or unity. The claim that they are stable cohesive units suggests that there is a mechanism of stability or some underlying relationship or substance that maintains the stability of the species. As such, this means that accurate attributions of stability ultimately depend on accurate metaphysical presuppositions, which are

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Can the Epistemic Value of Natural Kinds Be Explained Independently of Their Metaphysics? Catherine Kendig and John Grey

ABSTRACT

The account of natural kinds as stable property clusters is premised on the possibility of separating the epistemic value of natural kinds from their underlying metaphysics. On that account, (i) the co-instantiation of any sub-cluster of the properties associated with a given natural kind raises the probability of the co-instantiation of the rest, and (ii) this clustering of property instantiation is invariant under all relevant counterfactual perturbations. We argue that it is not possible to evaluate the stability of a cluster of properties without taking stock of the metaphysical picture used to account for that stability. Thus, even on the stable property cluster account, the epistemic value of natural kinds remains partly grounded in their metaphysical status.

- 1 Introduction
- 2 Cliquish Stability and Natural Kindness
- 3 Errors about Cliquish Stability: Three Cases
 - 3.1 Race and IQ
 - 3.2 Lichen symbionts
 - 3.3 Man o' war as jellyfish
- 4 Epistemic Value and Metaphysical Presuppositions
- 5 Conclusion

1 Introduction

In a recent but already influential article, Slater ([2015]) suggests that we shift the investigation of natural kinds away from inquiry into the metaphysics that underwrite such kinds. Instead, he proposes to examine those features of natural kinds that make legitimate their use in scientific inquiry. To this end, he develops an account of natural kindness, which is 'a kind of status things can have that partially underpins their role in our inferential practices'

Activities of *kinding* in scientific practice

Catherine Kendig

It seems obvious that the sciences do not simply produce piles of unrelated bits of knowledge, but it is much less obvious *how* they provide us with explanations, and how these explanations yield understanding about the processes, causes, and contents of the natural world. Perhaps the sciences explain by classifying the contents of the world into natural categories of being or what might be called 'natural kinds'. Knowing what kind something is would then greatly inform us about what other information we can infer about it, for example knowing what natural kind it belongs to means that we know what inferences we can make about it and what

to it as a member of that kind. Discussions over whether or not it is a member of that kind, what is the nature of their existence, and whether natural kinds aim to characterize not only the kinds of things but also what knowledge of these categories can provide. Historically critical, much of the past discussions of natural kinds have considered these questions in a way that is unresponsive to, or dismissive of, the empirical use of natural kinds and what natural kinds are. 'Natural kinds' and 'natural kinding practices'.¹ The natural sciences are those entities, events, mechanisms, processes, and properties that delimit investigation within it – but we might also ask: where these natural kinds discovered? How are they made? Are they discovered here do they come from? A turn to natural kinding practices opens up questions open for investigation: How do natural kinds shape practice? What are natural kinding practices and classifications? What is the nature of natural kinds viewed as a set of practices? What practice approaches to natural kinds shape and reconfigure

This volume answer these questions using empirically informed approaches to natural kinds. They investigate natural kinds using empirical approaches to explore the nature of kindhood and the activities of natural kinds, chemical classification, neuroscience, gene and protein science, theory in applied mathematics, homology in comparative biology, memory research, race, extended cognition, symplectic information science. Rather than offering a reductionist or generalist approaches to the nature of kindhood, this



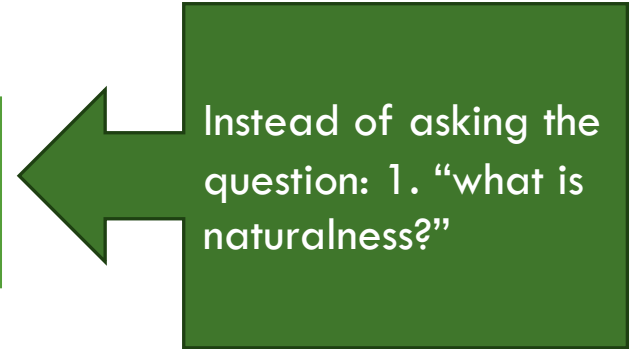
ONTOLOGICAL V. COGNITIVE CONCEPTIONS OF NATURALNESS

Ontological naturalness: for some entity, process, or classification to be natural is a property of the way the world is structured or partitioned – a world structure that excludes the influence of human scientific activity or the influence of their epistemic aims.

- “in so far as natural classification is grounded on real kinds, its groups are certainly not conventional; it is perfectly true that they do not depend upon an arbitrary choice of the naturalist” (Mill 1843: 720).

