III
Theory of the Root
The Life of the Stars

10
Roots

In Sneffels Yoculis craterem kem delibat
umbra Scartaris Julii intra calendas descende,
audas viator, et terrestre centrum attinges.
Kod feci. Arne Saknussemm.

[Descend into the crater of Yocul of Sneffels,
which the shade of Scartaris caresses, before the kalends of July,
audacious traveler, and you will reach the center of the earth.
I did it. Arne Saknussemm.]

Jules Verne

They are hidden and invisible to the vast majority of animal organisms, who compete for attention on the platforms of terra firma. Sunk as they are in a cryptic, cloistered world, they pass their lives without the slightest idea about the explosion of forms and events that swarm between Earth and sky. Roots are the most enigmatic forms of the plant world. Their body is often infinitely large and infinitely more complex than its aerial twin, the one that plants let appear in the light of day: the total surface of the root system of a rye plant can reach 400 square meters, that is, a surface 130 times larger than that of the plant's aerial body.[1]

In the history of plant life, they arrived relatively late: for millions of years, plants could do without roots—in the sea as on earth.[2] *Primum vegetari deinde radicare* [first be animated, then grow roots]: plant life would seem not to need roots in order to define itself, exist, or at least survive. The origin of roots is obscure, and it is not easy to distinguish their forms. The first fossil evidence dates back to 390 million years ago. As in all forms of life destined to last for millions of years, their origin is due to fortuitous invention and bricolage more than to methodical, conscious elaboration: the first kinds of roots were functional modifications of the trunk or horizontal rhizomes deprived of leaves.[3]

Their morphology as well as their physiology is extremely variable: their functions have changed over time and cannot be univocally attributed to them; sometimes—as is the case with mycorrhizae—they are delegated to other organisms, which enter into a symbiotic relationship with the plant.

They seem to live cut off from the multiplicity of living beings, and yet it is thanks to them that plants come to be aware of what goes on around them. Plato had already compared our head, and hence reason, to a "root": the human being, he said, is "a plant of the sky [*phuton ouranion*] and not of the earth," with the roots going up—a sort of inverted plant.[4] But the version that was to become canonical was given by Aristotle in the treatise *De anima*: "up and down are not for all things what they are for the whole world: if we are to distinguish and identify organs according to their functions, the roots of plants are analogous to the head in

animals."[5] "The action of the two," Averroes would gloss, "is identical."[6] The analogy between the head and the root sets up the one between human being and plant, which was to have an extraordinary success in the philosophical and theological tradition from the Middle Ages and up to the modern period (Francis Bacon would still use it). Likewise, in his philosophical treatise, when he expands over the parallelism between these two, Guillaume de Conches explains that "trees push their root, which has their head, toward the bottom, in the earth from which they derive their nutrition. Man, on the contrary, exhibits his head, which is like his root, in the air, because he lives by his spirit."[7] Linnaeus[8] would reverse the direction of the analogy, speaking of the plant as an upside-down animal. But the dictum *quemadmodum caput est animalibus ita radices plantis* ("the root is for plants what the head is for animals") seems never to have lost its efficacy. Thus, in the conclusion to his book on the motor faculty of plants, Darwin wrote:

> 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.[9]

Likewise, František Baluška, Stefano Mancuso, and Anthony Trewavas[10] extended this intuition through research on the concept of plant intelligence and attempted to demonstrate that the root corresponds perfectly to the animal brain, since they have the same capacities. It is through the root system, in effect, that a plant acquires the vast majority of information on its own state and that of the environment in which it is immersed; it is also through the roots that it comes into contact with other, limitrophic individuals and manages, collectively, the risks and difficulties of underground life.[11] The roots make the soil and the subterranean world a space of spiritual communication. Thanks to them, then, the most solid part of the Earth is transformed into an enormous planetary brain[12] through which matter circulates, along with information on the identity and state of the organisms that populate the surrounding environment. It is as if the eternal night, in which one imagines the depths of the Earth to be plunged, were anything but a long and deaf sleep. In the immense and silent horn of the underground, night is a perception without organs, without eyes and without ears, a perception that takes place through the whole body. Intelligence, thanks to roots, exists in mineral form, in a world without sun and without movement.

In ordinary speech as in literature and art, roots are often the emblem and the allegory of what is most *fundamental* and *originary*, what is most obstinately solid and stable, what is necessary. They are the plant organ par excellence. And yet it would be hard to find a more ambiguous form among those that life has created and adopted over the course of its history. They are not any more necessary to the survival of the individual than the other parts of the organism; from a strictly evolutionary point of view, they are not at the origin of the plant result —as is the photosynthetic function, for example. The advantages they bring are those of networking, and not those of isolation or distinction. But, even so, it would be naive to consider them a secondary and "decorative" appendage. Roots are not what we thought they were, but they express and embody, all the same, one of the most significant traits of plant

existence: ambiguity, hybridity, their amphibious and double character.

