

Ghost Lineages, Ghost Acres, and Darwin's "Diagram of Divergence of Taxa" in *On the Origin of Species*: Critical Commentary Inspired by Banu Subramaniam's *Ghost Stories for Darwin*

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Just after page 116 of Charles Darwin's original edition of *On the Origin of Species* appears the book's only illustration, a gatefold diagram of descent with modification, a branching-tree schema that would later come to be known as the "Diagram of Divergence of Taxa" (Darwin himself described it as charting "divergence of character" [Darwin, 1859, p. 116]) (Figure 1). The visual rhetoric of the tree diagram and the conditions and entailments of its theoretical declarations about change and inheritance over time have been expertly interpreted by historians, philosophers, anthropologists, and literary scholars of science (see Browne, 1980; Ospovat, 1981; Beer, 1983; Klapisch-Zuber, 1991; O'Hara, 1992; Smith, 2006; Hacking, 2007; Ingold, 2007; Pietsch, 2013; Lima, 2014; Bouzat, 2014). What I offer here is a reading inspired by Banu Subramaniam's *Ghost Stories for Darwin: The Science of Variation and the Politics of Diversity* (2015), a book in which Subramaniam reflects on the history of breeding experiments that aided in theorizing variation, on collections of old and new sentiments that have valued "native" over "alien" species, and on a range of eugenic scripts that have drawn upon theories of difference derived from readings and misreadings of Darwin. Writing as an experimental geneticist and feminist studies scholar, Subramaniam argues that inquiries into genetic variation have not been merely or abstractly intellectual enterprises alone. Rather, because they treat matters to do with relations among diversity, life, and death, such inquiries have necessarily been biopolitical in their implication, inflected by histories of colonialism, structural racism, sex/gender inequalities, and human-non-human hierarchies. Subramaniam writes that, "The seemingly innocuous history of genetic variation holds within it the countless bodies of the dead, the mutilated,

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the tortured, the irredeemable, the unwanted....” (pp. 7-8). In other words, the history of thinking about and working on genetic variation (in the lab, in the field, in the world, with model and wild organisms, with non-humans and humans) is a history that is crowded with ghosts.