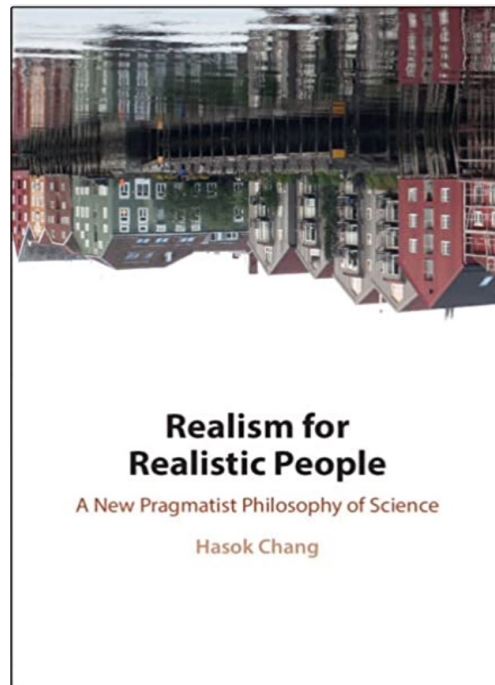
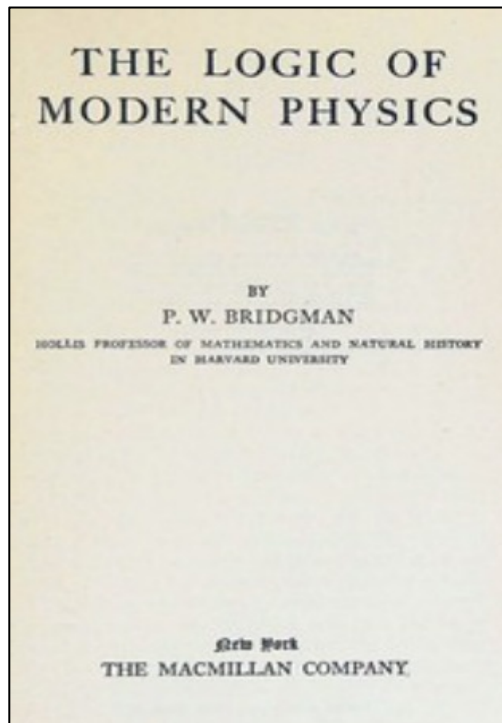
Cognitive naturalness: the naturalness of some entity, process, or classification is determined by the mode of investigation or aims of the investigator. On the cognitive account of naturalness, the property of naturalness, the existence of natural kinds, and the identification of natural partitionings are framed by the aims and purposes to which their naturalness is attributed. To be natural is to correspond to the way the investigator takes the world to be structured according to their presumptions and partitionings of it.

1A. HOW DO WE DISTINGUISH BETWEEN ONTOLOGICAL DIMENSIONS OF NATURALNESS AND COGNITIVE DIMENSIONS OF NATURALNESS?



Instead of asking the
question: 1. “what is
naturalness?”

HOW MIGHT WE UNCOVER CONCEPTUAL COMMITMENTS?



Activities of *kinding* in scientific practice

Catherine Kendig

It seems obvious that the sciences do not simply produce piles of unrelated bits of knowledge, but it is much less obvious *how* they provide us with explanations, and how these explanations yield understanding about the processes, causes, and contents of the natural world. Perhaps the sciences explain by classifying the contents of the world into natural categories of being or what might be called 'natural kinds'. Knowing what kind something is would then greatly inform us about what other information we can infer about it, for example knowing what natural kind it belongs to means that we know what inferences we can make about it and what generalizations apply to it as a member of that kind. Discussions over whether these natural kinds exist, what is the nature of their existence, and whether natural kinds are themselves natural kinds aim to characterize not only the kinds of things that exist in the world but also what knowledge of these categories can provide.

Although philosophically critical, much of the past discussions of natural kinds have often answered these questions in a way that is unresponsive to, or has actively avoided, discussions of the empirical use of natural kinds and what I dub 'activities of natural kinding' and 'natural kinding practices'.¹ The natural kinds of a particular discipline are those entities, events, mechanisms, processes, relationships, and concepts that delimit investigation within it – but we might reasonably ask, How are these natural kinds discovered? How are they made? Are they revisable? And Where do they come from? A turn to natural kinding practices reveals a new set of questions open for investigation: How do natural kinds explain through practice? What are natural kinding practices and classifications and why should we care? What is the nature of natural kinds viewed as a set of activities? and How do practice approaches to natural kinds shape and reconfigure scientific disciplines?²

Contributors to this volume answer these questions using empirically informed evidence-based approaches to natural kinds. They investigate natural kinds using practice-based approaches to explore the nature of kindhood and the activities of kinding within linguistics, chemical classification, neuroscience, gene and protein classification, colour theory in applied mathematics, homology in comparative biology, sex and identity theory, memory research, race, extended cognition, symbolic algebra, and geographic information science. Rather than offering a recapitulation of traditional or generalist approaches to the nature of kindhood, this

OPERATIONALIZING THROUGH COHERENT ACTIVITIES

“all concepts... should be treated as being synonymous with the corresponding set of operations [that are used in its detection]” (Bridgman 1927:5)

“Operational coherence consists in aim-oriented coordination. A coherent activity is one that is well designed for the achievement of its aim, even though it cannot be expected to be successful in each and every instance...it consists in doing what makes sense to do in specific situations of purposive action” (Chang 2022: 40).

