Covert Plants: Vegetal Consciousness and Agency in an Anthropocentric World

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Thinking Plants
Our understanding of the brain is bound up with our images of plants. One of the dominant metaphors for the way the brain works is the tree. If we reduce a tree to its most basic caricature — the sphere on the top of the trunk — we have an echo not only of the brain and the brain stem, but of the neuron and its branching dendrites and extensive axon as well. In addition to this broad structure of stem and efflorescence, this visual metaphor capitalises on the bloom of synaptic connections, redolent of the thinning and multiplying of twigs from branches. These metaphors of the brain become all the more significant given recent developments in the inverse field, as new work in plant science is changing the way we think about vegetation and thought.

Studies of plant behaviour now suggest that plants engage in processes of what we might call thinking and learning, even if this thought does not exactly resemble the sort of conscious rationality that vastly overdetermines our ideas about what the human brain primarily does. While the brain is often envisaged as a tree, this metaphoric exchange has only ever gone one way: it remains anathema to associate plants with brains in anything more than an illustrative sense. Although the neurological armoury of images seems to be phytological — and phytology is now deploying the concepts once unique to brain science — any exchange between the two is often rendered trivial, as if images and names existed in the realm of conceptual small change. Here I consider the way that current key popular texts in neurology deploy the
metaphor of the plant, in particular the tree, and explore the ways that this metaphor works to both stabilise and ‘extinguish’ its object. I consider the way that the ‘tree’ is simultaneously a material and immaterial metaphor, an embodiment of both neural object and function. This curious mode of metaphor, which I will associate with Paul de Man’s definition of ‘formal allegory,’ actually models the cognitive processes that it seeks to describe.

A formal allegory occurs where the text allegorises its own formal processes, its own processes of composition. If the ‘tree’ allegorises the very processes of thought that it is meant only to refer to, it does not so much represent the brain, but present the very neural processes at issue. This demands a reconsideration of the significance of the neural metaphor and also suggests a rhetorical mode by which we might approach new work on vegetal thought. My argument will be mediated through the idea of the ‘garden of bifurcating paths,’ the title of one of the best-known stories by the great Argentine writer, Jorge Luis Borges. My contention here is that these neural and phytological image gardens are best understood, and best brought into dialogue, by literary criticism and a critical approach to the triadic relationship between concept, image and thing. By braiding three different allegories—the brain as tree, the thinking plant and the allegory of a garden of forking paths in Borges’ short story—I will demonstrate that this tropology is far more substantial than illustration or ornamentation, and is essential to the mediation between neural object and event.

Brain Trees: Anatomy and Physiology, Analogy and Allegory

There are many accounts of the metaphors of the brain used in medical or scientific literature. One of the most prominent metaphors likens the brain to a computer. This metaphor arose in the twentieth century out of the nineteenth-century precedents that imagined the brain as machinic. The brain has long been viewed as a machine, whether as a hydraulic pump or as a telegraph machine. In the 1850s, ‘the arrival of the telegraph network provided Helmholtz with his basic neural metaphor, as did reverberating relay circuits and solenoids for Hebb’s theory of memory’ almost
a century later.¹ These machinic metaphors served the ends of nineteenth-century determinism and, in the twentieth century, have abetted a sort of behaviourism appropriate to networked society, revolving around inputs, outputs, and attention spans.² The brain is also frequently compared to writing utensils, be it a blackboard and chalk, a pen and paper, or Freud’s famous mystic writing pad.³ However, both the metaphor of the computer and the metaphor of the writing pad are essentially metaphors of the mind, rather than the brain itself. What makes the metaphor of the tree significant is that it is deployed to describe how the brain, or the neuron, might look as well as how it might function. Whereas the telegraph network, the computer, and the blackboard only evoke the way the brain might work, the metaphor of the tree is multifaceted, refracting an array of different aspects of the brain that are often considered in mutually exclusive terms. The tree is powerful because the metaphor is a material one as well as an immaterial one, it is structural as well as functional.

