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Discovering the Human

Life Science and the Arts in the Eighteenth and Early Nineteenth Centuries

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III. The Human and Media Change

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The Rise of the "Life Sciences" and the Dismissal of Plant Life in the Late Eighteenth and Early Nineteenth Centuries

While we certainly all agree that plants are living organisms we are less likely to agree that plants have lives. A life, that is, in the common use of the term that construes life as an animate existence centred upon agency.[1] However, it only takes a moment's reflection to unmask the underlying anthropocentric constraints of the term "life" as we use it (see Toepfer 170 – 1). Plants are agents, they interact productively with their environment. In fact, of all living organisms only some plants and fungi can justifiably claim to be productive in a strict material sense. As all other beings depend directly or indirectly on their productivity, it is surprising that plants have not as yet – or perhaps only very recently – been given the status of colonized subjects (see Valverde and Lafuente 139 – 42).[2]

In this paper I will focus on the still largely unlamented victim of the rise of the "Life Sciences" in the eighteenth and nineteenth centuries: the plant. My contention is that the changing conception of the term "life" in the eighteenth and nineteenth centuries resulted in cementing the division between plants and animals. My main point will come into focus if we consider two developments in the domain of cultural and intellectual history: first, the growing interest in systematic taxonomy in the latter half of the eighteenth century and, second, the rise of physiology in the empirical sciences in the late eighteenth and early nineteenth centuries. As a consequence of these converging developments a new conception of what it means to be human evolved at around 1800 – and it evolved at the expense of downgrading plant life.

1 This common use of the term "life" is brought to the fore by the colloquialism "Get a life!" – a colloquialism forged in the US to coerce someone to "stop being so boring, conventional, old-fashioned [and to] start living a fuller or more interesting existence". *OED* s.v. "life", Phrases 12k. Indicative of the bias are also the many derogatory phrases that discredit vegetable life like "couch potato" or "vegetable brain".

2 There is certainly no vegetable rights movement, and with the foundation of the "Vegetarian Society" in 1847 the moral issues were settled along the lines of Jeremy Bentham's contention that "the question is not, *Can they* reason? nor, *Can they* talk? *but, Can they suffer?*" (Gregory 97).

Language – so cognitive linguists keep reminding us – is revealing: the usage of the word plant is no exception. The *OED* lists three entries under the heading "plant" [Latin *planta.*] The primary meaning is divided into two variants: first, "senses relating to the living organism" – and, second, "various slang terms derived from the primary meaning" (e. g. plant as a spy or informer). The senses relating to the living organism are again divided into two groups: "senses that refer to a young tree, shrub, vegetable, or flower newly planted, or intended for planting" and:

> **plant, n**[1] **I 2.a.** *gen.* and *Biol.* A living organism other than an animal, able to subsist wholly on inorganic substances, typically fixed to a substrate and moving chiefly by means of growth, and lacking specialized sensory and digestive organs; *spec.* (more fully ***green plant***) such an organism belonging to a group (the kingdom Plantae) which comprises multicellular forms having cellulose cell walls and capable of photosynthesis by means of chlorophyll, including trees, shrubs, herbs, grasses, and ferns (the vascular or higher plants), and also mosses and liverworts (the bryophytes). Freq. *spec.:* a small (esp. herbaceous) organism of this kind, as distinguished from a tree or shrub; (in informal use) such an organism grown for or known by its foliage or fruit, as distinguished from a "flower".

Certainly, the *OED* is not the authority for biological terms and their usage – but the entry unmasks fundamental conceptions.[3] First, plants are defined *ex negativo* as something other than animals. Second, they are conceived of as closely related to matter as they can "subsist wholly on inorganic substances". Third, they lack active movement as well as specialized sensory and digestive organs. The definition thus marks a clear boundary between animal and plant life by focussing on the plant's metabolism and its apparent lack of interaction with the environment. While this entry suggests that the boundary between human and plant life can easily be drawn (a contention that interferes with the entry for "animal"[4]), the *OED* qualifies the definition of plant at length – a rare occasion:

3 Most textbooks today still divide the whole of living organisms into five distinct groups, a division that is informed by morphology, physiology, ecology as well as – more recently – genetics (see DeSalle, Egan and Siddall). There is an alternative model based on ribosomal RNA sequencing that favours three lines of descent (eubacteria, archaebacteria and urkaryotes) with urkaryotes comprising all prokaryotes and eukaryotes, i. e. animals, plants, fungi, etc. as one kingdom (see Woese and Fox). While this alternative model is accepted in the scientific community (see Margulis and Guerrero), the division of plants and animals is upheld in most textbooks.

4 *animal:* **1. a.** A living being; a member of the higher of the two series of organized beings, of which the typical forms are endowed with life, sensation, and voluntary motion, but of which the lowest forms are hardly distinguishable from the lowest vegetable forms by any more certain marks than their evident relationship to other animal forms, and thus to the animal series as a whole rather than to the vegetable series.

> Bacteria, formerly classified in the kingdom Plantae, have now been removed to a separate kingdom, and would generally not be referred to as plants. However, in the broadest (non-technical) sense, the term still may include fungi (and lichens), which are now classified in a separate kingdom, but were formerly regarded as lower (non-vascular) plants, together with algae and bryophytes. The position of algae is also equivocal: many scientific writers exclude them from the kingdom Plantae (placing them in the kingdom Protista or Protoctista), but green algae are still sometimes treated as lower plants, and non-technical use of the word "plant" would often include multicellular algae (e. g. seaweeds).