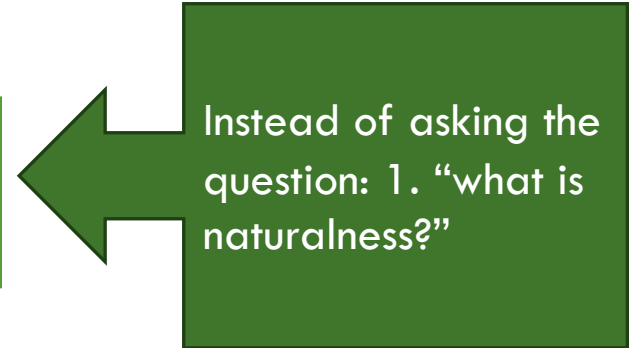
KINDING ACTIVITIES & ONTOLOGIZING PRACTICES

“the naturalness of natural kinds is revealed in how they are used, discovered, or made. This shifts metaphysical inquiry of natural kinds from the contents of the world to the activities of partitioning, conceptualizing, comparing, and categorizing—that is to ontologizing practices” (Kendig 2016:3).

“Paying attention to who is using natural kinds [means not just] studying putative natural kinds but also studying the activities and people who use them and value them” (Kendig 2020).

“in order to understand natural kinds, we need to do more than consider the existence claims of natural kinds, what is or is not the source of their naturalness, and their membership conditions. We also need to attend to how those activities contribute to the resulting categories” (Kendig 2023).

**1B: WHAT ROLE DOES THE CONCEPT OF
NATURALNESS PLAY IN THE
DEVELOPMENT OF ACTUAL SCIENTIFIC
KNOWLEDGE AND UNDERSTANDING?**



Instead of asking the
question: 1. “what is
naturalness?”

WHAT IS A NATURAL PART OF SOMETHING?

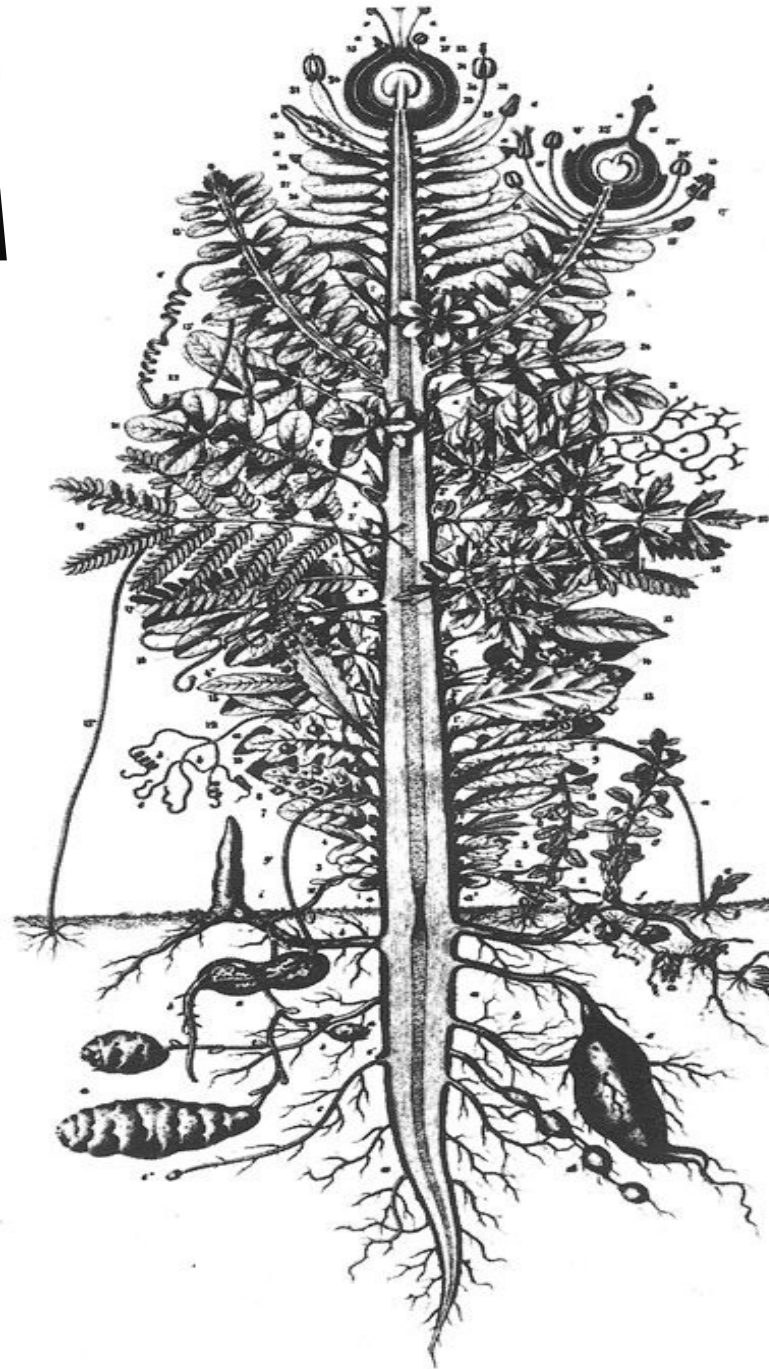
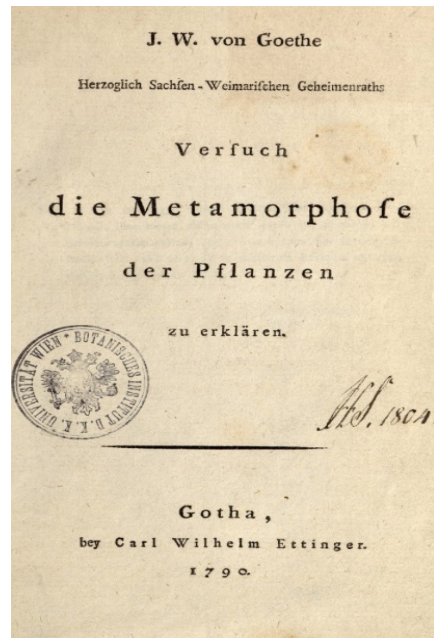