The comparison between the brain and the tree exists primarily in the armoury of metaphor attached to popular neuroscientific discourse. The explanation of neural anatomy from the Queensland Brain Institute is exemplary of this and bears quoting at length:

A neuron has three main parts: dendrites, an axon, and a cell body or soma, which can be represented as the branches, roots and trunk of a tree, respectively. A dendrite (tree branch) is where a neuron receives input from other cells. Dendrites branch as they move towards their tips, just like tree branch-

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³ See Douwe Draaisma, Metaphors of Memory: A History of Ideas about the Mind, trans. Paul Vincent (Cambridge: Cambridge University Press, 2000), for an account of this, in particular Freud’s vision of the mystic writing pad.
es do, and they even have leaf-like structures on them called spines. The axon (tree roots) is the output structure of the neuron; when a neuron wants to talk to another neuron, it sends an electrical message called an action potential throughout the entire axon.\textsuperscript{4}

Already, in this simple botanical tropology of the brain, the parts of the tree express both anatomy and physiology. The ‘branch’ of the dendrite is used in the above description to indicate material extension as well as action. The ‘branch’ doubles, here, as a noun and verb; the dendrite is a branch and, although this functionality is not detailed explicitly here, it also branches, an oblique reference to the role the dendrite plays in the propagation of neural electrochemical current. The word dendrite is the Latin for tree, and the term ‘cortex,’ which is used for the outer layer of neural tissue, is Latin for ‘bark.’\textsuperscript{5} These Latin terms, and their afterlives in metaphors of the brain, leads Giorgio Ascoli to coin the word ‘neurobotanical.’\textsuperscript{6} Ascoli views the ‘entire brain...as a whole neurobotanical world completely filled with trees.’\textsuperscript{7} For Ascoli, the notion of a ‘neurobotanical garden’ allows for an expression of the diversity of neuronal shape, size and function.

It is just as common to compare the links that exist between neurons with trees in a forest. For Ascoli, ‘much of the brain complexity is due to the massive web of connections and communication formed by its tens of billions of nerve cells through tiny tree-like structures.’\textsuperscript{8} Ascoli’s epigraph, by Stanford neuroscientist Stephen J. Smith, gives substance to this vision of brain complexity; Smith speculates that ‘our most beautiful landscape is the one within.’\textsuperscript{9} Smith’s similitude is significant, because it renders complexity aesthetic: the mind is like a beautiful land-

\textsuperscript{6} Ibid., vii.
\textsuperscript{7} Ibid.
\textsuperscript{8} Ibid.
\textsuperscript{9} Ibid.
scape, full of trees, mirroring the outside world. This ‘outside world’ here is, of course, not the world of blocks of flats or streetscapes or parking lots, but a forested world. In this sense, the trope of the tree works to produce an aesthetics of the brain, a landscape that is rich with foliage and vegetal life. So these metaphors do more than just serve as a tool for anatomic explication: the illustrations also render the brain scenic. The word ‘scene,’ of course, comes from the Greek word for the stage, and the ‘scenic’ implies the capacity of something to be performed.

This scenic capacity of the trope also indicates the mode in which the metaphor goes beyond simple description. The metaphor of the computer, for instance, hardly lends itself to a broader neural aesthetics that approaches both the awe and fascination that surround the brain. More specifically, the computer does not lend itself to the notion of either the organic object or the object that might grow or expand. The tree, on the other hand, is a useful metaphor because it entails an idea of organic growth, both individually and in terms of the forest of neurons. The tree is a material and even finite object, but it also does not have fixed boundaries. The tree is an emblem of complexity, growth and proliferation as much as a model for an object composed of a centre and branches in the case of the neuron, and an object with a ‘stem’ and ‘bark’ as in the case of the brain as a whole. In this sense, the tree is a complex symbolic object. It is both analogic and allegorical: a tree looks like a neuron and a brain, and it illustrates physiology, significance, and affect.

The combination of analogy and allegory means that the tree allows us to grasp not just the matter of the brain but that matter electrified. This combination offers us a rendering of the brain in language as it exists in both space and time. This is exemplified in the recent work of Stanislas Dehaene, in particular his work on neurology and reading. Dehaene’s use of the tree to describe the organisation and ‘location’ of words in the brain adds another intriguing dimension to this tropological coupling of green and grey matter. According to Dehaene, we are able to read by virtue of the unique physiology of the human brain. What is important here, in Dehaene’s account, is that humans did not evolve to read and, as such, reading is a relatively recent phenomenon in the long history of the species: we have only been reading for five
It is also significant that other primates, closely related to the human species, are unable to read. One of the things that makes humans unique is their ability to read, and for Dehaene this comes from a unique physiology of the brain, in particular the functional resemblance between neural pathways and trees.

For Dehaene, ‘every word is a tree.’

