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A Poetry of Science or a Science of Poetry?: The Speculative Method of Erasmus Darwin (1731–1802)

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Abstract: Specialization was not in the lexicon of Erasmus Darwin (1731–1802): doctor, scientist, poet, inventor, and socialite. By profession, he was an unparalleled general physician with a universality of mind that infused his practice of medicine as well as his technical innovation, scientific observation, and poetic vision. For Darwin, scientific findings involved a mixture of informed conjecture and imagination. Darwin's approach to poetry hinged on this ability to illumine a scope of subjects with concise couplets supported by imaginative exposition and speculation. Scientific facts and theories interwoven with mythological places and characters constitute his "hypotheses". Writing in an instructive and captivating manner, Darwin became the only best selling scientific poet in English history, largely due to his steadfast conviction that poetry should amuse and entertain the public. His poetry, and in particular his choice to recruit science and technology as its subject matter, will be discussed in this paper. The focus will be on two of Darwin's long poems. The first, "The Botanic Garden", is divided into Part I 'The Economy of Vegetation' (1791) and Part II 'The Loves of the Plants' (1789). The second poem is the posthumous "The Temple of Nature" (1803). Darwin's speculative method will be shown through close analysis of these works.

Keywords: Theme: Literary Humanities, English Literature, Erasmus Darwin, Science, Poetry, Speculation

Specialization was not in the lexicon of Erasmus Darwin (1731–1802): doctor, scientist, poet, inventor, and socialite (Smith and Arnott 2005, 1–4). By profession, he was an unparalleled general physician with a universality of mind that infused his practice of medicine as well as his technical innovation, scientific observation, and poetic vision. As an artist, he achieved notoriety as the sardonic, ponderous bard whose rhythmically crafted couplets embraced the scientific and technological issues of his time. Writing in both an instructive and captivating manner, Darwin became the only best-selling scientific poet in English history largely due to his steadfast conviction that poetry should amuse and entertain the public. His poetry, and in particular his choice to recruit science and technology as its subject matter, will be discussed in this paper. The focus will be on two of Darwin's long poems. The first, *The Botanic Garden*, is divided into Part I, 'The Economy of Vegetation' (1791), and Part II, 'The Loves of the Plants' (1789) (Darwin 1799). The second poem addressed here is the posthumous *The Temple of Nature* (1803) (Darwin 1804).

Both long poems demonstrate Darwin's talent for writing up scientific findings in verse. *The Botanic Garden* was highly acclaimed during its time and sold widely whereas the success of *The Temple of Nature* was stunted because of Erasmus Darwin's controversial evolutionary ideas. As we will see regarding his evolutionary theory, Darwin's approach to scientific discovery differed radically from the stereotypical modern image of the rogue scientist in an antiseptic lab, carefully plotting statistical frequency curves. For Darwin, scientific findings involved a

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mixture of informed conjecture and imagination. Darwin's approach to poetry hinged on this ability to illumine a scope of subjects with concise couplets supported by imaginative exposition and speculation. Scientific facts and theories, interwoven with mythological places and characters, constitute his 'hypotheses'. In the preface to 'The Economy of Vegetation', he even apologizes to the reader for putting forth so many conjectures, but asserts that a current of speculation sets in motion a much-needed series of confirmatory experiments (King-Hele 1963, 100). Hence, for Darwin, imagination is the fountainhead of ideas from which scientific discourse springs. Still, why would an esteemed physician write up his scientific 'findings', in particular the more controversial contentions, in poetry instead of as a more official or professional treatise? In other words, what special advantage did Darwin recognize that poetry presented for swaying the public toward his scientific assertions?

Figure 1: 'Flora at Play with Cupid' from The Botanic Garden

Before I present three suggestions in response to these questions, it should be mentioned that Darwin maintained a theory of poetry in which prose instructs while poetry amuses. He further believed that poetry, in order to reach the public, should consist largely of visual images: 'the Poet writes principally to the eye, the Prose-writer uses more abstracted terms' (Darwin quoted

in Logan 1936). Darwin replaced prose abstraction with poetic images by personifying a theoretical scientific account, then having the mythological being behave in captivating ways. *The Botanic Garden*, for instance, is punctuated with visually sharp mythological episodes, many relating to the Goddess of Botany addressing a humble audience of sylphs, gnomes, and nymphs. Hence, for Darwin, the imaginative yet palpable visual imagery appropriate to verse provided a forum for speculation whereas the pure abstraction of prose would never hold the same weight in popularizing his scientific findings.