“is both integrated internally and isolated from its surround[ings] ... [components that] may be spatially distributed [such as] a hormone-mediated control system or a local population of crickets chirping in synchrony” (McShea and Venit 2001: 262).

NATURALNESS:
3 INCOMPATIBLE
CONCEPTUALIZATIONS
IN PLANT
MORPHOLOGY

- 1) Johann Wolfgang von Goethe's LEAF-ROOT-STEM archetype model
- 2) Agnes Arber's developmental model of the leaf as a partial-shoot
- 3) Rolf Sattler's processual model

GOETHE'S 1790 LEAF-ROOT-STEM MODEL OF BOTANICAL MORPHOLOGY



Goethe describes his metaphysical finding that “everything is [a] leaf” (Goethe 1787).

LEAF was used as a concept through which plant morphology could be explained: “the process by which one and the same organ presents itself to our eyes under protean forms, has been called the Metamorphosis of Plants” (Goethe 1790).

The Plant Archetype by P.J.F. Turpin. In the 1837 edition of Goethe's *Works on Natural History* (Image courtesy of Houghton Library, Harvard University).

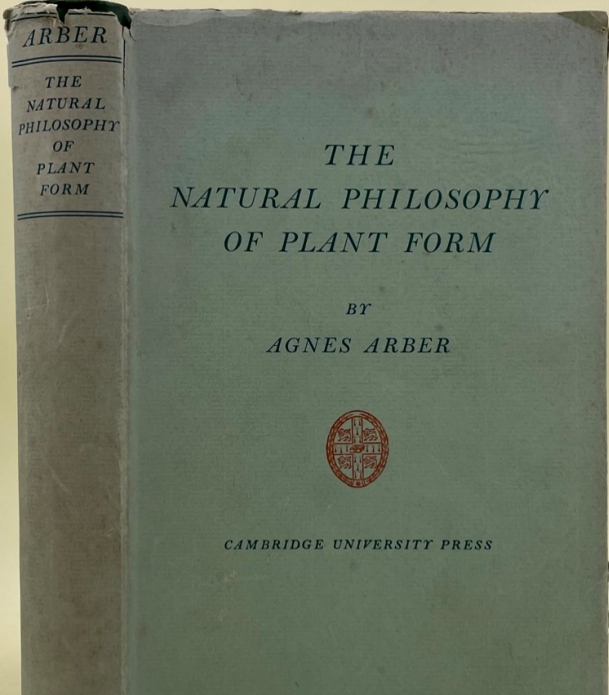


AGNES ARBER'S CRITIQUE OF GOETHE'S LEAF-ROOT-STEM ARCHETYPE MODEL

“the archetype concept is essentially mental—an intellectual instrument wherewith the mind brings order into the variegated manifold of phenomena” (Arber 1950: 68).