Physiologically, ‘every written word is probably encoded by a hierarchical tree in which letters are grouped into larger-sized units, which are themselves grouped into syllables and words.’ Dehaene’s work boldly suggests that the neural encoding of language happens through a spatial organisation in the brain, which, remarkably, resembles the aural and visual organisation of language. The matter of our brain spatially resembles the relations between the things we see and hear:

Shapes that appear very similar, such as ‘eight’ and ‘sight,’ are sifted through a series of increasingly refined filters that progressively separate them and attach them to distinct entries in a mental lexicon, a virtual dictionary of all the words we have ever encountered.

Our brain is structured so that, moving down this ‘hierarchical tree’, we decompose morphemes to understand the composition of words, even those that we may not initially recognise. In similar ways, the brain processes the graphemes that constitute the morphemes. As such, we move down or through a branching organisation that leads us to an increasingly specific understanding of the word, which captures its graphic and morphological singularity. For Dehaene, the ‘final point in visual processing leaves the word parsed out into a hierarchical structure, a tree made up of branches of increasing sizes whose leaves are the letters.’

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11 Ibid., 21.
12 Ibid.
13 Ibid.
14 Ibid., 24.
Structure and logic come together seamlessly in Dehaene’s unusual account of the reading process. Indeed, for Dehaene, it is the resemblance of human neural organisation to plants that allows for the recursive processing necessary for textual comprehension: ‘Tree structures require a specific recursive neural code, as yet unidentified by electrophysiology, possibly unique to humans, and which may explain the singularity of human language and cognition.’ It is, moreover, the fact that human neurons are more ‘tree-like’ that enables the level of neural connectivity that facilitates reading comprehension:

Some long distance connections, such as those that link the inferior prefrontal cortex to the occipital pole, may exist only in humans... Their dendritic trees, which receive incoming inputs, are bushier, and synaptic contacts are massively more numerous than those of other primates.16

So reading occurs, here, *like a tree*. This fascinating contention mixes the spatial and the temporal use of the metaphor. A physiological process is rendered material here and vice versa. These descriptions of the relation between biology and physiology, between matter and language, recursive code and dendritic branching, mirror the rhetorical dexterity of the metaphor of the tree, encompassing both analogy and allegory, structure and function, space and time. In other words, what is extraordinary about the longstanding metaphor of the brain as a tree, which is realised most fully in the recent work by Dehaene, is the fact that the trope is redoubled: the brain is, metaphorically, like a tree, but the form of this metaphor itself — specifically the bridging that occurs in this metaphor across matter and time, form and function — resembles the content.

To put this in the simplest terms, the metaphor of the brain as a tree is what we might call a ‘formal allegory.’ What is impor-

16 Dehaene, *Reading in the Brain*, 24.
tant in Dehaene’s use of the tree metaphor is not only the fact that function is mixed with structure, as in all good neurology, but that the use of the metaphor itself enacts the very process to which it refers. My understanding of formal allegory draws on Paul de Man’s classic theorisation of tropes as the essential features of language. For de Man, interpretation is always an act of reading another meaning into the text, and ‘any narrative is primarily the allegory of its own reading.’ This seemingly convoluted circuitry of textual allegory happens via what de Man calls the ‘rhetorical model of the trope.’ In its structure of deferred or displaced reference, the model of trope mirrors the model of reading and interpretation. In de Man’s theory of literature and meaning all language involves a displacement between referent and significance. A symbol of an olive branch, for instance, refers to ‘reconciliation’, but this meaning is entirely independent of the olive branch itself. The referent—the olive branch—is independent of its significance, which occurs by virtue of interpretation. This displacement is essential to all language: it always circumvents what it purports to capture in representation. In de Man’s powerful rereading of this essential feature of language, all figural form in fact allegorises its own reading: the very construction of the trope, which involves a divergence rather than a bridge between referent and significance, is the same as the process that occurs between text and reader, between the words on a page and the instability of their interpretation. This ‘rhetorical model’ is also a ‘formal allegory’: an instance where the text allegorises its own formal processes. The metaphor of the brain as tree is a formal allegory insofar as it not only describes the brain, but also models it. It performs this latter function through the branching in language—from brain to tree—that occurs in the form of the metaphor itself and mirrors the neural and neuronal differentiation that it purports to describe.