My first suggestion consists of two intertwined points: poetry provided the imaginative medium for Darwin's scientific conjecture, and an imaginative scenario was the sugary coating that allowed Darwin to feed his scientific and technological ideas to the populace. Section I of this paper will address this suggestion as it pertains to Darwin's first long poem, *The Botanic Garden* with emphasis on Part I, 'The Economy of Vegetation'. *The Botanic Garden*, with its complex imaginative structure, best exemplifies Darwin's weaving together of scientific observation and innovation with phantasmagoric characters and settings. By entertaining the populace with stunningly crafted verses and amusing preternatural persona, Darwin made his notions palatable to a wide audience and thereby broadcast his scientific speculation (Torrens 2005, 259–272).

Figure 2: 'Erasmus Darwin' (1792) by Joseph Wright of Derby (Oil on Canvas)

The second suggestion here is that the versification of science relates to Darwin's theory of organic happiness in which the contentment of a creature enhances its potential to survive. Hence, his scientific poetry with its intention to amuse and delight shows Erasmus working through his own theory; in some way, the couplets are the doctor's attempts to ensure, through organic happiness, his own existence within the scheme of evolution. This point will be expanded in Section I through an examination of Darwin's second long poem, *The Temple of Nature*.

The final suggestion of this paper relates mostly to the first suggestion: poetry serves as a vehicle for his voluminous footnotes and additional notes through which he expounds, in a more serious tone, the innovative scientific concepts put forth in his verse. Thereby, Erasmus could offer the best of both worlds: amusing poetry and didactic prose notes. That the notes often exceed the poems in length implies that Darwin was very confident in the ability of the notes to propound his theoretical ideas while floating under the cover of verse.

Versified Science: Blending Poetic Imagination and Scientific Theory

For Erasmus Darwin, scientific findings involved informed conjecture and hypothesis mixed with imagination. Poetry provided Erasmus a versatile medium on which to speculate freely on scientific matters in a way not possible through formal scientific writing. In fact, after the success of his long poems, Erasmus was often ridiculed with the derogatory term *Darwinizing*, coined by Coleridge to mean *speculating wildly* (King-Hele 1963, 86). Indeed *The Botanic Garden* is unrestrained and frankly impressive in its sheer breadth of wild speculation with all of science as its subject matter. Part I, 'The Economy of Vegetation', focuses on physical science and technology with botany making an appearance at the end. The second part, 'The Loves of the Plants', reflects its title by detailing the process of fertilization in various classes of plants. In general, the poem anticipates several modern developments in science and technology, and illuminates many subjects, including electricity, chemistry, photosynthesis, solar physics, plant physiology, and geomagnetism, which Darwin accurately attributes to the rotation of the planet.

While imagination provided the field for supposition, it also succeeded in communicating Darwin's far-ranging speculation and more grounded hypothesizing in poetic terms that both the general public and literary individuals could appreciate. The title of *The Botanic Garden* attracted gentrified readers of poetry to a regime of instruction in science and technology. Most readers would only later realize that very little of the work has to do with plants. Darwin admits his dubious motive '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 [logic] of philosophy' (Darwin quoted in King-Hele 1963, 98–99). Imagination brought levity of spirit to an otherwise rote compendium of science. Famous for his wit and robust sarcasm, Darwin further describes the poem as 'trivial amusement' (King-Hele 1968, 193). That irony especially appealed to Darwin is evident throughout *The Botanic Garden* where nymphs and dryads dramaticize the bonding of molecules or bemoan the birth of the moon from a gash in the earth's side.