“the notion that leaf and stem are ultimate and discrete units of the plant body, is indeed of great antiquity; it was fostered, no doubt, by the observation of autumnal leaf-fall, which was taken, not unnaturally, to indicate an essential discontinuity between the leaf and the axis which bore it” (Arber 1950:70).





ARBER'S DEVELOPMENTAL MODEL

“the plant in endeavoring to preserve in its own being, repeats that being time after time, each daughter shoot or root becoming, in its turn, a parent shoot or root” (Arber 1950:78).

“the leaf is a partial-shoot, with an inherent urge towards becoming a whole-shoot...just as the naked stem is a part of the shoot in which leaf development is in abeyance” (Arber 1950: 78-79).



PERSISTENCE OF GOETHE'S LEAF-ROOT-STEM ARCHETYPE

“Roots, stems and leaves are the only vegetative organs of vascular plants. All other plant structures are modifications of one or another of these” (Greulach 1973: 488).

“the shoot bears leaves as lateral appendages and the root bears no leaves, just endogenously initiated lateral root branches” (Kaplan and Hagemann 1991: 695).

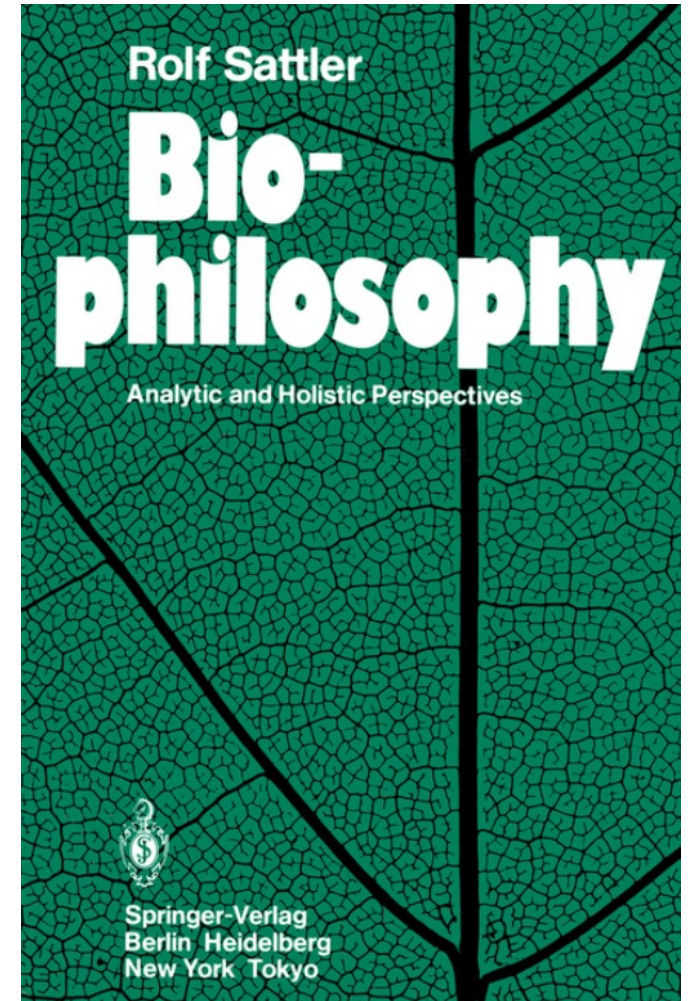
“the shoot bears leaves as lateral appendages and the root bears no leaves, just endogenously initiated lateral root branches” (Kaplan and Hagemann 1991: 695).

“organs in plants are defined principally by their topographic-positional relationships”, (Kaplan 2022: 265).

ROLF SATTLER'S CRITIQUE OF GOETHE'S LEAF-ROOT-STEM ARCHETYPE MODEL

“although it is possible that a less general proposition, such as the statement that all trees have leaves, might be formed inductively, the invention of a generalization with the scope of [Goethe's] classical model required intuition and imagination” (Sattler 1986: 103).

“the phrase ‘the true nature of an organ’ and other essentialist expressions are still used by the majority of modern plant morphologists” (Sattler 1974: 369).