While the boundary between animals and plants thus seems to be uncontroversial, the closeness of plants to bacteria, algae, lichens and fungi is stressed. It is noteworthy that the original entry in the first edition of Johnson's *Dictionary of the English Language* (1755) avoids juxtaposing plant, animal and bacteria life and lists the 27 "genders or kinds" of plants that John Ray proposed with respect to the different kinds of fruits. The definition of plants *ex negativo* that is common today is a result of eighteenth-century botany which established that plants lack the essential feature of an animal: plants are not animated, plants do not have souls. However, the folk etymology that supported the notion by amalgamating "animal" and "anima" is misleading. Aristotle in his *De Anima* explains at great length that plants do have a soul, they only lack the faculty to feel.[5] The passage explaining the lack of sensation on the plant's side (*DA* $424^{a}32 - 424^{a}32^{b}3$) was deemed obscure until Richard Sorabji in 1992 illuminated it by pointing to intra- and extratextual references (215 – 7). For Aristotle, plants are not able to feel because they mainly consist of the element earth (which is cold and dry) and thus lack the material quality necessary to receive sensory input (which relies on heat and moisture).

It is impossible to discuss the changing attitude to plants from Aristotle to the Enlightenment comprehensively within the scope of this paper.[6] The concept that instigated a new perspective on the animal-plant division in the eighteenth century was the idea of plant sexuality (see George, 105 – 12; see Schiebinger 201 – 4). As Linnaean taxonomy was based on this concept, "to be a Linnaean taxonomist was to believe in the sex life of flowers" (Browne 597). Ascribing a sex

5 For a fuller account of the notion that plants have souls see Ingensiep.

6 While changing attitudes to cultivated plants have been discussed recently (see Prance and Nesbitt; Murphy; Pollan), a concise intellectual history of human interaction with wild plants, or plants in general, is still missing. Attempts to describe that relationship often revolve around a quasi-mythic connection between plant life and human existence along the lines of Charles Lewis's contention that "plants signal the presence of an unremitting life energy that pulses throughout the universe" (3). While non-reductive approaches are always at risk of indulging in esoteric lore, attempting to write, as Bühler and Rieger have done, a "Wissensgeschichte der Pflanzen" (9) that will inform us as humans *vis a vis* plants is certainly a deserving task.

life to plants then opened the playing field for comparing human and plant life on several accounts. At the same time, the discovery of the polyp by Abraham Trembley and John Tuberville Needham raised the interest in "plant-animals" (see Vartanian). La Mettrie's *L'Homme-Plante* dating from 1748 is only one of the many treatises that pointed to the similarities and differences between plant and human life in the wake of this discovery:

> Il n'y auroit [sic] cependant rien de surprénant dans cette idée [l'Homme est un Insecte qui pousse ses Racines dans la Matrice, comme le Germe secondé des Plantes dans la leur], puisque Néedham observe que les Polypes, les Bernacles & autres Animaux se multiplient par Végetation. Ne taille t'on pas encore, pour ainsi dire, un Homme comme un Arbre? (26)[7]

While La Mettrie dismissed the idea of an affinity between plants and humans in the latter half of his treatise, he nevertheless "elaborate[d] a broad, fundamental analogy embracing all living types, from the vegetable to the human" (Vartanian 272). Throughout the last decades of the eighteenth century animal-plants and *homme-plantes* inspired the imagination of artists and novelists, sometimes investigating Bacon's aphorism "homo sit tanquam planta inversa" (404), sometimes establishing other creative comparisons. In Holberg's *Nicolaii Klimii iter subterraneum* (1741), published in London in 1742 as *A Journey to the World Under-Ground. By Nicholas Klimius*, for example, the protagonist finds himself surrounded by trees that move and talk:

> Having opened my Eyes I beheld all about me a whole Grove of Trees, all in Motion, all animated … but I had no Time to examine these Machines, or to inquire into their Causes; for presently another Tree advancing to me, let down one of its Branches, which had at the Extremity of it six large Buds in the Manner of Fingers. With these the Tree took me up from the Ground, and carried me off (14).

Nicholas is taken to the subterranean city inhabited by trees and marvels at the complexity of arboreal life:

> I now plainly perceived, that the Inhabitants of this Globe were Trees and that they were endued with Reason; and I was lost in Wonder at that Variety in which Nature wantons in the Formation of her Creatures. … Words cannot express into what a Labyrinth of Thought these strange Appearances threw me … for altho' these Trees seemed to me to be sociable Creatures, to enjoy the Benefit of Language, and to be endued with a certain Degree or Portion of Reason, insomuch that they had the Right to be inserted in the Class of rational Animals, yet I much doubted whether they could be compar'd to Men. (18)

7 "There would be nothing surprising about this idea [that the human embryo and the seedling are nurtured similarly], since Needham observes that polyps, barnacles, and other animals multiply by vegetation. Moreover, do we not prune men like trees?" (Transl. Watson and Rybalka; 83)