We are dealing here in the first place with ecological hybridity. Thanks to roots, the vascular plant, alone among all living organisms, inhabits *simultaneously* two environments that are radically different in their texture, structure, and organization and in the nature of the life that inhabits them: earth and air, sun and sky. Plants are not content to touch them lightly, they push into each one of them with the same stubbornness, the same capacity to imagine and to fashion their bodies in the most unexpected forms. Cosmic mediators, plants are *ontologically amphibious* beings:[13] *they connect environments and spaces*, showing that the relation between the living being and the environment cannot be conceived of in *exclusive* terms (say, those of niche theory, or Uexküll's); they always have to be inclusive. Life is always cosmic, and not a matter of niches; it is never cloistered in a *single* environment, but it radiates through all environments; it makes of those environments a *world*, a cosmos whose unity is atmospheric.

This ecological duplicity is accompanied and as if redoubled by a dynamic, structural duplicity. Although in communication and in mutual interpenetration (much like in the whole cosmos), the two environments not only are juxtaposed against each other but structure themselves as reversed mirror images. It is as though plants lived two lives at the same time: one aerial, bathed and immersed in light, made of visibility and of an intense interspecific interaction with other plants and with other animals of all kinds; the other chthonic, mineral, latent, *ontologically* nocturnal, chiseled in the stony flesh of the planet, in synergistic communion with all the forms of life that populate it. These two lives do not alternate and do not exclude each other: they are the being of the same individual, the only one who succeeds in reuniting, in its body and in its experience, the earth and the sky, the stone and the light, the water and the sun, and to be the image of the world in its totality. Already in the body of the plant, everything is in everything: the sky is in the Earth, the Earth is pushed toward the sky, the air makes itself body and extension, and extension is nothing but an atmospheric laboratory.

Plants are beings that are ecologically and structurally double: but their bodies are the ones that are *anatomically geminated* first. The root is like a second body, secret, esoteric, hidden; an antibody, an anatomical antimatter that reverses as in a mirror, point by point, everything the other body does, and that pushes the plant in a direction exactly opposite to that of all the efforts it makes above the surface. Imagine that, for each movement of your body, there is another one that goes the opposite way; imagine that your arms, your mouth, your eyes have an antithetical correspondent in a matter that mirrors perfectly the one that defines the texture of your world: you would then have an idea, albeit a vague one, of what it means to have roots. This is what Julius Sachs calls the anisotropy of the plant body—in other words, the antitropy specific to its extremities.[14] As if the body of plants were divided into two, each one of its parts structures itself according to a force and a texture radically opposed to each other. The root is an apparatus of meticulous deconstruction of forms and geometries from the terrestrial surface, starting with the force that seems to determine entirely our life, the life of mobile animals: gravity.[15]

Augustin Pyramus de Candolle wrote in the nineteenth century:

> We give a more exact idea of this organ in saying that the Root (*radix*; *racine*) is that part of the plant which, at its origin, tends to descend towards the centre of the earth with more or less energy. It is to this prevailing character of roots that some naturalists have made allusion when they have designated the root, in a general manner, under the name of *Descensus*.[16]

They are the essence of descent: the way toward the bottom, the geological plunge of life. Their existence—as though they were Otto Lidenbrocks or, better still, nonhuman Arne Saknussemms—is a perpetual voyage to the center of the Earth, an attempt to meld with it. Thomas Andrew Knight had already observed, at the start of the nineteenth century, that "it cannot elude any observer, even the most inattentive, [that,] regardless of the position one puts it in, the seed to bring about the root will invariably make the effort to descend toward the center of the Earth, whereas the elongated germ will take the exact opposite direction."[17] Extending Julius Sachs's research,[18] Charles Darwin, with his son Francis, located the origin of this force in the extremities of roots:

> Sensitiveness to gravitation resides in the tip; and it is the tip which transmits some influence to the adjoining parts, causing them to bend. […] Different parts of the same plant and different species are affected by gravitation in widely different degrees and manners. Some plants and organs exhibit hardly a trace of its action. […] In the case of the radicles of several, probably of all seedling plants, sensitiveness to gravitation is confined to the tip, which transmits an influence to the adjoining upper part, causing it to bend towards the centre of the earth.[19]

One would be wrong to see in this love for the Earth a simple effect of gravity: the root does not limit itself to perceiving and passively submitting to the gravitational force, as does any body situated on the surface of the Earth. Of course, gravity is "the most constant and most permanent force among all the environmental forces that act on plants,"[20] but the reaction to gravity is not the same as the reactions that other bodies—animal bodies—display. It is not simply the effect of weight; it is a different attraction, a force of growth that is directed toward the center of the planet. Darwin had noticed it:

> Geotropism […] excites the primary radicle to bend downwards with very little force, quite insufficient to penetrate the ground. Such penetration is effected by the pointed apex (protected by the root-cap) being pressed down by the longitudinal expansion or growth of the terminal rigid portion, aided by its transverse expansion, both of which forces act powerfully.[21]

It is as if the root doubled the weak force of gravity that pushes it toward the bottom. As if the plant, in its totality, used all its means to overcome the resistance against its descent—with an intensity equal to that which the stem uses to elevate itself.