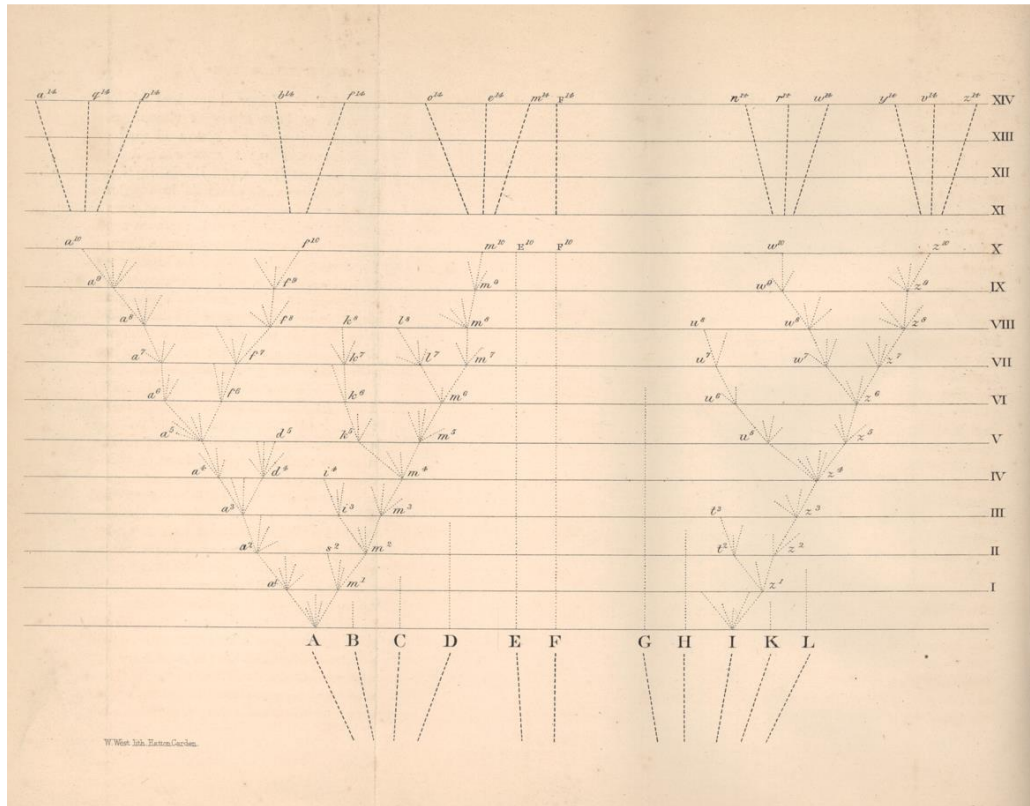


Figure 1. William West's lithographed diagram of the divergence of character, from Darwin 1859.

In what follows, I trace some ghostly lineages we might read within the form of Darwin's diagram and I also consider those multispecies bodies layered into the material history and political economy that made possible the lithograph and its reproductions. The point here is not to ask after Darwin's individual intentions (though his uneasiness with his theory will come up) so much as it is to ruminate upon a scientific representation and its conditions of possibility, both apparent and occluded. Following Avery Gordon, whose *Ghostly Matters* (2008) is a touchstone for Subramaniam's book, I am interested in Darwin's diagram's *hauntings* — both formal (how is death or extinction represented or managed in the image?) and material (out of what substances, organic and otherwise, were the diagram and its copies made and in what ecological and economic relations?). As a drawn and published artifact, Darwin's diagram can be read not only as a schematic for evolutionary plots (Beer, 1983), but also as a suggestive pointer to the absent and vital presences of the dead in nascent evolutionary theory and in the material substances of the theory's presentation. Let us think about such material substances from a presentist angle for a moment: just as today's digital

texts (including the one I am writing now) sometimes seem to hover above the material world but in fact depend upon rare earth and conflict minerals, under-remunerated labor, and environmental toxins (see Gabrys, 2011; Parikka, 2014 on the “Anthroscene,” Alaimo, 2016), so too did Darwin’s lithograph sit within the unequal material economy and ecology of its time.

I begin, though, with the diagram’s form, with the lines that give the diagram its purpose. Lines of organismic descent travel upward from the bottom of the page, representing species lineages ramifying into new, naturally selected varieties (see Bouzat, 2014), their classificatory thresholds marked by horizontal lines labeled on the diagram’s right side with clock-face Roman numerals, ticking upwards one through fourteen. The space between one horizontal line and the next above marks the passage, Darwin writes, of a thousand — or better, he speculates, ten thousand — generations. He explains:

Let (A) be a common, widely-diffused, and varying species, belonging to a genus large in its own country. The little fan of diverging dotted lines of unequal lengths proceeding from (A), may represent its varying offspring . . . Only those variations which are in some way profitable will be preserved or naturally selected . . . When a dotted line reaches one of the horizontal lines, and is there marked by a small numbered letter, a sufficient amount of variation is supposed to have been accumulated to have formed a fairly well-marked variety, such as would be thought worthy of record in a systematic work. (1859, p. 117)

Those offspring that do survive, Darwin continues, will “partake of those more general advantages which made the genus to which the parent species belonged, a large genus in its own country” (p. 118)

Folded into this account is the theme of the fittedness of species to their native land — to, in Darwin’s language, their “own country.” This moment in Darwin hints at the valuation of native species that Subramaniam analyzes across a range of later evolutionary accounts indebted to this model of natural selection. Darwin’s diagram is suffused too with the hauntings of those creatures possessed of variations in some way unprofitable. Study the diagram: the off-white expanse around the lines of surviving lineages is empty. But this blankness is also full — of the dead. As Darwin observes,

during the process of modification, represented in the diagram, another of our principles, namely that of extinction, will have played an important part . . . [T]here will be a constant tendency in the improved descendants of any one species to supplant and exterminate in each stage of descent their predecessors and their original parent. (p. 121)