The uneasiness expressed in this fictional text revolves around the status of the *civis potuani* conceived of as "Machines", "all in Motion, all animated", "endued with Reason" and "enjoy[ing] the Benefit of Language". Evidently, as the dividing line between animals and humans with the discovery of polyps and plant sex life became increasingly porous, the division between plants and animals including humans became more urgent as Agamben, among others, has pointed out: "[t]he division of life into vegetal and relational, organic and animal, animal and human, therefore passes first of all as a mobile border within living man, and without this intimate caesura the very decision of what is human and what is not would probably not be possible" (15). To sustain my argument that plant life was downgraded with the rise of the "Life Sciences" it will suffice to discuss three crucial points that resulted in drawing the line between animal and plant life: metabolism, sensual perception and mobility.[8]

The focus on the plant's metabolism is the result of a general rise of physiology in the empirical sciences (see Israel 478 – 80; see Eisnerova 219 – 20), with Stephen Hales's *Vegetable Staticks* (1727) marking the beginning of a series of publications that documented "Experiments upon vegetables". These experiments became increasingly popular from the 1770s onwards when Priestley conducted his experiments and published the results as *Experiments and Observations on different kinds of Air, and other branches of Natural Philosophy, connected with the subject* in 1775). Historians of science usually focus on the advancements made by Priestley in chemistry. With respect to our subject his observation that plants were able to restore the "phlogisticated air" while the animals kept in his sealed glass jars suffocated and died (vol. 2, 247) was particularly decisive because it established a new principle for the division between plant and animal life. While Priestley still believed that the plants cleansed the "fixed air" and restored its phlogiston, Ingenhousz, Lavoisier and finally van Helmont argued that it was carbon dioxide that was absorbed by the plants and ultimately turned into plant matter (see Conant). With this new paradigm – biochemistry – the focus was now on metabolic cycles. It can be argued that as a result plants were perceived primarily as material objects. With these models, precursors to the photosynthesis-model, the plant became a machine processing inorganic matter into organic matter.[9]

The Aristotelian notion that plants have souls, however, never quite dis-

8 The aestheticization of plants in art and in science, which has reduced plants to visual objects and has thus decisively shaped our attitude to plants, will not be discussed in this paper. It has been extensively treated by Martin Kemp and, more recently, by Anne Secord.

9 This did not, of course, disqualify them from being seen as alive, or as comparable to animals, as the joint histories of materialism and vitalism show. René Descartes, Erasmus Darwin and William Lawrence all pointed at similarities between animals and plants, arguing that irritability to stimulation is common to all. (see Levere 194 – 198; Packham 2012, 6 – 13)

Fig. 1: Plate from the French translation *Voyage de Nicolas Klimius dans le Monde Souterrain* (1741)

appeared. Charles Webster has convincingly shown that "[t]he emergence of the idea of plant sensitivity was one aspect of the development of experimental science" (6) in the seventeenth century. Some of the experiments at the beginning of the nineteenth century, conducted by Johann Wilhelm Ritter and others, tested the plant's reaction to electricity (see Wetzels; Henderson). Electricity was *a la mode*, of course, along with the interest in nerves. And the fact that plants

showed some reaction to electricity despite not having nerves was a serious testing case in the emerging field of neurophysiology. Experiments designed to shed some light on this apparent paradox were conducted throughout the nineteenth century – but all to no avail. It remained somewhat of a mystery why plants reacted to electricity, and the question whether plants disposed of sensual perception could not be resolved.[10]

At the same time, there was little doubt that plants reacted to light and temperature. Investigating the circadian rhythm of plants, Johann Gottfried Zinn, John Hill and Charles Bonnet suspected that "the sleeping and the sensitive plants are naturally allied; that their motions, tho' differently brought on, are dependent on the same principle" (Hill 7). At the end of the eighteenth century plants had thus actually climbed up the *scala naturae:* they did not only possess a soul, they were also thought to have the faculty to feel. The sunflower (*Helianthus spec.*) and the mimosa (*Mimosa pudica*) served as crucial test cases for a dividing line between sensitive and non-sensitive plants. As early as the fifteenth and sixteenth centuries botanists were eager to understand the cause for the movement of the sunflower and the mimosa – a movement that was particularly mysterious because it seemed both voluntary and mechanical.[11] The polymath Athanasius Kircher speculated on the movement of the sunflower and devised a sunflower clock (see Hankins and Silverman 14 – 17) but only in the eighteenth century did botanists begin to conduct physiological and histological experiments to find out what exactly caused the movement. The first laboratory experiments by Henry Power, Timothy Clarke, Robert Hooke and John Ray, who all investigated the movement of the mimosa, "served only to establish what they could not explain – that the *Mimosa* has a dramatic capacity for reaction to stimulus" (Ritterbush 237; see Webster 13 – 20).

I think it is fair to say that in eighteenth-century Western thought Aristotle's question whether plants can feel was increasingly reduced to the question whether they can move voluntarily and thus show a reaction to sensory stimuli that could be measured and investigated empirically. Johann Gottfried Zinn, who experimented with the absence of light, discovered that two types of movements had to be distinguished: movements that are governed by internal processes and follow a circadian rhythm regardless whether the plant is exposed to sunshine or not, and movements that are triggered directly by changes in the environment, foremost by the exposure to light. For a clear division between animals and plants, the latter seemed particularly relevant. While Hill was

10 The question of plant communication has only recently been re-addressed by botanists, most prominently by contributors to the textbook *Communication in Plants. Neuronal Aspects of Plant Life* (see Bakuska et al.; Trebacz; Trewavas; Gurovich).