One is tempted to see the root as the most perfect accomplishment of the Nietzschean program of *amor fati*: "I entreat you, my brothers, *remain true to the earth*, and do not believe those who speak to you of superterrestrial hopes!"[22] The root is not simply a base on which the superior body of the trunk is based, it is the simultaneous inversion of the push toward the

upward direction and the sun that animates the plant: it incarnates "the sense of the earth," a form of love for the soil that is intrinsic in any vegetal being. In the pseudo-Aristotelian treatise *De plantis*, the connection with the earth was already understood as one of the essential elements of the nature of plants: one reads there that "the plant *lives on earth*, as though tied to it"; and this is the reason why "it has no need of sleep."[23] But this is only a part of the truth, and it misconstrues what the root brings to each plant: its hybrid, amphibious character. The root is only a half of the seeded body of the plant—the relation with the earth is just one of the two lives of all plant organisms. And it cannot be understood except in relation to its other half: geotropism is one of the directions of an impulse [*élan*] that has no purpose besides being faithful to the Earth. It is an effect and a result of heliocentrism, which defines the very essence of plant life. If it needs to bury itself in the mineral body of the Earth, this is in order to bind it better to the fire that determines, part by part, its forms and movements.

Notes

1. Howard J. Dittmer, "A Quantitative Study of the Roots and Root Hairs of a Winter Rye Plant (Secale cereale)," *American Journal of Botanics*, 24 (1937): 417–20.

2. At least until the end of the Devonian era, vascular plants seemed to have lived without developed radical axes. See J. A. Raven and Diane Edwards, "Roots: Evolutionary Origins and Biogeochemical Significance," *Journal of Experimental Botany*, 52 (2001): 381–401; P. G. Gensel, M. Kotyk, and J. F. Basinger, "Morphology of Above- and Below-Ground Structures in Early Devonian (Pragian-Emsian) plants," in P. G. Gensel and D. Edwards (eds.), *Plants Invade the Land: Evolutionary and Environmental Perspectives* (New York: Columbia University Press, 2001), pp. 83–102; Nuno D. Pires and Liam Dolan, "Morphological Evolution in Land Plants: New Designs with Old Genes," *Philosophical Transactions of the Royal Society*, 367 (2012): 508–18, particularly 511–12; Paul Kenrick and Christine Strullu-Derrien, "The Origin and Early Evolution of Roots," *Plant Physiology*, 166 (2014): 570–80; Paul Kenrick, "The Origin of Roots," in A. Eshel and T. Beeckman (eds.), *Plant Roots; The Hidden Half*, 4th edn. (London: Taylor & Francis, 2013), pp. 1–13 (the volume is essential and includes a vast bibliography).

3. Gar W. Rothwell and Diane M. Erwin, "The Rhizomorph of Paurodendron: Implications for Homologies among the Rooting Organs of the Lycopsida," *American Journal of Botany*, 72 (1985): 86–98; Liam Dolan, "Body Building on Land: Morphological Evolution of Land Plants," *Current Opinion in Plant Biology*, 12 (2009): 4–8.

4. [Plato, *Timaeus* 90a, in Benjamin Jowett's translation in Edith Hamilton and Huntington Cairns (eds.), *The Collected Dialogues of Plato*, Princeton: Princeton University Press, 1987, p. 1209.] The origin of this image is quite ancient. On this topic, see Cari-Martin Edsman, "Arbor inverse: Heiland, Welt und Mensch als Himmelspflanzen," in *Festschrift Walter Baetke dargebracht zu seinem 80. Geburtstag am 28 Marz 1964* (Weimar: Böhlaus, 1966), pp. 85–109 and Luciana Repici, *Uomini capovolti: Le piante nel pensiero*

dei greci (Bari: Laterza, 2000).

5. Aristotle, *De anima* 2.4, 416ª2 ff [translation from Jonathan Barnes (ed.), *The Complete Works of Aristotle*, vol. 1, Princeton: Princeton University Press, 1984, p. 662].

6. Averroes, *Commentarium magnum in Aristotelis De anima libros*, ed. by F. Stuart Crawford. Corpus commentariorum Averrois in Aristotelem [CCAA] versio Latina VI.1 (Cambridge, MA: Medieval Academy of America, 1953), p. 190.

7. Guillaume de Conches, *Dragmaticon philosophiae* 6.23.4, in idem, *Opera omnia*, vol. 1, ed. by Italo Ronca. Corpus Christianorum, Continuatio mediaevalis [CCCM] 152 (Turnhout: Brepols, 1997), p. 259; Alain de Lille, *Liber in distinctionibus dictionum theologicalium*, in volume 210 of Migne's Patrologia latina [MPL], cols. 707–8; Alexander Neckham, *De naturis rerum* 2.152 (p. 232 Wright); Hugo Ripelin, *Compendium theologicae veritatis* 2.57 (= vol. 34, col. 78a of Albertus Magnus, *Opera omnia*, ed. by Auguste Borgnet and Émile Borgnet, Paris: Louis Vivès, 1895). We are dealing here with a commonplace found in all forms of knowledge and writing; see, for example, Cornelius a Lapide, *Commentaria in Danielem Prophetam* ch. 4, section 7–8, in idem, *Commentaria in quatuor prophetas maiores* (Antwerp: Apud Henricum et Cornelium Verdussen, 1703), p. 1298; and Cornelius a Lapide, *Commentaria in Marcum*, ch. 8, in idem, *Commentarius in quatuor evangelia*, 2nd edn. (Venice: Ex typis Hieronymi Albritii, 1710–17), p. 461. See also Francis Bacon, *The New Organon*, ed. by Lisa Jardine and Michael Silverthorne (Cambridge: Cambridge University Press, 2000), pp. 107–8 (= Book 2, section 7).