Reading happens ‘like a tree’ twice here. For Dehaene, reading visually and logically resembles the structure of the tree and the functions implied in that structure. As this neural process is

17 Paul de Man, Allegories of Reading: Figural Language in Rousseau, Nietzsche, Rilke, and Proust (New Haven: Yale University Press, 1979), 76.
18 Ibid., 15.
rendered in the linguistic art of the trope, this structure is replicated in the rhetorical form that bridges, differentiates, and specialises, branching out from the initial referent. The ‘jump’ that the trope enacts between the neural and the botanical does not represent reading so much as present it: the material signature of the neuron indicates the abstract function, biological divergence indicates logical branching, and in order to represent this in language we must, inevitably, inscribe the very process of reading into the attempt to describe the branching of the brain by branching our language, from brain to tree. The object—the brain, here, and specifically the uniquely human ability to read—is utterly implicated in its own representation. This is the moment in which neurology comes to resemble the quantum physics of the early twentieth century, which had to abandon the notion of objectivity in scientific representation because the object changed depending on how it was observed. Reading, here, is entailed in the very attempt to describe or understand reading.

In this botanical metaphor of the brain we have two versions of the bifurcating path. The content of the description contains a fork, a branching, and the form of the description equally contains a fork, a branching. This fork refuses the totality inherent in less subtle comparisons such as the computer, by mimicking that which it is meant to rhetorically subsume. As the trope attains its symbolic power it also divests itself of the capacity to represent its object, becoming implicated in it. In Walter Benjamin’s words, an allegory ‘signifies precisely the non-being of what it represents’ and this observation is key to de Man’s work as well. In this sense, allegory does not affix a meaning to something, or delimit meaning, but both extends and nullifies it simultaneously. The metaphor of the brain does this quite perfectly for neurology: just as it renders the morphology and function of the brain in language, making it communicable and recognizable, all recognizability is lost as the trope refuses its own status as metaphor and becomes its object. The formal allegory—the metaphor, here—is significant because it does something scientifically invalid: the mode of

19 Walter Benjamin, quoted in Paul De Man, Blindness and Insight: Essays in the Rhetoric of Contemporary Criticism (Minneapolis: University of Minnesota Press, 1983), 35.
representation mirrors the object of representation. In this sense, language threatens to dislodge from its status as representation and occupy a strange presentational position. The very formal qualities of the trope start to threaten the idea of formalism itself: the idea that something can be represented, outside of its context and presence, in a stable notation system. This allegory, then, complicates the simple representational structure of language at issue here and implicates it in its object.

**Allegory as Bifurcating Path**

Allegory, here, is the road not to the scientific object, but instead is much more akin to a ‘garden of bifurcating paths’, whose metaphysics departs from the critical regime that still governs scientific description. The metaphysics of neurobotanical allegory is, instead, the kind that belongs to what de Man calls the ‘temporal labyrinth of interpretation.’ Jorge Luis Borges’ short story ‘The Garden of Forking Paths’ is a classic example of formal allegory, and as a third bifurcating line in this essay, it provides us with a theory of narrative with which to understand this strange implication of ‘neurobotanical’ language in its object. ‘The Garden of Forking Paths’ (otherwise known as ‘The Garden of Bifurcating Paths’) is a story about the relation between language and time, and it echoes many of Borges’ other stories in that it deals with questions of the infinite, in particular the possibility of a sort of infinite book. The story opens with a reference to a battle against the Serre-Montaubaun line in Liddell Hart’s *History of World War I*. This battle, we are told, is illuminated by a statement written by a certain Dr. Yu Tsun, and the rest of the story presents Tsun’s account for our consideration. Dr Tsun, we find out, was a German spy in World War I, who was captured in Britain after he discovered the location of an important British artillery park. He was arrested, however, not for locating this information but for killing an eminent sinologist by the name of Stephen Albert. Tsun had realised that he was being pursued by an intelligence agent, an ‘Irishman at the orders of the English,’ Richard Madden, and that his time was up, and he needed to communicate

20 Benjamin, quoted in ibid., 35.
to German intelligence the name of the town where the artillery park was located. The town’s name was Albert, and by making front-page news for killing Stephen Albert, Tsun successfully alerted German intelligence to the name of the secret location. However, the meeting between Stephen Albert and Yu Tsun is not an entirely random one. Tsun tells us that he grew up in the ‘symmetrical gardens of Hai Feng’ and that his great grandfather was Ts’ui Pen, ‘who was governor of Yunan province and who renounced all temporal power in order to write a novel containing more characters than the Hung Lu Meng and construct a labyrinth in which all men would lose their way.’ Stephen Albert is an expert in Ts’ui Pen’s work, and the brief meeting between the two men reveals, for Yu Tsun, the way that his mysterious ancestor managed to construct an infinite book.