11 For a brief historical sketch that outlines the investigation of plant movement see Whippo and Hangarter 2116 – 2119.

Fig. 2: Kircher. *Magnes sive, De arte magnetica opus tripartitum* (1643). 508.

adamant that the presence and absence of light induced sleep and movement, Zinn and Bonnet were more reserved: "anbey aber bleiben noch immer viele Zweifel übrig, ob der Abwesenheit des Lichts auch der tägliche Schlaf derselben

zuzuschreiben sey, wie H. D. Hill behauptet, und ob nicht in verschiedenen anderen Ursachen der Grund dieser Erscheinung zu suchen sey" (Zinn 47).[12]

The discovery of cells by Henry Dutrochet in 1822, a discovery that was published in 1824, decisively altered the approach in investigating plant movement (Wilson 15). Dutrochet had found that, in the case of *Mimosa*, the motion of the leaves triggered by light depended on cell clusters at the base of the leave's main rib (see Schiller and Schiller). From now on plant physiology was intertwined with histology. Yet despite advances made in morphology and physiology, the question how exactly external stimuli initiated movement of the plant remained a conundrum.

In order to shed some light on the apparently "voluntary" movement of plants, the medical school at the University of Tübingen offered a prize in 1826 for the study that could best explain the movements of twiners and creepers. The winner, Hugo von Mohl, Professor of botany at the University of Jena, naturally agreed with the committee that empirical research in this field was still lacking.

> Da noch nie ein Botaniker mit dem in dieser Schrift behandelten Gegenstande, so wichtig er auch für die Pflanzenphysiologie ist, sich ernsthaft beschäftigte, da bis jetzt die Kenntnis von den Erscheinungen, welche die Ranken und Schlingpflanzen zeigen, höchst unvollkommen war, indem ihr freiwilliges Winden, die Art, wie sie sich an eine Stütze anlegen, wie sie dieselbe umschlingen, der Einfluss, den die Aussenwelt auf die Bewegung dieser Pflanzen äussert, theils gänzlich unbekannt waren, theils abenteuerliche Vorstellungen darüber gehegt wurden, so wird man vielleicht eine nähere Auseinandersetzung der Lebensverhältnisse dieser Pflanzen, wie eine fleissige und unbefangene Beobachtung dieselben kennen lehrte, für keine überflüssige und undankbare Arbeit halten (1827: iv).[13]

Before we look at Mohl's line of argument I should like to point out that there is a definite anthropomorphic ring to the text. Mohl's prize-winning and widely acclaimed study includes a series of metaphors and allegories that make the plant's movement appear human, e. g. when the plant's movement is conceived of as a "freiwilliges Winden", a voluntary winding. The text suggests that Mohl was full of empathy for the plants that are condemned to creep on the face of the

12 "Many doubts remain, however, whether the absence of light can account for sleep during the day of a plant as it is proposed by Doctor Hill, and we may have to investigate other possible causes for this phenomenon." (my translation)

13 "So far no botanist has dealt with the subject of this treatise seriously despite the fact that it is central to plant physiology and that knowledge about the phenomena displayed by the climbers and creepers is imperfect and sketchy: the voluntary winding, the way that these plants lean against their support, how they entangle it, the influence that the environment exerts on the movement of these plants, all this is either completely unknown or immersed in bizarre ideas. Hence, a detailed discussion of the living conditions of these plants that is based on a diligent and unbiased inspection will certainly not be deemed a dispensable and misguided endeavour." (my translation)