8. Carl von Linné, *Philosophia botanica in qua explicantur fundamenta botanica* (Vienna: Ioannis Thomae Trattner, 1763), p. 97: *planta animal inversum veteribus dictum fuit* ("the ancients said that the plant is an animal upside down").

9. Charles Darwin, *The Power of Movement in Plants* (London: John Murray, 1880), p. 573. See also F. Baluška, S. Mancuso, D. Volkmann, and P. W. Barlow, "The 'Root-Brain' Hypothesis of Charles and Francis Darwin: Revival after More than 125 Years," *Plant Signaling & Behavior*, 12 (2009): 1121–7.

10. See Anthony J. Trewavas, *Plant Behaviour and Intelligence* (Oxford: Oxford University Press, 2014) and Stefano Mancuso and Alessandra Viola, *Brilliant Green: The Surprising History and Science of Plant Intelligence*, trans. by Joan Benham (Washington: Island Press, 2015).

11. F. Baluška, S. Lev-Yadun, and S. Mancuso, "Swarm Intelligence in Plant Roots," *Trends in Ecology and Evolution*, 25 (2010): 682–3; M. Ciszak, D. Comparini, B. Mazzolai, F. Baluška, F. T. Arecchi, T. Vicsek, et al., "Swarming Behavior in Plant Roots," *PloS ONE* 7 (1): e29759, doi: 10.1371/journal.pone.0029759, 2012. The literature on this subject has become massive; see especially F. Baluška, S. Mancuso, D. Volkmann, and P. W. Barlow, "Root Apices as Plant Command Centres: The Unique "Brain-like" Status of the Root Apex Transition Zone," *Biologia*, 59 (2004): 9–17; E. Brenner, R. Stahlberg, S. Mancuso, J.

Vivanco, F. Baluška, and E. van Volkenburgh, “Plant Neurobiology: An Integrated View of Plant Signaling,” *Trends of Plant Science*, 11 (2006): 413–19; F. Baluška and S. Mancuso, “Plant Neurobiology from Stimulus Perception to Adaptive Behavior of Plants, via Integrated Chemical and Electrical Signaling,” *Plant Signaling & Behavior*, 6 (2009): 475–6; A. Alpi, N. Amrhein, A. Bertl, M. R. Blatt, E. Blumwald, F. Cervone, et al., “Plant Neurobiology: No Brain, No Gain?” *Trends in Plant Science*, 12 (2007): 135–6; E. D. Brenner, R. Stahlberg, S. Mancuso, F. Baluška, and E. van Volkenburgh, “Plant Neurobiology: The Gain Is More Than the Name,” *Trends in Plant Sciences*, 12 (2007): 285–6; P. W. Barlow, “Reflections on ‘Plant Neurobiology,’” *BioSystems*, 92 (2008): 132–47; F. Baluška (ed.), *Plant-Environment Interactions: From Sensory Plant Biology to Active Plant Behavior* (Berlin: Springer, 2009); and F. Baluška and S. Mancuso (eds.), *Signalling in Plants* (Berlin: Springer, 2009). See also the recent manifesto by P. Calvo, “The Philosophy of Plant Neurobiology: A Manifesto,” *Synthese*, 193 (2016): 1323–43.

12. Anthony J. Trewavas tries to define a noncerebral concept of intelligence, in opposition to what Vertosick had called cerebral chauvinism. See his *Plant Behaviour and Intelligence*, p. 201. See also Anthony J. Trewavas, “Aspects of Plant Intelligence,” *Annals of Botany*, 92.1 (2003): 1–20 and Frank T. Vertosick, *The Genius Within: Discovering the Intelligence of Every Living Thing* (New York: Harcourt, 2002). For some criticism of Trewavas (rather weak, in fact), see for example Richard Firn, “Plant Intelligence: An Alternative Viewpoint,” *Annals of Botany*, 93 (2003): 475–81 and F. Cvrcková, H. Lipavská, and V. Zarsky, “Plant Intelligence: Why, Why Not, or Where?” *Plant Signal Behaviour*, 4–5 (2009): 394–9. The idea of *Earth* as brain is an extremely frequent refrain in the last texts of Marshall McLuhan: see “The Brain and the Media: The ‘Western’ Hemisphere,” *Journal of Communication*, 28 (1978): 54–60.

13. It was Dov Koller (*The Restless Plant*, ed. by Elizabeth van Volkenburgh, Durham: Duke University Press, 2015, p. 1) who observed this most clearly: “In this respect, all but very few plants are obligate amphibians, with part of their body permanently in the aerial environment and the remaining part within the soil. This structural differentiation in plants is based on function.” On the notion of an ontological amphibian in anthropology, see the excellent book by Eben Kirksey, *Emergent Ecologies* (Durham: Duke University Press, 2015); and also René ten Bos, “Towards an Amphibious Anthropology: Water and Peter Sloterdijk,” *Society and Space*, 27 (2009): 73–86. But, in this case as in the orthodox use of the concept in biology, one assumes a successive habitation of two or more environments.

14. Julius Sachs, “Über Orthotrope und Plagiotrope Pflanzenteile,” *Arbeiten des Botanischen Instituts in Würzburg*, 2 (1882): 226–84.