Albert, who is excited to meet an ancestor of Ts’ui Pen, explains that “The Garden of Forking Paths” is an incomplete, but not false, image of the universe as conceived by Ts’ui Pen…. He believed in an infinite series of times, a growing, dizzying net of divergent, convergent and parallel times. Although Pen’s so-called ‘novel’ appears only as ‘chaotic manuscripts,’ Albert tells Tsun that he has solved the mystery of this profoundly important yet seemingly disordered work:

‘The Garden of Forking Paths’ is a huge riddle, or parable, whose subject is time; that secret purpose forbids Ts’ui Pen the merest mention of its name. To always omit a word, to employ awkward metaphors and obvious circumlocutions, is perhaps the most emphatic way of calling attention to that word. It is, at any rate, the tortuous path chosen by the devious Ts’ui Pen at each and every one of the turnings of his inexhaustible novel.

22 Ibid., 122.
23 Ibid., 127.
24 Ibid., 126–27.
In their brief time together, before Tsun shoots the eminent sinologist, Albert explains that Ts’ui Pen’s work is a giant riddle. And, like all riddles, it omits the key to unravelling the conundrum. In this case, it omits the word ‘time.’ In Pen’s garden of forking paths, characters do not choose one fate or future, but many, with each future in turn consisting of many forking paths. Yu Tsun is given a sudden impression of Ts’ui Pen’s ‘labyrinth’ — not a vision of it, as such, but some more ephemeral sense of the infinity that the labyrinth opened: ‘I sensed that the dew-drenched garden that surrounded the house was saturated, infinitely, with invisible persons. Those persons were Albert and myself—secret, busily at work, multiform—in other dimensions of time.’

Ts’ui Pen’s bifurcating paths are temporal; they are divergent futures. Stephen Albert discovers the ‘secret’ to the garden because he reads the text allegorically, even if his is an unusual type of allegorical reading, far more speculative than traditional allegorical interpretation. Ts’ui Pen’s novel is, in Stephen Albert’s understanding, an allegory of time. Here lies one of the more interesting aspects of ‘The Garden of Forking Paths’: there is a split between the narrative that is described in the story (Ts’ui Pen’s novel) and the form of the story itself (Yu Tsun’s account, in Borges’ short story), a common Borgesian construction. In ‘The Garden of Forking Paths’, we are dealing with three layers of narrative: the framing narrative, which introduces Yu Tsun’s ‘statement,’ rendering it an artefact within the story itself; Yu Tsun’s linear account of his murder of Stephen Albert; and, of course the ‘novel’ by Ts’ui Pen, which is described in the story, although we never actually see the text. There is a fourth narrative dimension here that is also relevant: the presence of a kind of hermeneutic endeavour that we see in Albert’s interpretation of Ts’ui Pen’s work as well as in the German recognition of Yu Tsun’s message. Albert reads a double meaning into the absence of a word, and the Germans recognise a double meaning in the Yu Tsun’s crime. Recognition, here, involves being able to register the polysemy of a certain word in the context of intention: Albert’s name is recognised as exceeding its immediate signifi-

25 Ibid., 127.
cation and meaning something entirely different. It is the very act of reading, rather than writing, which facilitates this ‘bifurcation’ in meaning, suggestive of the temporal rather than the spatial infinity that Ts’ui Pen creates. Here we encounter — to paraphrase de Man again — the ‘temporal labyrinth of interpretation,’ another layer of ‘bifurcation’ that forks away from the literal meaning of words.