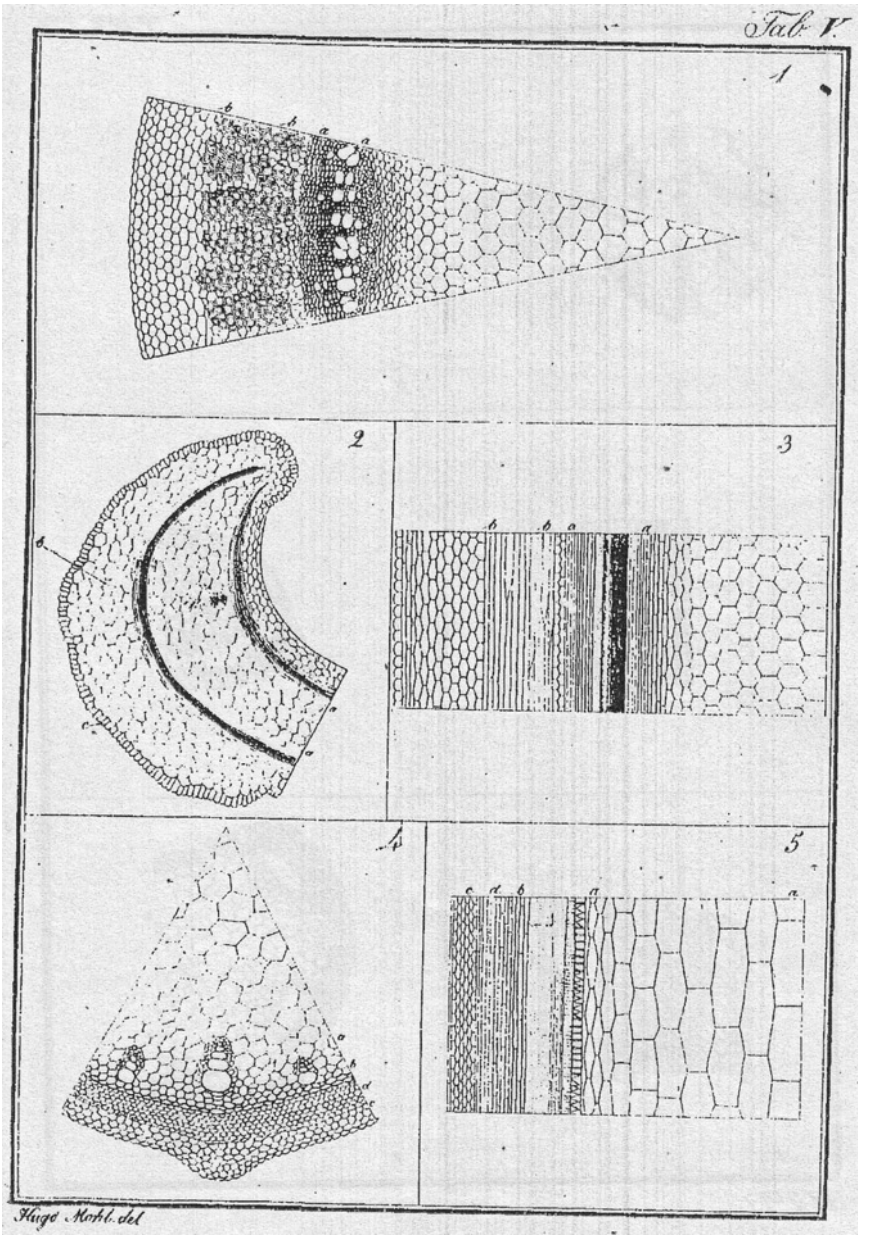

Fig. 3: Hugo von Mohl. *Über den Bau und das Winden der Ranken und Schlingpflanzen* (1827). Tab. V.

earth. He assumed that creeper plants have an inner longing to crawl up the carrier plant and that they are capable of enjoying the lofty heights. Mohl's language is clearly at odds with his intention, expressed in the introduction, not to elevate the plants to the rank of "höherem Leben":

> Wenige nur haben diesen Gewächsen ihre Aufmerksamkeit geschenkt, und diese wenigen haben leider nicht immer auf Beobachtung der Natur ihr Raisonnement gegründet, sondern zu rasch in ihren Folgerungen, haben sie auf unvollständige Beobactungen [sic] sich stützend, und ihrer Phantasie freien Spielraum lassend, in diesen Erscheinungen den Beweis eines höheren Lebens, als den Pflanzen je zukommt, gefunden. (1827: 2)[14]

Mohl's explanation for the movement of creepers is simple. He explains that the plant's movement results from an uneven growth of tissue: the tissue on the far side of the branch grows more quickly than the tissue resting against the carrier plant. "Die nächste Ursache dieser Bewegungen liegt in [der] Expansion des Zellgewebes der obern Seite und der Seitenfläche der Ranke (§. 45 – 46)" (139).[15]

By providing a morphological explanation, Mohl has shown that the movement is, in the end, a question of the plant's metabolism. His careful study supported by a thorough microscopic analysis of the tissue structure does explain how plants grow around a carrier plant and thus cling to it but he does not explain what exactly triggers the irregular growth. It is surprising that neither Mohl nor the committee seem to have noticed the fact that the study is merely descriptive. Mohl's insistence that the creeper only clings to the carrier plant when there is a contact zone between the two raises the old Aristotelean question: is it possible that the plant can *feel* the carrier plant?

It should not go unnoticed that the focus on histology blurred the boundary between animal and plant life, at least for a short period as physiologists like Thomas Southwood Smith and Theodor Schwann "held that the simple constituent parts of animals and plants were the same and could, in certain circumstances, possess an independent vitality" (Jacyna 22). In the long term, however, the focus on histology codified the boundary between animals and plants and served as a definite marker to cluster diverse groups of eukaryotic cells. With the investigation of the vacuole in his *Grundzüge der Anatomie und Physiologie der vegetabilischen Zelle* (1851), published as *Principles of the Anatomy and Physiology of the Vegetable Cell* in 1852, Mohl contributed deci-

14 "Few have paid attention to these plants and the few who have unfortunately have not always based their line of reasoning on observing nature. Instead, they have, briskly in their inferences relying on inchoate observations, overindulged in their imagination and ascribed on account of these phenomena to these plants a higher level of existence than appropriate." (my translation)

15 "The reason for this type of movement is found in the expansion of cell tissue on the upper side and the sides of the tendril." (my translation)

sively to the distinction between plants and animals based on histology (Wayne 2). It is also in his *Grundzüge* that Mohl returns to the issue of plant movement and revisits his own line of argument:

> Diese von mir (Ueber den Bau und das Winden der Ranken und Schlingpflanzen) aufgestellte Ansicht, daß das Umschlingen der Stütze die Folge einer durch Berührung erregbaren Reizbarkeit sei, hat sich gerade keines besonderen Beifalles zu rühmen gehabt, dennoch finde ich nicht, daß Besseres an ihre Stelle gesetzt worden ist (1851: 149).[16]