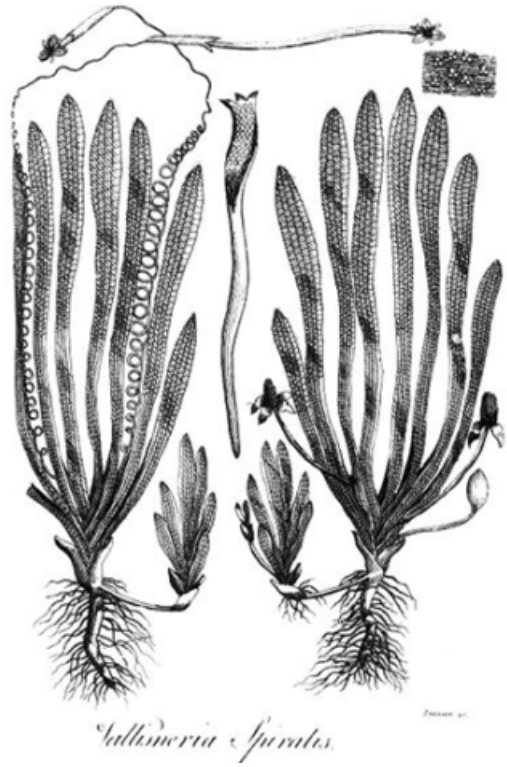

Figure 3: 'Vallisneria Spiralis' (1789–91) from The Botanic Garden

The first two cantos of 'The Economy of Vegetation' describe the Earth's origin and its physical features with discourses on geology, chemistry, and technology mixed in. The topics jump around between lightning, rainbows, fireballs, comets, steam engines, volcanoes, earthquakes, limestone, porcelain, coal, morasses, mines, minerals, manure, and much more. Around the celestial Goddess of Nature convene nymphs of fire and water, earthly gnomes, and airy sylphs, through whom she will elucidate the origins of natural phenomena. Canto I commences with a discourse to the 'nymphs of primeval fire', which explains the origin of the solar system. The planets arose from the Sun and 'Bend, as they journey with projectile force/ In bright ellipses their reluctant course' (I. 109–10). Darwin then associates the nymphs of fire with precise descriptions of many fire-related or luminous events. Shooting stars and lightning are linked to the activities of the nymphs: 'Ethereal powers! You chase the shooting stars/ Or yoke the vollied lightnings to your cars' (I. 115–6). The nymphs 'untwist the sevenfold threads of light' to make rainbows (I. 117) and 'fire the arrowy throne of rising Morn' to create morning and evening sky colors (I. 119). Darwin alludes to the hydrogen composition of the outermost atmosphere 'Where lighter gases, circumfused on high/ Form the vast concave of exterior sky' (I. 123–4). The nymphs are responsible for the aurora, which 'Dart from the North on pale electric streams/ Fringing Night's sable robe with transient beams' (I. 129–30). In the eighteenth century, auroral lights were classified as terrestrial phenomena, but Darwin was perspicacious in recognizing that the aurora belonged to the outermost layer of the atmosphere (King-Hele 1963, 103). The fervid catalogue goes on with planets, fixed stars, volcanoes, and phosphoric lights. Darwin then postulates that flying machines powered with steam or another explosive material will be used in war:

Soon shall thy arm, UNCONQUER'D STEAM! Afar
Drag the slow barge, or drive the rapid car;
Or on wide-waving wings expanded bear
The flying-chariot through the fields of air.
Fair crews triumphant, leaning from above
Shall wave their fluttering kerchiefs as they move;
Or warrior-bands alarm the gaping crowd,
And armies shrink beneath the shadowy cloud. (I. 289–96).

The first canto finishes with the nymphs of fire exiting in a firework exhibition. During this grand exeunt, Darwin shows his humorous side by describing electricity as an aphrodisiac: 'Through her fine limbs the mimic lightnings dart/ And flames innocuous eddy round her heart' (I. 349–53).

The second canto is directed to the gnomes of earth and proposes a version of the Earth's creation. Here Darwin demonstrates his keen sense of geological history. The gnomes are guardians of the natal Earth born recently from the fiery sun. Darwin details the evolution of the oceans from the Earth's 'vaporous air, condensed by cold' and characterizes gravitational pull as 'fierce attraction with relentless force' that 'bent the reluctant wanderer to its course' (II. 11–20). Darwin speculates that the moon originated in the Pacific Ocean, a proposal later supported mathematically by his great-grandson George Darwin (King-Hele 1963, 103). The elder Darwin fancies that the gnomes were aghast when the moon came into existence 'from her wounded side/ Where now the South-Sea heaves its waste of tide' (II. 77–8).

After a tumultuous early period, the history of earth smoothed out. Here, Darwin attends to the geological and atmospheric composition of the planet. He first explains the process by which limestone forms from shells and how bogs yield iron salts. Darwin contends that most rocks form from organic remains combined with existing minerals, and he includes notes on coal, flint, clay, and calcareous earth (King-Hele 1963, 108). He discusses three regions of the atmosphere. The first, which is the site of cloud-formation, goes up about four miles and corresponds to the troposphere in modern atmospheric thinking. He estimated the second region to extend thirty-five miles above the first layer. Lighter gases, consisting mostly of hydrogen, dominated the most distant region beyond thirty-five miles. For his time, Darwin was remarkably accurate, although we now know that hydrogen does not become the dominant gas until about 2000 miles out (King-Hele 1963, 107).

The third canto of *The Economy of Vegetation* deals with various aquatic subjects including clouds, rain, rivers, canals, pumps, and geysers. The aquatic nymphs supervise the water cycle of the planet by leading 'the winged vapours up the aerial arch' (III. 12–3), then down once more as rivers, seas, and fluids within organisms. Darwin is usually accurate in his discourses on lower atmospheric occurrences such as evaporation, clouds, and winds. He revels in the omnipresence of water from the rivers beneath snow-clad summits and the tumult of tropical monsoons to glacial geysers and hotsprings. The nymphs are aware of the powerful chemical bonds between 'pure air' oxygen and 'flaming Gas' hydrogen that constitute water:

Nymphs! Your bright squadrons watch with chemic eyes
The cold-elastic vapours, as they rise;
With playful force arrest them as they pass,
And to pure air betroth the flaming Gas.
Round their translucent forms at once they fling
Their rapturous arms, with silver bosoms cling. (III. 201–6).