The empty space of this diagram is thus a space of *ghosts*. These were ghosts that had an upsetting resonance for Darwin himself, who was famously unsettled by the cruelty in his model of evolution — and personally devastated by the death of three of his ten children, two in infancy, one at age ten. “If he had any inclination to think about his theory of natural selection at ... [the time of his children’s deaths],” writes Janet Browne, “he might easily have reflected on the melancholy fact that his ideas of struggle required the death of the weakest individuals, even of his own babies. His theory was a bleak theory of elimination” (2002, p.37). The ghosts in this diagram may also be *prefigurings*, premonitions of the ghosts Subramaniam identifies as at the heart of many of our received evolutionary theories.¹ These may be the ghosts of eugenics future — ghosts of both a theoretical kind as well as of what Subramaniam names as the “ghostly dispossessed,” the coming victims of projects animated by social Darwinisms that would take a version of Darwin’s account not just as an attempt at description, but as a political prescription.

Darwin’s diagram is inhabited by ghosts *inside* its lineage lines too. Darwin, before settling on describing this divergence as a *tree*, wrote in his 1837 notebooks: “The tree of life should perhaps be called the coral of life, base of branches dead; so that passages [between one variety and another] cannot be seen” (Darwin, 1837-38, p. 25; and see Beer, 1983, p.261, note 12). Julia Voss, in *Darwin’s Pictures*, reports that, “for this reason, Darwin drew the trunk as a dotted line” (2010), borrowing a convention he had used in depictions of coral reefs, which indexed with a dotted line those portions submerged or out of view (Figure 2) (and see Sponsel, 2018). Life grows upon the dotted-line bodies of the dead.

Fast-forward for a moment to the late twentieth century to another use of dotted lines, to indicate species inferred, but not definitively known, in a phylogeny. Biologist Mark Norell, in his 1992 *Taxic Origin and Temporal Diversity: The Effect of Phylogeny* (Figure 3), calls these *ghost lineages*. He writes: “These additional entities are taxa that are predicted to occur by the internal branching structure of phylogenetic trees.... I refer to these as ghost lineages because they are invisible to the fossil record” (p. 105; see Wray, 2001, Figure 1a, reproduced as Figure 3, below, for a diagram). I want to leverage and amplify Norell’s *ghost lineages*, using the term to also name those lines of inheritance that have been disavowed or forgotten in the many dominant modes of narrating or drawing lines of descent.