Three decades before Mohl published his seminal study, Erasmus Darwin was busy writing *The Botanic Garden* (1791) which consists of two distinct poems, the *Economy of Vegetation* [*EV*] dealing with the physiology of plants and the *Loves of the Plants* [*LP*] explaining the Linneaen classification of the plant kingdom. While Mohl was apparently largely unaware of the anthropocentric images and metaphors in his writing, Darwin addresses the reader with a reminder that scientific prose – unlike his poems that are imbued with anthropomorphic imagery – should abstain from imagination and "loose analogies":

> The general design of the following sheets is to inlist Imagination under the banner of Science; and to lead her votaries from the looser analogies, which dress out the imagery of poetry, to the stricter ones, which form the ratiocination of philosophy (*EV* iii).

Throughout *The Botanic Garden*, and in particular in the interludes in which a poet and a bookseller discuss the advantages of rendering natural philosophy in poetic language, Darwin admits that scientific writing needs to resort to "more appropriated and abstracted terms" and should consequently "eradicat[e] the abundance of metaphor" (*LP* 182). His long poem, Darwin explains, is meant as a didactic poem, as an introduction that will "induce the ingenious reader to cultivate the knowledge of Botany" (*EV* iii). According to Darwin, this cultivation culminates in consulting the *Systema Naturae*, the *Species Plantarum* and the *Philosophia Botanica* by Linnaeus.[17] However, Darwin's work is not simply a laborious advertisement for the "Swedish sage" (*LP* 3), *The Botanic Garden* is not merely a poem of praise, nor is it a poem that deals predominantly with plant taxonomy. *The Botanic Garden*, according to Desmond King-Hele "the most popular poem of its day, which the literary world took as its guide to science" (19), is a multiplex poem that addresses many issues of natural philosophy and

16 "The view propounded by me (in *Ueber den Bau und das Winden der Ranken und Schlingpflanzen*) that the curling round the support results from an irritability excited by contact, was not met with approval, let alone acclamation, yet I do not find that anything better has been put in its place." (1852: 156, my translation)

17 Darwin had spent six years translating Linnaeus's *A System of Vegetables*, published in 1785, and *The Families of Plants*, published in 1787.

links them to human life. Written in the late 1780s and published in 1791, it is no surprise that the movement of plants is discussed again and again.

Instead of listing all the references to the movement of plants in *The Botanic Garden*, I should like to concentrate on Darwin's comments on the movement of the mimosa and the sunflower in the first canto of *The Loves of the Plants*. Darwin vividly describes the sense of touch shown by the mimosa:

> Weak with nice sense the chaste MIMOSA stands,
> From each rude touch withdraws he timid hands;
> Oft as light clouds o'erpass the summer-glade,
> Alarm'd she trembles at the moving shade;
> And feels, alive through all her tender from,
> The whisper'd murmurs of the gathering storm;
> Shuts her sweet eye-lids to approaching night,
> And hails with freshen'd charms the rising light.
> Veil'd, with gay decency and modest pride,
> Slow to the mosque she moves, an eastern bride;
> There her soft vows unceasing love record,
> Queen of the bright seraglio of her lord. –
> So sinks or rises with the changeful hour
> The liquid silver in its glassy tower.
> So turns the needle to the poles it loves,
> With fine librations quivering, as it moves. (*LP* 39 – 41)

The image of the trembling mimosa shutting her "sweet eye-lids to approaching night" and moving "with gay decency and modest pride" is juxtaposed with the explanation that it is the ascent and descent of sap in the plant's stem and stalks, the "liquid silver [of the mercury thermometer sinking and rising] in its glassy tower", as well as magnetic attraction, "turn[ing] the needle to the poles it loves", which cause the movement of the plant. The mechanistic explanation that the poem suggests appears to be rebutted by the lengthy annotation but it is ultimately supported by focussing on "the fluids of the plants":

> Naturalists have not explained the immediate cause of the collapsing of the sensitive plant; … Now, as their situation after being exposed to external violence resembles their sleep, but with a greater degree of collapse, may it not be owing to the numbness or paralysis consequent to too violent irritation, like the fainting of animals from pain or fatigue? I kept a sensitive plant in a dark room till some hours after day-break; its leaves and leaf-stalks were collapsed as in its most profound sleep, and on exposing it to the light, above twenty minutes passed before the plant was thoroughly awake and had quite expanded itself. During the night the upper or smoother surface of the leaves are pressed together; this would seem to shew that the office of this surface of the leaf was to expose the fluids of the plant to the light as well as to the air (*LP* 40).

The annotation replicates the poems line of argument: we are first asked to follow Darwin in his "personification or allegoric figure" (*LP* 65) of the plant but

then our gaze is directed at the plant's morphology and physiology that, in Darwin's poem, resound with mechanistic explanations for the movement. As Molly Mahood has pointed out, "it was 'vegetable spontaneity', sudden movement, that struck him as sure proof of plant animality" (65) but in his explanation of that sudden movement Darwin remained poised between a mechanistic and animalistic view of plant movement.