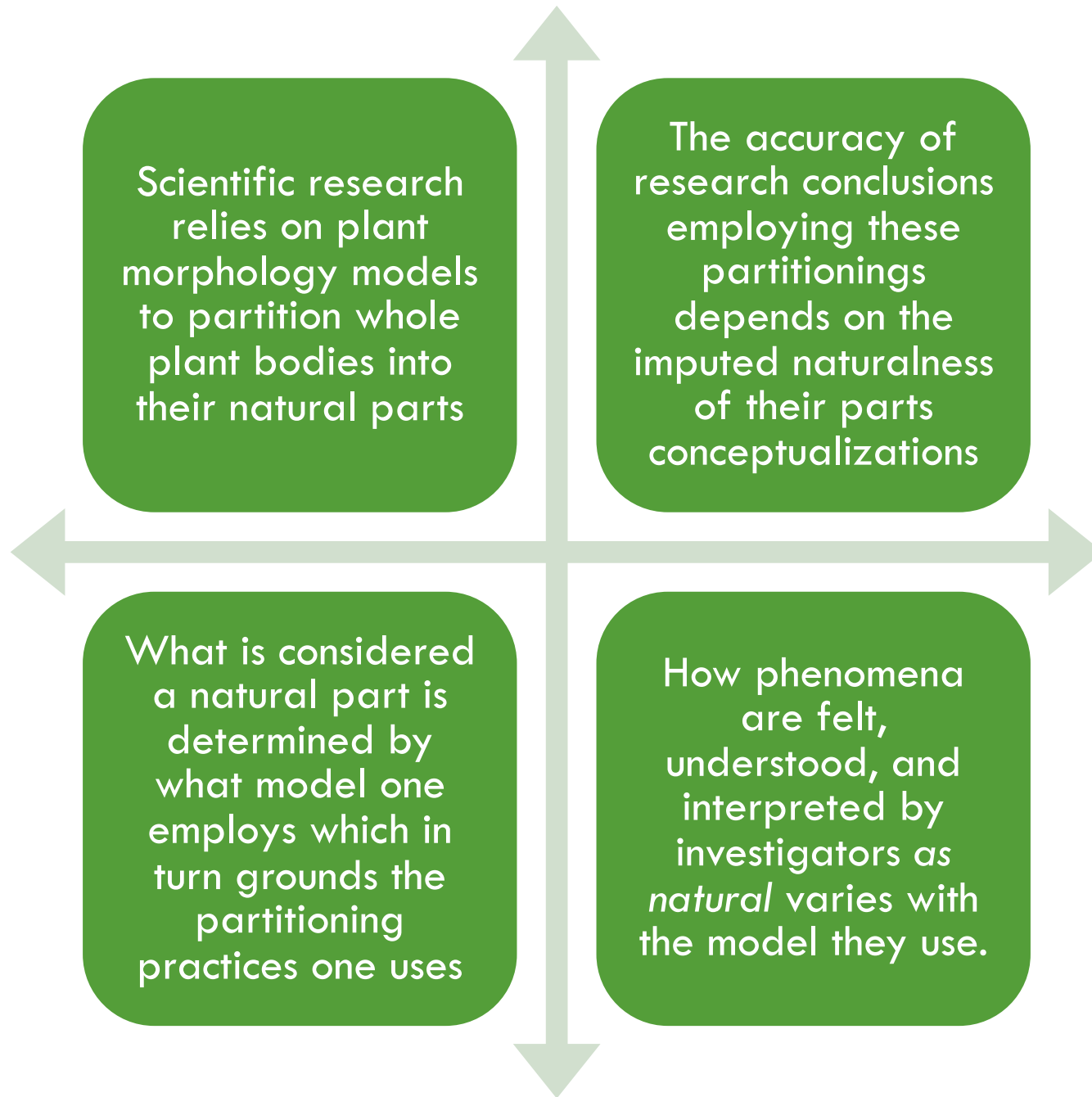


ROLF SATTLER'S PROCESSUAL MODEL

“the shoot may consist of the following parts: shoot, caulome, phyllome, root, emergence, and structures intermediate between any of the preceding...and are no longer mutually exclusive; they may merge into each other...and all changes in position are accepted as such” (Sattler 1974: 367).

“developmental and positional constraints deviate considerably from the rules used in classical morphology...and may be better understood within the conceptual framework of Arberian morphology” (Rutishauser and Isler 2001: 1194).





NATURALNESS IN THE MAKING

NATURALIZING NATURALNESS?

What does describing naturalness as a property that can be naturalized tell us about scientific knowledge-making activities like partitioning or kinding?

- 1) Naturalizing naturalness describes a process by which a concept of naturalness becomes associated with or treated as, natural (NB: this may lead to epistemic failure as well as success)
- 2) Naturalness is something that is not so much made through the model the investigator adopts but is made and remade in its repeated use and revision within plant morphology. This repeated use and revision is informed by the purpose for which the investigator is seeking to partition parts as natural.
- 3) If what we are interested in is the nature of naturalness, understanding of it would seem to necessitate that we attend to the activities involved in the making and remaking of naturalness in the field in which it is used.
- 4) Naturalness can perhaps best be described as a contextually-bound classificatory concept that is made and remade in its operationalized use within a model, theory, set of practices, or discipline.