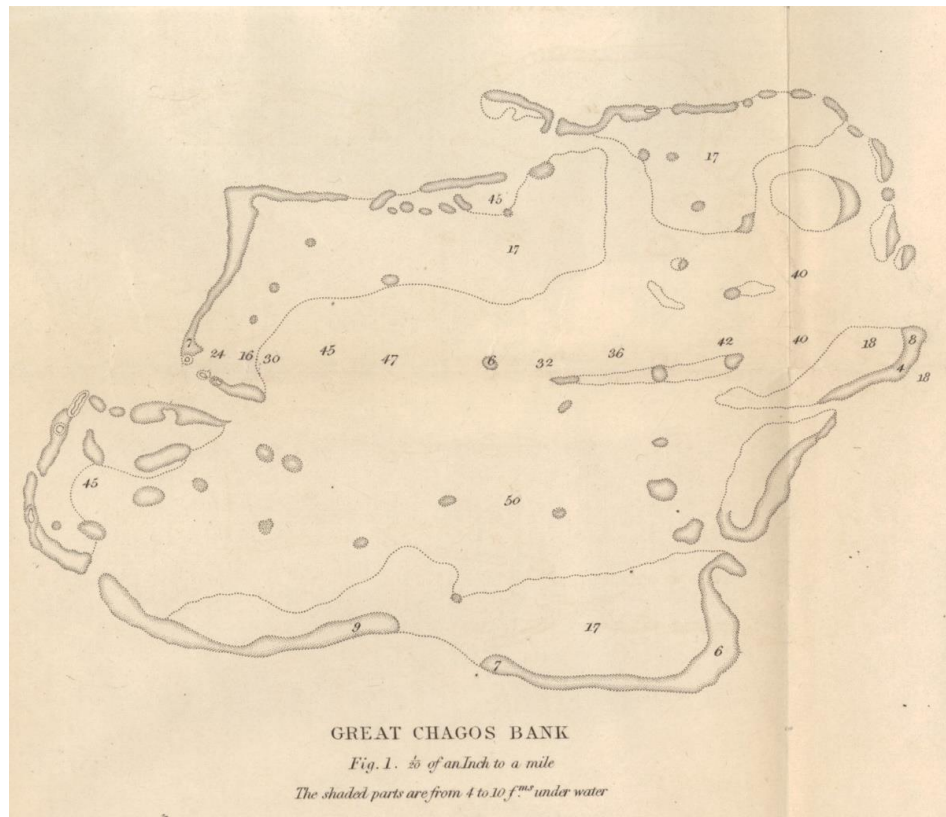


Figure 2. Dotted lines in Darwin 1842.

Patrilineal pedigrees that assign women to subsidiary roles as mothers and daughters under a ramifying patronymic grid are a significant and telling example (for a history, see Klapisch-Zuber, 1991, p.108; Mitchell, 2014; for a contemporary instance from the realm of genetic genealogy, see Scully, 2018). Most diagrams of family pedigrees during the Victorian period in which Darwin lived saw lines of sons and fathers given pride of place — patrinalism, patrilineality, and patriarchy all reinforcing one another in concert with a wider cultural dedication to paternity as that socially fashioned, sanctioned, and naturalized tether that could legitimate property inheritance (see Delaney, 1986).² Women could appear in such mappings of ancestry only insofar as they were included as daughters, sisters, and mothers in patrilineal lines (see Helmreich, 2001). The very form of the family tree representation in those European systems of patriarchal kin reckoning that conditioned Darwin's usage was thus crafted in ways that subordinated and ghosted women's lives, keeping in shadow what might rather (or also) have been recorded through matrilineal lines or through other genealogical or a genealogical format (see Richards 2017 on the naturalization of sexed asymmetry in the pedigree accountings of those gentlemen pigeon and horse breeders whose work inspired some of Darwin's thinking about artificial, natural, and sexual selection). Think, too, of the effaced lineages — the erased mothers and children — resulting from the reproductive subordinations of women under racialized chattel slavery (cf. Spillers, 1987; Roberts, 1997). These, too, are ghost lineages