15. On gravitropism, apart from the monographs by Chamovitz and Karban [cited in ch. 1, nn. 1 and 10 respectively] and Koller’s *Restless Plant*, see the classic by Theophil Ciesielski, *Untersuchungen über die Abwärtskrümmung der Wurzel: Beiträte zur Biologie der Pflanzen*, 1 (1872): 1–30; also Peter W. Barlow, “Gravity Perception in Plants: A

Multiplicity of Systems Derived by Evolution?" *Plant, Cell, and Environment*, 18 (1995): 951–62; R. Chen, E. Rosen, and P. H. Masson, "Gravitropism in Higher Plants," *Plant Physiology*, 120 (1999): 343–50; C. Wolverton, H. Ishikawa, and M. L. Evans, "The Kinetics of Root Gravitropism: Dual Motors and Sensors," *Journal of Plant Growth Regulation*, 21 (2002): 102–12; R. M. Perrin, L.-S. Young, N. Murthy, B. R. Harrison, Y. Wang, J. L. Will, and P. H. Masson, "Gravity Signal Transduction in Primary Roots," *Annals of Botany*, 96 (2005): 737–43; and Miyo Terao Morita, "Directional Gravity Sensing in Gravitropism," *Annual Review of Plant Biology*, 61 (2010): 705–20.

16. Augustin Pyramus de Candolle, *Vegetable Organography, or, an Analytical Description of the Organs of Plants*, trans. by Boughton Kingdon (London: Houlston & Stonesman, 1839), p. 209. The motif is Aristotelian. See Aristotle, *De anima* 2.4, 416[a]: "Empedocles is wrong in adding that growth in plants is to be explained, the downward rooting by the natural tendency of earth to travel downwards, and the upward branching by the similar natural tendency of fire to travel upwards" [translation from Jonathan Barnes (ed.), *The Complete Works of Aristotle*, vol. 1, Princeton: Princeton University Press, 1984), pp. 661–2].

17. Thomas Andrew Knight, "On the Direction of the Radicle and Germen during the Vegetation of Seeds," *Philosophical Transactions of the Royal Society*, 99 (1806): 108–20, here p. 108. Before Knight, Henri-Louis Duhamel de Monceau (from whose text Knight quotes) had already tried to furnish an explanation of the fact that "glands placed in a cup in a humid place germinate, and one constantly sees that situation that chance has created for these glands, all the radicules tend toward the sun" (Henri-Louis Duhamel de Monceau, *La Physique des arbres, où il est traité de l'anatomie des plantes et de l'économie végétale* (Paris: Guérin and Delatour, 1758), p. 137.

18. Julius Sachs, "Über Orthotrope und Plagiotrope Pflanzenteile."

19. Darwin, *Power of Movement in Plants*, pp. 196–7, 548, and 567–8.

20. Koller, *Restless Plant*, p. 46.

21. Darwin, *Power of Movement in Plants*, p. 197.

22. Friedrich Nietzsche, *Thus Spoke Zarathustra*, trans. by Robert J. Hollingdale (New York: Penguin, 1969), p. 42 (= Prologue, section 3).

23. [Aristotle], *De plantis*, 817[b]20–2.

11
The Deepest Are the Stars

We struggle to imagine their environment. Light barely reaches them. Here the sounds and noise of our higher world are a deaf, continuous tremor. On Earth, almost everything that goes on up there exists as, and is translated into, quakes and shudders. Water percolates, like any liquid that comes from the world above and, like everything down here, makes efforts to go down toward the center. Everything is in contact with everything, and a slow circulation of materials and juices allows all to live well beyond the limits of their body. Everything breathes, but in a different way from the aerial world. Besides, the breath of bodies has no need to pass through lungs—or through organs, for that matter: any body is defined by its breath, any body is a port, open to the circulation of matter—within and outside itself. The organism is nothing but the invention of a new way of mixing with the world and of allowing the world to mix with what is inside it. Down here, to breathe means to give oneself a tentacular body, capable of clearing for itself a path blocked by stone, and to multiply one's arms and appendages so as to embrace as much Earth as possible, so as to expose oneself to it like the leaf to the sky.

But if roots are active organs of cosmic mixture, this is not only because they put into communication the different elements of the pedological biosphere—the underground world they inhabit—or the other organisms of plants. Their function is, on the contrary, of a cosmic order: their breath involves not only the colloidal substances to which they adhere and the fauna that lives there, but the relations between Earth and Sun. One of the great botanists of the last century wrote:

> The plant plays the role of a mediator between the Sun and the animal world. The plant, or rather its most typical organ, the chloroplast, is the connection that brings together the activity of all the organic world—everything we call life—to the center of energy of our solar system: such is the cosmic function of the plant.[1]

The root is what allows plants to implicate in this cosmic mediation the Earth, in its *planetary dimension*. If the Earth rotates physically around the Sun, it is *in* plants and *thanks to* them that this connection produces life and matter, which always exists in new forms. Plants are the metaphysical transfiguration of the rotation of the planet around the Sun, the step that transforms a purely mechanical phenomenon into a metaphysical event. What is more, they make the Sun live on the Earth: they transform the Sun's breath—its energy, its light, its rays—into the very bodies that inhabit the planet, they make of the living flesh of all terrestrial organs a solar matter. Thanks to plants, the Sun becomes the skin of the Earth, its most superficial layer, and the Earth becomes a star that feeds off the Sun and constructs itself from its light. They metamorphose light into an organic substance and make life a primarily solar fact. Around the mid-nineteenth century, Julius Mayer wrote this:

> Nature has given itself the task of catching in flight the light that overflows on Earth and of guarding this most mobile of forces after having frozen it into a solid form. To reach this goal, it has covered the terrestrial surface with organisms that take solar light in themselves and, as they use this force, produce a continuous sum of chemical differences. These organisms are the plants. The plant world constitutes a reservoir in which the volatile solar rays are skillfully frozen and made available for use.[2]

Thanks to plants to a certain extent, heliocentrism changes from an erudite and speculative problem into a question of life: through them, life is—and is nothing but—the form par excellence of heliocentrism. This is not a matter of truth or opinion: every living being is only the effect and the expression of heliocentrism, on account of the fact that everything on Earth exists thanks to the Sun. The root makes it possible for the Sun—and for life itself—to penetrate down to the marrow of the planet, to bring the Sun's influence to its deepest resting places, to infiltrate down to the center of the Earth the metamorphosed body of the star that generates us.

"Once blasphemy against God was the greatest blasphemy, but God died, and thereupon these blasphemers died too. To blaspheme the Earth is now the most dreadful offence, and to esteem the bowels of the Inscrutable more highly than the meaning of the Earth."[3] It would be difficult to find words that can summarize with greater precision the spirit of the new religion that defines the contemporary world. Attachment to the Earth—in its planetary, environmental dimension—is the foundation not only of most practices and theories of deep ecology: it is also the spirit that animates the new global politics that has come into view in the past several decades. The Earth is the *only* supreme instance in whose name it becomes possible again to affirm *universal* decisions, which concern not only a specific nation or a specific people but the human species in its totality—in the present as in the future. This cult, as well as the fidelity to the Earth invoked by Nietzsche, is far less novel than one can imagine: to replace the personal divinity of ancient Mediterranean religions with the planet Earth means, once again, to forget what is literally more evident, clear, luminous: the Sun. Heliocentrism has for a long time defined the self-consciousness displayed by the natural sciences, and yet it is far from having left its mark on common consciousness.

Despite the numerous celebrations and the innumerable declarations of conversion, philosophy, just like our common sense, seems never to have let go of its faith in geocentrism. We've never truly been heliocentrists: geocentrism is the deepest soul [*âme*] of western forms of knowledge.[4] Proof of this is in the exclusion that astrology has suffered since the Renaissance: the modern period has identified with the call of the Earth and oblivion of the stars, with the even deeper affirmation of the Earth as the definitive horizon of our existence and of our knowledge. First of all, *being in the world* means being on Earth, measuring everything that is and that happens starting from the forms and figures specific to the planet that is supposed to host us. The Earth, then, is the *definitive* metrical space: the science of place and space is called geometry, measure of the Earth. The Earth is the ultimate place in which everything has to figure. Only what takes the form of the elements present on this planet exists.

This geometrical obsession becomes explicit in Husserl's phenomenology. In a famous

fragment where he tries to overturn Copernicus's results, Husserl shows how the Earth is not and cannot be an object of experience, because it is its fundamental structure: each body "is nonetheless directly referred to the ground of all relative ground-bodies, to the earth-ground."[5] Before being a body, the Earth is the fact itself that there is a ground, a base, that from which one *can* represent to oneself the world, the bodies, their movement and their stillness: "in the primordial shape of its representation, the Earth itself does not move and does not rest; only in relation to it are movement and rest given as having their sense of movement and rest."[6] And western geocentrism would seem to relate to a strange nostalgia for the world of the root. The Earth is not and cannot be a star, it has first of all to be the *ground* [sol]: "For all of us, however, the earth is ground and not a body in the complete sense."[7] Besides, it is *thanks to* the possibility of considering the Earth as soil [*sol*], as *root*, *origin*, *universal base*, that it is possible to affirm the unity of humanity. Every object of experience cannot but be "relative to the earth-ground ark and the 'earthly sphere' and to us, earthly human beings, and the objectivity is related to universal humanity."[8] This is exclusively because, as he writes, "the earth is for everyone the same earth—the same bodies rule over it, in it, above it"; thus "the totality of the We, of human beings, of 'animals,' is in this sense earthly."[9] "There is only one humanity and one earth—all the fragments which are or have been separated from it belong to it."[10]

We continue to conceive of ourselves through the prism of a falsely *radical* model, we continue to think the living being and its culture from a false image of roots (because they are isolated from the rest)—as if, by dint of conceiving of the root as reason, we have transformed reason itself and thought into a blind force of rooting, into the faculty of constructing a cosmic connection with the Earth. From this perspective, the replacement of the classical root-based model with that of the rhizome does not represent a real paradigm shift: thought continues to be what allows us to think of the Earth, and only of the Earth, as *ground*, to affirm that "[t]he earth is not one element among others but rather brings together all the elements within a single embrace while using one or another of them to deterritorialize territory."[11] Fidelity to the Earth —the extreme geotropism of our culture, its will, and its insistence on "radicalness"— has an enormous price: it means devoting oneself to the night, choosing to think without the Sun. Philosophy seems to have chosen, several centuries ago, the way of darkness.