The allegory for time is embedded in a narrative that revolves around textual interpretation. In each example of textual interpretation in this story, what we see is the displacement of either a voice or a word from where it should be. At the most basic level, the word ‘Albert’ means something entirely different to the reader from its intended or referential or contextually based meaning. As such, the story is itself composed of bifurcating paths in language: action occurs because of acts of interpretation and the ability to recognise concealed or hermetic meanings in words. Kyoo Lee has referred to de Man’s concept of allegory as ‘a calligraphy of time,’ which is, equally, a perfect description of Ts’ui Pen’s labyrinth. So, inasmuch as the labyrinth in this story is time, it is also language as a temporal medium. It is not for nothing that Ts’ui Pen’s route to discovering time as the ultimate labyrinth happens through his writing a novel. What is important, here and in many of Borges’ stories, is that this particular ‘novel,’ this ‘garden of forking paths,’ is not presented for direct consumption. In other words, the path to Ts’ui Pen’s extraordinary work is forked away from a direct representation of this work. And although we read of the bifurcating futures in Ts’ui Pen’s novel, the text enacts it by virtue of the multiple levels of narrative, bifurcating between frame, quotation, narrative, and interpretation. In this sense, Yu Tsun’s story is also an allegory of its composition.

David Baulch has argued that Borges’ short story offers a challenge to literary criticism in the form of a ‘multiverse’ that contests the dominant configuration between narrative and time. He writes that ‘foremost among the concepts of classical/empirical science that structure literary realism in particular, and narrative in general, is the assumption that time is a more or less endless linear progression and that events within time refer to a single-
valued, objectively verifiable world.’ Insofar as Borges’ ‘The Garden of Bifurcating Paths’ is a formal allegory, it refuses both the linear progression and the single world that is recognisable for literary criticism. Baulch claims that the problem with literary criticism is that it remains thoroughly ‘Newtonian’: ‘Despite roughly a century of study of the various paradoxes quantum phenomena present for science’s understanding of the behavior of the material world at its most minute, literary criticism continues to regard its object in predominantly Newtonian terms.’

In addition to Baulch’s reading of the ‘multiverse’ in Borges’ fiction, formal allegory is an important way of approaching this textual inventiveness, not least because this type of allegory, as de Man notes, extinguishes its object as it defines it. It is stories like ‘The Garden of Forking Paths’ that challenge modes of reading that privilege distinctions between subject and object, cause and effect, and put under pressure our ideas about narrative time.

In order to access the full satisfaction of Borges’ story, we cannot take the story at face value, reading it as a strange and singularly unsatisfying account of a seemingly impossible infinite book. We need, instead, to be able to read the story with full attention to the bifurcations in the narrative and, above all, to the way that these bifurcations facilitate an elaborate formal allegory of the relation between time and language. In order to understand allegory as a bifurcating path, we need to be able to read the story in non-linear, or even non-Newtonian, terms, reading across the different levels of narrative and understanding that the allegory, here, serves precisely to bifurcate the lines of the narrative rather than, as in traditional allegorical interpretation, to fix and stabilise meaning. This modality of reading, taught to us by an exquisite formal allegory, must be applied to the ‘neurobotanical world,’ to use Ascoli’s term again, to grasp the implication of the strange formal allegory deployed by the sciences. The tree undoes our ability to represent the brain as much as it provides a

27 Ibid., 56–57.
vital key to understanding it. It differentiates the scientific object, rather than containing it. In other words, the branches of the neuro-botanical tree are temporal as well as spatial—the word trees that Dehaene writes of offer routes to both literal and allegorical interpretation.

Future (Neural) Forests: Plant Sapience as Allegory

The tree is a powerful metaphor in neurology because it allows simultaneously for a temporal and a spatial metaphor. As a formal allegory, the tree models the object that it is meant to describe, implicating metaphor in that which language is only supposed to represent. Borges’ ‘The Garden of Bifurcating Paths’ offers a key to imagining this neurobotanical world, not as a stable case of symbolic illustration but as a three-dimensional set of intersecting and bifurcating narratives, whose interaction brings into being a clear scientific object and extinguishes it simultaneously.

This knotting together of tree and brain through formal allegory also presents a modality by which to address one of the new challenges emerging out of evolutionary biology. One of the key challenges in plant science today relates to our ability to understand the inverse of what this essay has been preoccupied with: plant thought. New studies of plant ‘learning’ and memory suggest that plants are capable of what we might call ‘thought’. Part of the difficulty in approaching current work on plant learning relates to our inability to see plants as temporal objects. What is unique about our relation to plants is that we do not perceive them temporally, or when we do, it is only through crude schemes of growth rather than change, behaviour, or learning. Monica Gagliano’s recent work on plant learning provides experimental grounds with which to begin to conceive of plants differently. Although we have long understood plants’ capacities for habituation, whether plants could ‘learn through forming associations [has] remained unclear.28 Gagliano and her colleagues embarked on a series of ‘Pavlovian’ experiments to test whether plants were able to learn through forming associations. They dis-

covered that if plants were exposed to a fan that accompanied their light source, they would respond by growing in the direction of the fan even when it was no longer accompanied by the light source. These experiments revealed:

Learned behaviour prevails over innate positive tropism to light, which is thought to be the major determinant of growth direction in plants. In both experiments, the ability of seedlings to anticipate both the imminent arrival of light (‘when’) and its direction (‘where’) based on the presence and position of the fan indicates that plants are able to encode both temporal and spatial information and modify their behaviour under the control of environmental cues.  