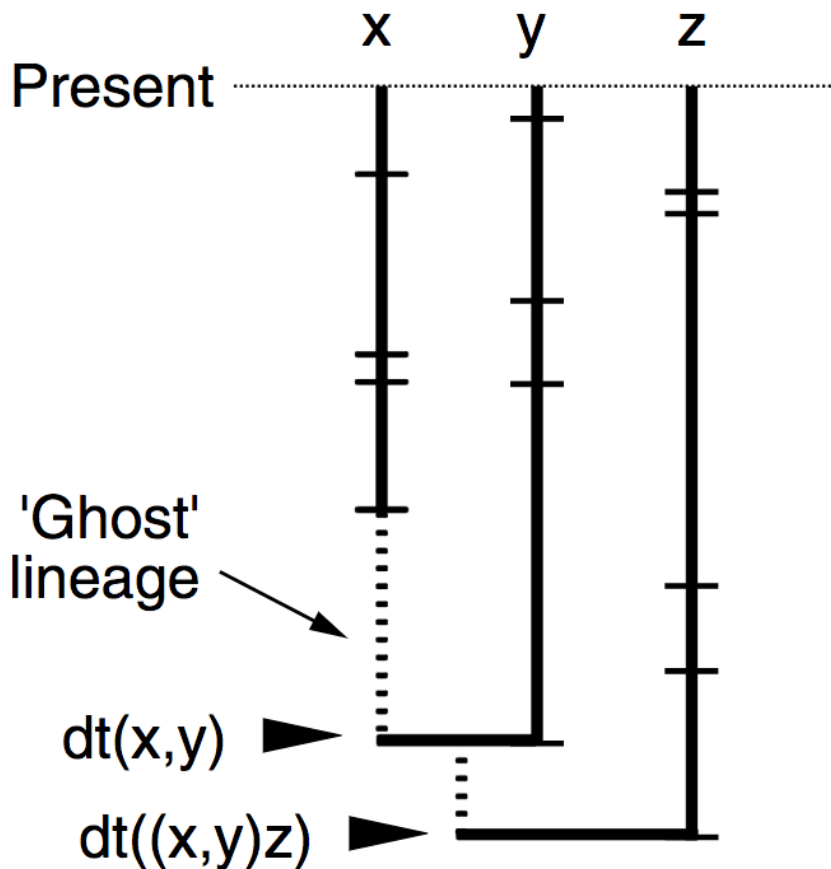


Figure 3. A Diagram of Ghost Lineages from Figure 1 of Wray's 2001 "Dating Branches on the Tree of Life Using DNA": "Thick bars represent periods for which there is a fossil record for the lineage; dotted lines represent 'ghost' lineages, times when a group is inferred to have been present but left no record."

What other ghost presences reside in Darwin's diagram? The diagram, figuring life on the dotted-line bodies of the dead, itself depended, as a material made paper thing, on a network of once living materials become dead. The diagram was created for Darwin's book as a *lithograph* even though he had hoped it might be a copper engraving (see Darwin's 31 May 1859 letter to publisher John Murray [Darwin Correspondence Project, "Letter no. 2465"] and see Paisley, 2016, 2017). Lithography is a printing technique invented in Germany in 1796 that employs smoothed limestone as a substrate on which an image is drawn using oil, fat, or wax. That image is then treated with gum arabic, a substance that permits the image to transfer to a piece of paper. Limestone is a sedimentary rock composed of calcite or dolomite, often incorporating the fossilized remains of marine creatures such as coral, algae, sponges, microbes, and bryozoans. In Darwin's day, British limestone would have been sourced from Yorkshire, Derbyshire, Dorset or Lincolnshire, quarried from deposits dating from the Permian to the Jurassic periods (The source of the limestone used by William West of 54 Hatton Garden, Middlesex, to create Darwin's diagram is not, to the best of my knowledge,

recorded, though it almost certainly came from limestone suppliers in London; whether they sourced their limestone from inside the country or from common sources in France or Germany is not a question to which I know the answer). The bodies of dead creatures (perhaps even extinct species) were thus the very matter on which the diagram was drawn (as indeed would have been the case for lithographs in many other books during this period). Or, following environmental historian Etienne Benson's call to "go beyond the important work overreading the traces that non-human animals have left in human texts" (2011, p. 7), lithographs were materializations of non-human writing because they embodied traces and tracks of past organismic vitality (see also Sir Joseph Boehm's 1885 statue of Charles Darwin, made of marble, which is metamorphosed limestone — and therefore composed of the crystallized carbonates that were once the sedimented accumulation of dead marine creatures).

The gum arabic sourced from acacia trees from the Western Sahara — that vegetal resin used for fixing lithograph images — used to transfer Darwin's diagram from stone to paper, meanwhile, would have been of much more recent origin than the limestone. As historian of West Africa James Webb writes: "[F]rom the late seventeenth century until the 1870s, gum arabic was the single most important product traded by the Europeans who stopped along the 'gum coast' of southern Mauritania or traded at the mouth of the Senegal River" (1985, p. 150). The gum would be seasonally harvested from acacia groves by people laboring, perhaps as slaves or indentured labor, for overseers from the Zawāyān nomadic tribes of Mauritania, who would have in turn traded with Europeans, primarily from France and England.

There is also a tale to tell about Darwin's book as a thing itself. Its paper, made by Spalding paper makers (Peckham, 1959), would likely have been from wood pulp, a process invented in 1843 to replace rag content. Since England's forests had been depleted because of charcoal production (see Nef, 1977) — an early signal of the Anthropocene? — the wood for the pulp may have come from outside England.³

The material making the reproduction of the tree of life lithograph and its carrying medium of copies of *Origin*, then, likely points in many ways away from England to a network of European, colonial, and subaltern suppliers and to a collection of human and non-human bodies bound up in relations of difference and inequality. (*Origin* is of course not unique in this way; a similar story could be told for many other Victorian books created in the webworks of the British Empire. And, as I remarked above, today's digital publishing is also bound up in networks of unequal economies and ecologies — often obscured by rhetorics of data storage that would have us believe that our texts exist in some ethereal form, in something called "the cloud").