Geocentrism is the delusion of false immanence: there is no autonomous Earth. The Earth is inseparable from the Sun. To go toward the Earth, to dig into its breast means always to raise toward the Sun. This double tropism is the breath itself of our world and its primary dynamism. It is this same tropism that animates and structures the life of plants and the existence of stars: there is no Earth that is not intrinsically tied to the Sun, there is no Sun that is not in the course of making possible the superficial and profound animation of the Earth. To the lunar and nocturnal realism of modern and postmodern philosophy, one should oppose a new form of heliocentrism, or rather an extremization of astrology. This is not, or not only, to make the simple assertion that the stars influence us, that they govern our life, but to accept all this and to add that we also influence the stars, because the Earth itself is a celestial body among others, and everything that lives on it (as well as in it) is of an *astral* nature. There is nothing but sky, everywhere, and the Earth is one of its portions, a state of partial aggregation.

> At rest, however, in the middle of everything, is the sun. For in this most beautiful temple, who would place this lamp in another or better position than that from which it can light up the whole thing at the same time? For, the sun is not inappropriately called by some people the lantern of the universe, its mind by others, and its rulers by still others. [Hermes] the Thrice Greatest labels it a visible god, and Sophocles' Electra, the all-seeing. Thus indeed, as though seated on a royal throne, the sun governs the family of plans revolving around it. […] Meanwhile the earth has intercourse with the sun, and is impregnated for its yearly parturition.
>
> In this arrangement, therefore, we discover a marvelous symmetry of the universe, and an established harmonious linkage between the motion of the spheres and their size, such as can be found in no other way.[12]

These are the words by which Copernicus tried to revolutionize the way in which we relate to the world. The stake, for him, was not simply the affirmation of the centrality of the Sun. To place the Sun *in the middle of everything* amounted to several cognitive and metaphysical displacements.

To posit that the Sun lies at the center of the universe means, first of all, to *universalize movement*. The Earth *needs to turn* around the Sun in order to exist: all its reality has to be comprised of and observed starting from this infinite source of light and energy. The core of our world is not a stable point, forever frozen; it is something in the nature of a continual bubbling of energy and something to which we have access only through movement, of which the Sun itself is the cause. Everything exists thanks to this source. On the other hand, our bodies, the rocks, the animals are the extreme point of the sky. Our constant, daily heart is the Sun—a cosmic gulf that produces and emanates that of which our bodies are at once captors, archives, and mirrors. To eat is already to recognize the centrality of the Sun and its energy along with its acts, to find on Earth an indirect relation to it: *every* organic compound is, directly or indirectly, the result of the influence of solar energy captured by plants and transformed into an organic mass, into living matter. Each time we eat, we try to make up for our incapacity to absorb immediately this energy of which plants make use. Our body is the archive of what the Sun offers the Earth.

To assert that the Earth turns around the Sun means, then, to deny the ontological separation between human, terrestrial space and celestial, inhuman space—and thus to transform the very idea of *sky*. The sky is no longer an accidental atmosphere that envelops the Sun; it is the only substance of the universe, the nature of everything that exists. The sky is not what is above. The sky is everywhere: it is the space and the reality of mixture and movement, the definitive horizon starting from which everything has to draw itself. There is nothing but sky, everywhere; and everything, even our planet and what it hosts, is but a condensed portion of this celestial, infinite, and universal matter. Everything that happens is a celestial event, everything that occurs is a divine fact. God is no longer elsewhere, he coincides with the reality of forms and accidents. Plants have made life a perpetual devotion to the sky, to what takes place in the sky, and all this while being firmly rooted in the Earth. This means that, thanks to the plants, life is no longer a purely *chemical* fact but especially an *astrological* one.

To assert a *material* continuity between the Earth and the rest of the universe means to change the idea itself of the Earth. The Earth is a celestial body, and everything in it is sky.[13] The human world is not the exception in a nonhuman universe; our existence, our gestures, our culture, our language, our appearances are *celestial*. To recognize the *astral* nature of the Earth is to make astrology—the science of the stars—not just into a local science, but also into *the global and universal science*: the task is no longer to understand the dominion of the stars over us—their governance—but to understand the sky as the space of flux and of influences. It is not just that biology, geology, and theology are no more than branches of astrology; on this model, astrology becomes a science of contingency, unpredictability, irregularity. The sky is not the site of the return of the same.