Prudence Gibson, in her report on Gagliano’s experiments, notes that one of the key problems presented by this work is that ‘there is no vocabulary that can be used to talk about brain-like plant structures beyond mere vascular and survival processes, nor about decision-making, sentience, intelligence, learning, and memory in the plant world.’

This is evident in Gagliano et al’s work. Key to their findings is the fact that plants can think, although the presence of ‘traces’ of this thought differs from anything one might find in neurology:

In multicellular organisms with a nervous system, changes in the synaptic strength between neurons, for example, can be stored as a memory trace that sustain associative learning. In plants and other organisms that do not have a nervous system, modifications of the patterns of interactions between molecules and communication between cells can be stored in a way rather similar to neural networks.

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29 Gagliano et al., ‘Learning by Association in Plants,’ 3.
The authors acknowledge the difficulty involved in conceptualising plant sentience without the presence of a measurable, observable brain, and circumvent the radical acephaly of this vegetal thought by positing a comparison between the information networks of the brain — ironically, in the work of Dehaene and others, the ‘brain trees’ — and plant epigenetics: ‘Presumably, then, the mechanisms maintaining associative learning operate in plants as in other organisms on the basis of fundamental ‘rules’ that alter the flow of information by modifying the shape and connections within a network via epigenetic changes.’

Although Gagliano et al. do not pursue the issue of these material traces of thought, if we read their conclusions in terms of the neurological preoccupation with botanical metaphor, this bifurcation from phytological behaviour to the logic of brain processes presents a fascinating reciprocal gesture that mirrors and complicates the question of the ‘neurobotanical.’

Understanding plant sentience requires a prior conception of the tree as no longer an object; it requires a supplementation of the visual and spatial relation of the tree with temporality, both in terms of the temporal nature of learning and epigenetics. It also seems to require a similar allegorical structure to the neurobotanical metaphor, in that the object of thought is extinguished as it is rendered in language. Although the mechanisms that facilitate learning follow the same networked, bifurcating structures as the nervous system in multicellular organisms, there is no nervous system to speak of here. Obviously no plant has a brain, and we cannot measure neural currents that suggest thought or consciousness. This is a kind of acephalous thinking, which happens without some material centre devoted to the orchestration of cognisance. The comparison to neurological structures in other organisms functions to reveal the absence of a brain just as it posits an analogy to physiological organisation of thought. This presents yet another fork in the neurobotanical garden of bifurcating paths: vegetal thought that, to use Lee’s term again, can be traced as a ‘calligraphy of time’.

Plant sapience may then require the sort of language that Ts’ui Pen achieves in his ‘The Garden of Forking Paths’: descrip-

32 Ibid., 5.
tion and representation that is not Newtonian. Allegories that fork are valuable not for some stable parallel ‘deciphering’ of meaning but instead for a kind of linguistic differentiation that enacts the ‘branching’ of thought common to both brains and trees both figuratively and formally. Plant science that attempts to represent plants as capable of thought without necessarily being subjects in the traditional sense would benefit precisely from the non-Newtonian and non-objective modalities of language that are already implied in neuroscientific metaphor. Biology is now presenting us with an inverse form of ‘neurobotany’ to the one I considered in this essay, which involves a restitution of the capacity of thought to the form of the plant. These future ‘forests’ of sentience will also need to be ‘gardens of forking paths’ in the sense that the powerful image of a neurobotanical world now describes that which was meant to be supplementary to it. Where the tree had always been the illustration that describes the brain, the two may mutually illustrate each other now, in a double allegorical bifurcation. Attending to the types of allegories used in science, and their implications in scientific objects, allows us to account for the dissolution of the scientific object that is subject to allegorical reading. It is precisely this textual dissolution that also opens up the allegory to other meanings and other connections, including this image of plant thought.