Darwin's treatment of the sunflower is similar. The poem animates the plant: "GREAT HELIANTHUS guides o'er twilight plains / … And bows in homage to the rising dawn; / Imbibes with eagle eye the golden ray, / And watches, as it moves, the orb of day" (*LP* 30). The annotation, however, diverts any speculation that the sunflower is the agent of the movement: "The sun-flower follows the course of the sun by nutation, not by twisting its stem (Hales veg. stat.)" (29). Darwin resorts to the technical term "nutation", the rotation of an axis, to describe the nature of the sunflower's movement. The first entry in the *OED* listing the word "nutation" as a botanical term is taken, in fact, from this passage in Darwin's poem and defined as "bending or directional movement of a plant stem or root, spec. when caused by variation in the rate of growth on different sides of the organ, a movement of this kind." (*OED* s. v. "nutation") However, the *OED* is mistaken here, both Nehemia Grew in his *Anatomy of Plants* (1682) and Stephen Hales in his *Vegetable Staticks* (1724) had resorted to the term "nutation" prior to Darwin (see Oliver 60, 74). Sketchy as the list in the *OED* may be, we can see that the term Darwin chose and firmly established in botany was highly productive. The movement of plants was increasingly construed as a mechanical process caused by differing rates of growth or the ascent and descent of sap and the resulting expansion and contraction of cells.

Darwin's choice to opt for the mechanistic term "nutation" is certainly surprising considering the programmatic theme of his poem:

> It was important for [Darwin] to show plants as an integral part of animate nature, as organisms with the same attributes as animals in a degree appropriate to their place in the scale of organization, and important to show them as sexual beings able to contribute to the variability and progress of the natural world. … This was to be carried out by a sustained application of the simple metaphorical device of seeing plants as people (Browne 604).

Darwin carefully chose metaphors and allegories to sensitise his readers for the closeness of plant and animal life but in his *Botanic Garden* he seems to have been reluctant to compare the movement of plants with the movements of animals. A few years later, in his medico-philosophical *Zoonomia* (1794), Darwin speculated more candidly about the movement of plants:

> That the vegetable world possesses some degree of voluntary powers, appears from their necessity to sleep […]. This voluntary power seems to be exerted in the circular

> movement of the tendrils of vines, and other climbing vegetables; or in the efforts to turn the upper surface of their leaves, or their flowers to the light. (1, 103 – 104)

Referring to the additional note XXXIX in *The Botanic Garden*, in which "[i]t is […] shewn, that the roots of vegetables resemble the lacteal system of animals […]; [and] that the leaves of land plants resemble lungs […]," Darwin lists a whole range of morphological and functional similarities between plants and animals. (104) And he finishes the paragraph with a remarkable proposition:

> And lastly, that the anthers and stigmas are real animals, attached indeed to their parent tree like a polypi or coral insects, but capable of spontaneous motion; that they are effected with the passion of love, and furnished with powers of reproducing their species, and are fed with honey like the moths and butterflies, which plunder their nectarines. (1, 105)

At first sight the passage seems to suggest that Darwin sees no essential difference between animals and plants. In fact, for him some of the plants' organs are "real animals". However, it is difficult to assess where Darwin's analogies end and where his propositions begin. As pointed out by Devin S. Griffiths, Darwin himself "sounds a cautionary note, as analogy's potent associative power can also corrupt scientific inquiry." (647) Darwin knew that when analogy "links together objects, otherwise discordant, by some fanciful similitude; it may indeed collect ornaments for wit and poetry, but philosophy and truth recoil from its combinations" (*Zoonomia* 1, 1; quoted in Griffiths 647). And we know that his grandson, Charles, "criticized the strange brew offered in [Erasmus] Darwin's writings." (647) So we must be careful not to take the analogies offered here for a consistent argument. Darwin's closing statement on the issue is in fact a poetic closure rather than a hypothesis:

> "[…] I think we may truly conclude that they [plants] are furnished with a common sensorium belonging to each bud, and that they must occasionally repeat those perceptions either in their dreams or waking hours, and consequently possess ideas of so many of the properties of the external world, and of their own existence. (107)

This suggestive passage ascribes a level of self-reflection to plants that goes well beyond what was acceptable among botanists at the time.[18] And it must remain a matter of speculation whether Darwin would have seriously defended this conclusion. However, the whole line of argument exemplifies that Darwin and La

18 T.A. Knight, President of the London Horticultural Society, argued, for example, that the movement of plants was simply mechanical: "and therefore, in conformity with the conclusion I drew in my last memoir, respecting the growth of roots, I shall venture to infer, that they [i.e. the movements of tendrils] are the result of pure necessity only, uninfluenced by any degrees of sensation, or intellectual powers." (320)

Mettrie shared the notion that being able to move was the criterion most fitting to distinguish between organisms that have feelings and those that have none.