Thus astrological universalism involves the destruction of the very idea of absolute immanence, the assertion of something like an infinite floating where no body and no being lets itself be anchored anywhere any more, where in fact there is no longer any soil, any stable base, any ground. The ultimate source of our existence is the sky. The Earth and its extension are not the base or the universal substrate of our existence but rather its extreme surface, the ultimate and least substantial screen of the universe of the real: depth is represented by the stars, the Earth and sky are the infinite extension of our skin. This destruction of the traditional idea of ground also allows us to go beyond the ordinary horizon of ecology. From its very beginning, ecology always considers the environment exclusively in terms of habitat, of a soil that hosts and welcomes: it makes the world a universalization of the idea of inhabitability. It reduces the great space, the universe of the sky, to an inhabitable Earth. And it is because of this conception of the world as ground, welcoming space, and inhabitability that ecology can consider the cohabitation of living beings in an *ordered* and *standardized* collective. To recognize or to become aware that the Earth is an astral space, that it is only a condensed portion of the sky, is to recognize that there is such a thing as the uninhabitable, that space can never be, and will never be, definitively inhabited.[14] One crosses and penetrates space, one mixes with the world, but one will never be able to establish oneself in it. Every dwelling tends to become uninhabitable, to be *sky* and not a house. This is what the root demonstrates—what ordinary language considers to be the most successful example of habitation: it is but the extremity of a device of conjunction between Earth and sky, the ruse that allows us to transform the Earth into a celestial body down to its core.

To make the Earth into a celestial body is, once again, to render contingent the fact that it represents our habitat. Like the vast majority of stars, the Earth is not by definition inhabitable. The cosmos is not the inhabitable in itself—it is not an *oikos* [a home], it is an *ouranos* [a sky]: ecology is no more than the refusal of *uranology*.

Notes

1. Kliment Timiryazen, *The Life of the Plants: Ten Popular Lectures* (Moscow: Foreign Languages Publishing House, 1953), p. 341. See also p. 188: “It is not the leaf as a whole, but the chloroplast that colours it green, which serves as a connecting link between the Sun

and all things living upon the Earth."

2. Julius Mayer, *Die organische Bewegung im Zusammenhang mit dem Stoffwechsel: Ein Beitrag zur Naturkunde* (Heilbronn: Drechsler'sche Buchhandlung, 1845), pp. 36–7.

3. Friedrich Nietzsche, *Thus Spoke Zarathustra*, trans. by Robert J. Hollingdale (New York: Penguin, 1969), p. 42 (= Prologue, section 3).

4. Since Deleuze and Guattari's proposal for a "geophilosophy," this geocentrism has become explicit. See Gilles Deleuze and Félix Guattari, *What Is Philosophy?*, trans. by Hugh Tomlinson and Graham Burchell (New York: Columbia University Press, 1994); Ray Brassier, *Nihil Unbound: Enlightenment and Extinction* (London: Palgrave, 2007); Eugene Thacker, *In the Dust of This Planet: Horror of Philosophy*, vol. 1 (Winchester: Zero Books, 2011); Ben Woodard, *On an Ungrounded Earth: Towards a New Geophilosophy* (New York: Punctum Books, 2013). A work that goes against this tendency is the splendid book by Peter Szendy, *Kant in the Land of Extraterrestrials*, trans. by Will Bishop (New York: Fordham University Press, 2013).

5. Edmund Husserl, "Foundational Investigations of the Phenomenological Origin of the Spatiality of Nature: The Originary Ark, the Earth, Does Not Move," trans. by Fred Kersten, in Maurice Mearleau-Ponty, *The Limits of Phenomenology: Including Texts by Edmund Husserl*, ed. by Leonard Lawlor and Bettina Bergo (Evanston: Northwestern University Press, 2002), pp. 117–31, here p. 121.

6. Ibid., p. 118.

7. Ibid., pp. 123–4.

8. Ibid., p. 127.

9. Ibid., pp. 123, 126.

10. Ibid., p. 130.

11. Deleuze and Guattari, *What Is Philosophy?*, p. 85.

12. Copernicus, *De revolutionibus* 1.10 [translation from Nicolaus Copernicus, *On the Revolutions* [1543], trans. by Edward Rosen (Baltimore: Johns Hopkins University Press, 1992), p. 22]. On the significance of the Copernican revolution, the literature is enormous. See, among others, Michel-Pierre Lerner, *Le monde des sphères*, vol. 2: *La fin du cosmos classique* (Paris: Les Belles Lettres, 2008); Alexandre Koyré, *The Astronomical Revolution: Copernicus–Kepler–Borelli* [1961], trans. by R. E. W. Maddison (London: Routledge, 2009); and Thomas S. Kuhn, *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought* (Cambridge, MA: Harvard University Press, 1977).

13. This is the conclusion that Giordano Bruno had drawn from the works of Copernicus:

Astrorum igitur unum terra est, que non minus digno altoque caelo comprehenditur quia quodcunque ex aliis aliud ("In conclusion the Earth is one of the planets, and it is surrounded by the sky no less properly and deeply because anything else [is surrounded] from different directions": Giordano Bruno, *Camoeracensis Acrotismus* art. 65, in idem, *Opera latine conscripta*, Naples: F. Fiorentino, 1971). On Bruno and Copernicus, see the splendid books by Miguel A. Granada, *El debate cosmologico en 1588: Bruno, Brahe, Rothann, Ursus, Röslin* (Naples: Bibliopolis, 1996) and *Sfere solide e cielo fluido: Momenti del dibattito cosmologico nella seconda metà del Cinquecento* (Milan: Guerini e associati, 2002).

14. For a quite different, but equally radical and original cosmocentric perspective, see the masterpiece by Fabian Ludueña, *Más allá del principio antrôpico: Hacia una filosofia del Outside* (Buenos Aires: Prometeo Libros, 2012). Ludueña's whole oeuvre can be considered a speculation on the cosmos as an abiotic space.