Naturalness in the Making: Classifying, Operationalizing, and Naturalizing Naturalness in Plant Morphology

Catherine Kendig¹

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Abstract

What role does the concept of naturalness play in the development of scientific knowledge and understanding? Whether naturalness is taken to be an ontological dimension of the world or a cognitive dimension of our human perspective within it, assumptions of naturalness seem to frame both concepts and practices that inform the partitioning of parts and the kinding of kinds. Within the natural sciences, knowledge of what something is as well as how it is studied rely on conceptual commitments. These conceptual commitments shape how entities and processes are categorized as natural depending on how naturalness has been understood within that discipline. In this paper, I explore how commitments to naturalness shape different conceptualizations of what were previously and what are now considered to be fundamental parts in plant morphology. Relying on an historically informed epistemological approach, I trace the origins and development of models of plant morphology from (1) Goethe's classical LEAF-ROOT-STEM archetype model; (2) Agnes Arber's revisions to Goethe's model reconceived in her partial-shoot theory of the leaf; and (3) Rolf Sattler's proposal for a processual model of plant morphology. These influential models posit ontologically and epistemologically inconsistent conceptualizations of the natural fundamental parts of plants and how they are related to each other. To explain what this inconsistency means for the concept of naturalness and the role it plays in plant morphology, I suggest naturalness might best be conceived of as a contextually bound classificatory concept that is made and remade through its operationalized use within a model, theory, set of practices, or discipline.

Keywords Natural · Naturalness · Conceptual commitments · Agnes Arber · LEAF-ROOT-STEM model · Rolf Sattler · Ontologizing practices · Historical epistemology · Philosophy of plant morphology · Kinding · Operationalism