Considering the poetic nature of Erasmus Darwin's take on plant movement, it is perhaps not surprising that Charles Darwin ignored his grandfather's remarks about plant movement in *The Botanic Garden* when he investigated the movement of plants. In a paper read at the Linnean Society of London on 2 February 1865 and published later that year as *On the Movements and Habits of Climbing Plants* he explains:

> I was led to this subject by an interesting, but short paper by Professor Asa Gray on the movements of the tendrils of some Cucurbitaceous plants. My observations were more than half completed before I learnt that the surprising phenomenon of the spontaneous revolutions of the stem and tendrils of climbing plants had been long ago observed by Palm and by Hugo von Mohl, and had subsequently been the subject of two memoirs by Dutrochet. Nevertheless, I believe that my observations founded on the examination of above a hundred widely distinct living species, contain sufficient novelty to justify me in publishing them. (1 – 2)

Charles Darwin's perspective on plant movement was primarily diachronic: he wishes to understand how the power of movement was brought about – or perhaps lost – in the process of evolution. Explaining the concept "struggle for life" (in the full title) or "struggle for existence" (chapter heading) in his *Origin of Species* (1859) Darwin had argued that plants struggle for life just like animals: "Two canine animals in a time of dearth, may be truly said to struggle with each other which shall get food and live. But a plant on the edge of a desert is said to struggle for life against the drought, though more properly it should be said to be dependent on the moisture" (63) This comparison, often quoted to explain that Darwin had conceptualized the "struggle for life" as a default condition of all living beings rather than an aggressive behaviour, deprives the plants of agency: they are victims of their habitat because they cannot move. It is thus surprising that Charles Darwin turned to climbing plants only a few years after the publication of his *Origin.*

Darwin certainly had a vested interest in showing that plants and animals are related as he was of the conviction that "all living things have much in common". According to Darwin, all living organisms shared the life once "breathed [into] one primordial form":

> I believe that animals have descended from at most only four or five progenitors, and plants from an equal or lesser number. Analogy would lead me one step further, namely, to the belief that all animals and plants have descended from some one prototype. But analogy may be a deceitful guide. Nevertheless all living things have much in common, in their chemical composition, their germinal vesicles, their cellular structure, and their laws of growth and reproduction. … Therefore I should infer from analogy that

> probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed. (1859: 484)

Be that as it may, in his *On the Movements and Habits of Climbing Plants* Darwin had to acknowledge that, as a result of scientific debates pursued well over a century, the ability to move had become a generic feature of animals. Only if it could be proven, Darwin argued, that plants moved like animals would they be eligible to rise to the scale of organization that was typically associated with animals:

> It has often been vaguely asserted that plants are distinguished from animals by not having the power of movement. It should rather be said that plants acquire and display this power only when it is of some advantage to them; but that this is of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the wind and rain. We see how high in the scale of organization a plant may rise, when we look at one of the more perfect tendril-bearers. (1865: 117 – 118)

The short description that follows which compares the climber plant to a "polypus plac[ing] its tentaculy" is reminiscent of the debate of the mid-eighteenth century and it is ripe with anthropomorphic imagery: the tendrils "spontaneously revolve" and "quickly curl round and firmly grasp" the support (118).

Darwin's sustained interest in plant movement resulted in his *The Power of Movement in Plants* (1880), with which he wished to show that "circumnutation is universal in land plants and how it conferred an adaptive benefit for the plant." (Whippo and Hangarter 2120) Assisted by his son, Francis, Darwin conducted experiments to show that plant movement was restricted to the shoot or root tip. In Darwin's view that movement resembled a habit not unlike instincts in animals, and in his closing statement Darwin maintained:

> It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the movements of the adjoining parts, acts like the brain of one of the lower animals; the brain being seated within the anterior end of the body, receiving impressions from the sense-organs, and directing the several movements. (573)

Darwin's theory of evolution, first expressed in his *Origin*, "showing how plants and animals, most remote in the scale of nature, are bound together by a web of complex relations" (1859: 73), and applied specifically to plants in his *Power of Movement* undoubtedly shifted the focus. The ecological perspective construed movement of both plants and animals as instances of a continuum. However, it did not alter the scientific foundations for taxonomic approaches to nature as they had been established in the eighteenth century (see Scharf 75 – 9; Stern 173 – 5). Linnaeus's system with its Aristotelean division into *lapides* (stones, minerals, fossils) *vegetabilia* (plants) and *animalia* (animals), reaffirming the

generic dividing line between plants and animals still exerted an influence: Linnaean taxonomy, indeed all taxonomic systems, as Dan H. Nicolson has pointed out, include a complex "overlay of hierarchical […] specified ranks and associated endings" (9). The binomial system, which appeared to be objective in the sense that it was merely descriptive, was pervaded from the outset with a set of values along the lines of foundational metaphors but it was only "in the early nineteenth century [that] logical divisions based on the tree of Porphyry, became associated with the concepts of "higher" and "lower" organisms in animal classification, thus emphasising the conceptual connection of the tree and the *scala naturae*" (Panchen 19). While lower and higher states within a kingdom are conceived of as gradual, the boundary between the kingdom of plants and the kingdom of animals was drawn on qualitative grounds. The obsession to identify the order of nature and to establish boundaries between genera and ultimately kingdoms thus resulted in focussing on what separated living organisms rather than acknowledging what united them. By focussing on spontaneous or even voluntary movement of plants, eighteenth-century botanists set the agenda for finding proof that plants can feel. Developments in physiology and histology in the late eighteenth century then circumscribed this research project to the effect that attention was directed away from what caused the movement to how it was achieved. In the wake of botanists as dissimilar as Hugo von Mohl and Erasmus Darwin plants thus lost their decisive battle for recognition as organisms that have a life. And we as humans are the poorer for it.

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