Figure 4. Sir Joseph Boehm's 1885 statue of Charles Darwin — a material ghost of the marine skeletons making up its marble substance — at the Natural History Museum, London.

Historian Kenneth Pomeranz, in *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (2000), argues that British dominance during the industrial revolution depended on production in the colonies, on what Pomeranz called “ghost acres,” land outside the nation that produced cotton, sugar, corn, and tea. Of course, for people not in Britain who were working in these lands, these were not *ghost* acres at all. These plots were likely those stages on which played out what Subramaniam names “the lives of the ghostly

dispossessed—the bodies displaced, starved, colonized, violated, sterilized, experimented upon, maimed, killed, exterminated” (p. 122). Ghost lineages, then, on ghost acres.

What I am gesturing toward here, with my attention to the form as well as substance-infrastructure of Darwin’s diagram, are further material lineages for what Subramaniam calls “ghost stories for Darwin” —stories, in their way, paradoxically (?), imaginable because of Darwin’s own theories of excess and extinction (themselves a transcription of Victorian views of nature as red in tooth and claw [Beer, 1983], the grim side of the “grandeur” Darwin forwarded [1859, p. 490] as a possible aesthetic for the unfolding tale of natural selection). Trained in evolutionary genetics, Subramaniam centers her analysis on the formal frameworks of canonical evolutionary theory — their mathematics, their hypotheses — a crucial vantage point from which can begin to be unpacked their conditions of possibility as well as the way historical contexts often disappear when theories start to circulate. She observes, for example, that mid-twentieth-century questions to do with whether variation in a population is due to mutation or to balancing selection— referring to Hermann Muller and Theodosius Dobzhansky — are haunted by eugenic debates about whether variation is good or bad. Population genetic formalisms like the “genetic load,” she argues, are ghostly survivals of these debates. “Ignoring the historical backdrop of eugenics debates dooms scientists,” writes Subramaniam, “to a future as co-conspirators in the production of inequality” (p. 226; and see Mackenzie, 1978 and Norton, 1978). Her call to think carefully about our inheritances from this history follows, but also amplifies, the “thought collective” analytic of Ludwig Fleck (1935), that scholar for whom the Fleck Prize was named, which *Ghost Stories for Darwin* received in 2016 from the Society for the Social Studies of Science. Subramaniam goes ingeniously beyond Fleck’s analytic of the “thought collective” to think about the lively, deadly, material, and deathly ghosts that haunt such imaginaries, ghosts around which thoughts themselves may be formed and given substance. My sketch here on both the form and matter of Darwin’s diagram is meant as a companion think piece, a way to ponder the history, at once material and ghostly, of the tools created to draw scientific conclusions — and diagrams.

.Acknowledgments

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Notes

¹ Lenora Ledwon, in "Darwin's Ghosts: The Influence of Darwinism on the Nineteenth-Century Ghost Story" (1989), argues that, in the wake of Darwin, Victorian ghost stories became populated by bestial, sub-human spirits imagined as disowned and disavowed ancestors. These were not so much prefigurings of where Darwinian phantasms might travel in the future, but rather, she suggests, returns of the repressed racist anxieties of nineteenth-century white Europeans.

² Such representations — and their legal supports in laws of "coverture"— came, however, also during the Victorian period, to be contested in early feminist activism that sought to undo gendered inequalities in marriage and inheritance law (see Shanley 1993).

³ The original version of this article erroneously stated that the first edition binding was of goatskin from tanneries in Morocco. This was true of one singular copy; the book in its many reproductions was in green publishers' cloth. For general information on book binding in Victorian England, see <https://www.adelaide.edu.au/library/special/exhibitions/victorian-bindings/>. Error was corrected 6/15/2021.

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