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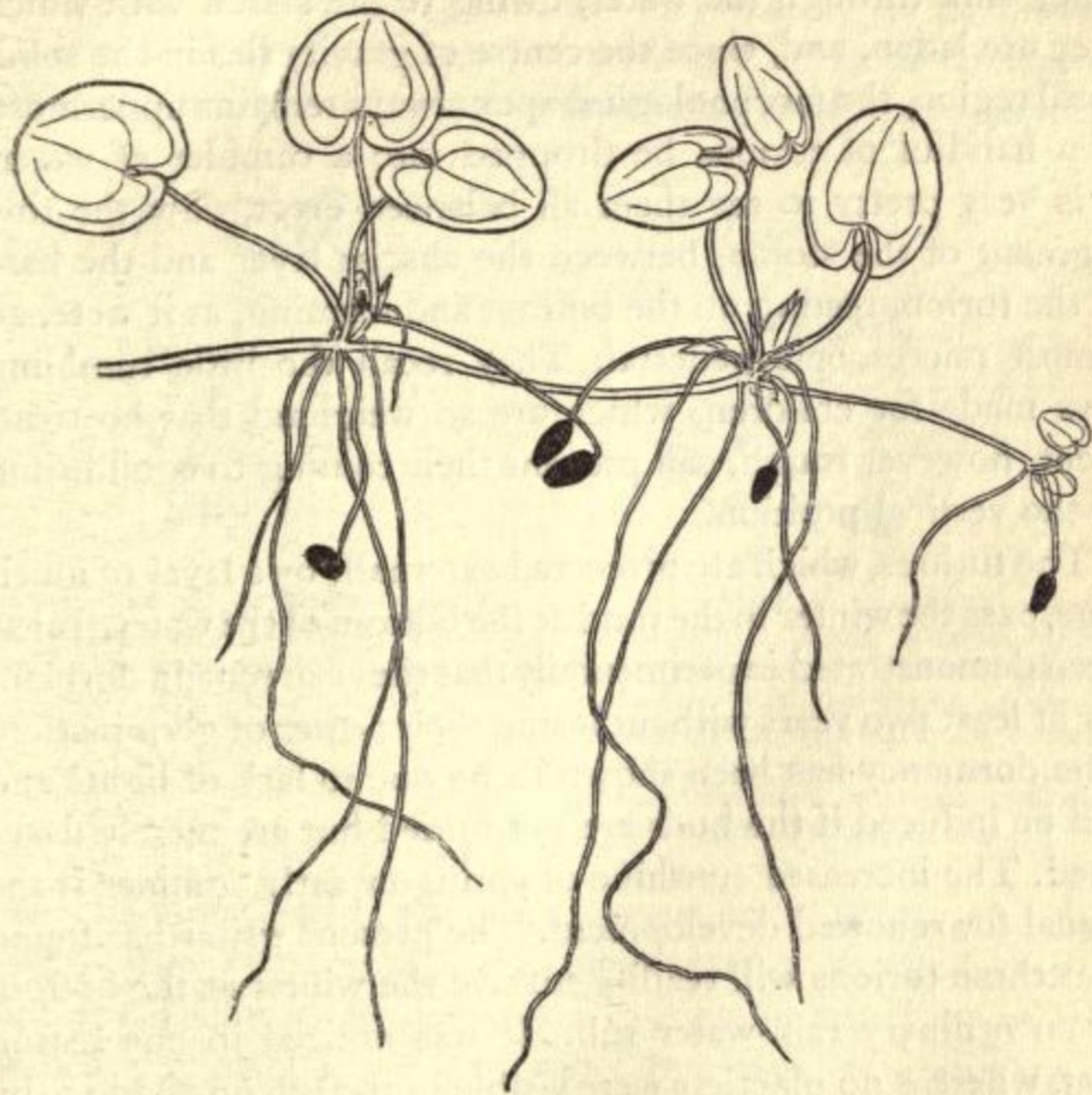
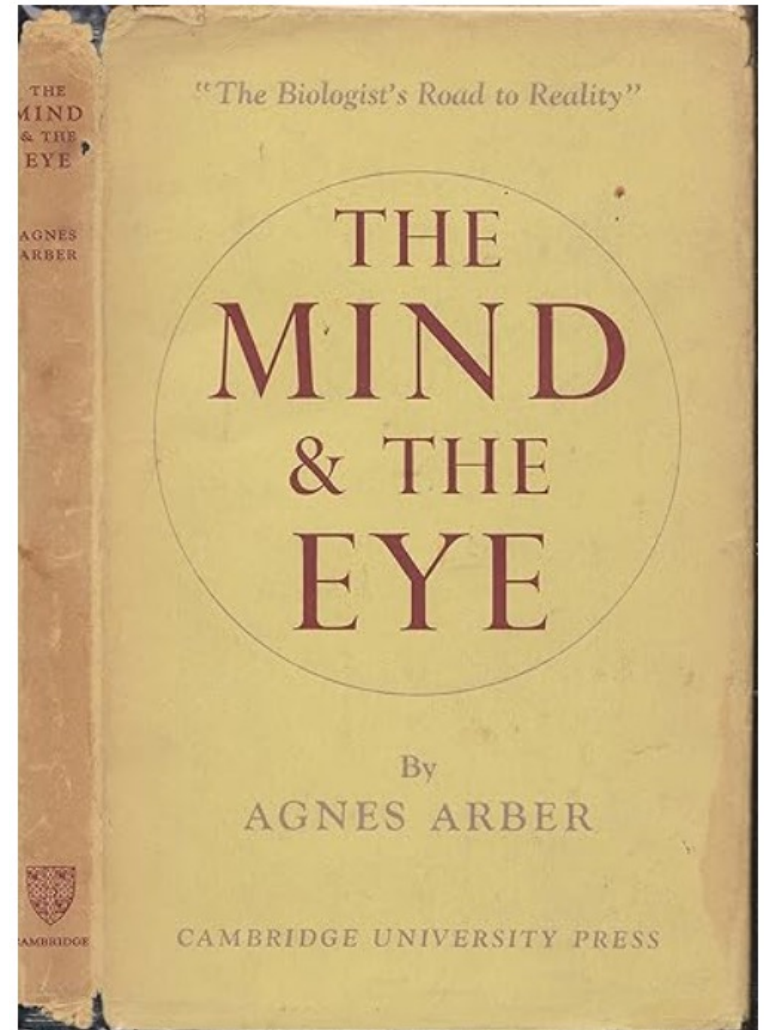


FIG. 29. *Hydrocharis Morsus-ranae*, L. Part of plant, October 1, 1910, showing turions, marked solid black. (Reduced.) [A. A.]



ROLF SATTLER'S CONTINUUM MODEL

“Each of the four concepts [SHOOT, CAULOME, PHYLLOME, and TRICHOME] functions as an injunction so that any individual structure that occupies the space between the four points can be a partial member of two, three, or four [of them]. For example, structures occurring on the leaves of *Begonia hispida* var. *cucullifera* may belong 100% to 0% to the leaf class and 0% to 100% to the trichome class. In other words: some are leaves, others are hairs (trichomes), and still others are intermediate between leaves and hairs (trichomes)” (Sattler 1986: 123).

While Sattler suggests his view is just a loosened-up version of the classical model--one that allows for both non-mutual exclusive relationships between organ categories and variable organ positions--he claims that this looser model should be adopted as these changes have important epistemic and metaphysical consequences for our understanding of the nature of plant morphology (Sattler 1974: 378).