This is a prime example of Darwin combining rote scientific facts and imagination in the form of spry nymphs provoking loving embrace between hydrogen and oxygen with stable water the result of their union. The image, though preposterous, is quite effective. The poet then turns his attention, as he so freely does, from science to technology by discussing water pumps for extinguishing fires or draining swamps. The nymphs instructed mortals 'to pierce the secret caves/ Of humid earth, and lift her ponderous waves' (III. 345–46). Darwin again shows his dexterity in setting scientific fact in imaginative contexts by switching from the nymphs to a treatment of pump pressure dynamics:

> Bade with quick stroke the sliding piston bear
> The viewless columns of incumbent air;
> Press'd by the incumbent air the floods below,
> Through opening valves in foaming torrents flow. (III. 346–350).

By expressing his grasp of scientific and technological issues through verses, such as these, Darwin adds weight to the fanciful excursions of *The Economy of Vegetation*. Through this fusion of science and imagination, the poet has achieved a compelling vehicle for substantiating his scientific observations with a mere trimming of empirical backing, if any at all.

Canto IV begins with monsoons, fogs, barometers, and submarines, but, alas, vegetation makes an appearance towards the end with a treatment of the anatomy and physiology of seeds, flowers, and leaves. The sylphs of the air stimulate wind currents in the atmosphere and make plants transpire oxygen. In more taciturn moods, the sylphs bring fog and tornadoes. Darwin entreats them to explain how to master winds:

> Oh, Sylphs! disclose in this inquiring age
> One Golden Secret to some favour'd sage;
> Grant the charm'd talisman, the chain, that binds,
> Or guides the changeful pinions of wind! (IV. 307–10).

Afterall, the sylphs showed Torricelli and Boyle 'How up exhausted tubes bright currents flow...And with the changeful moment fall and rise' (IV. 130 & 134), so they must be able to disclose the pattern behind the fickleness of the winds. Turning to technology, the identification of oxygen suggested to Darwin the feasibility of extended submarine travel: 'The diving castles, roof'd with spheric glass/ Ribb'd with strong oak, and barr'd with bolts of brass' (IV. 197–8). In this final canto, Darwin charts the course for Part II, 'The Loves of the Plants', by propounding the general principle of vegetable growth and reproduction. *The doctor* here emphasizes the vital role of light in stimulating oxygen to escape from the leaves of plants to the atmosphere; *the poet* imagines that oxygen is infatuated with light.

Whilst 'The Economy of Vegetation' is a broad survey of science and technology, 'The Loves of the Plants' is a tightly focused discourse on plant reproductive mechanisms in which Darwin discloses the romantic lives of almost one hundred plants. Although this second part brought Darwin fame after its 1789 publication, the skillful couplets and mythic setting barely disguise the abiding monotony of the subject matter (King-Hele 1963, 110). So, Darwin humanizes each plant according to its color, form, habitat, or method of fertilization. He argued that plants experienced sensations, including love. He also substituted English equivalents for the Latin names in order to craft human metaphors that entertained those who would appreciate a charming love story. As a result of this shrewd entrenchment of plant physiology in a morass of romantic tomfoolery, the average reader of the late 1700s probably had a broad grasp of botany that would be humbling by our modern standard.

Darwin begins the second part by explaining the Linnaean plant classes as distinguished by the character of the reproductive components. He then humanizes some of the plant reproductive

characteristics. Indian reed is virtuous because one male (stamen) and one female (pistil) in each flower are engaged in 'their nuptial vow' (I. 48). The stargrass, conversely, shares two virgins (two pistils) with one male and *Collinsonia* is impious in pairing two males (two stamens) to one female. However, with Dyer's broom for which 'ten fond brothers woo the haughty maid' (I. 58) polygamy has fully erupted. Amidst the hedonism, however, Darwin manages perspicacity of scientific fact when he alludes to 'Two knights before thy fragrant altar bend/ Adored Melissa! And two squires attend' (I. 65) to account for the two higher (two knights) and two lower (two squires) stamens arranged on the broom species, *Genista melissa*. Darwin continues to lighten the botanical tedium with comic scenarios. In *Lychnis*, for instance, the five females 'rise above the petals, as if looking abroad for their distant husbands' (I. 144). Unlike Dyer's broom, the sensitive mimosa is prudish: 'Weak with nice sense, the chaste Mimosa stands/ From each rude touch withdraws her timid hands' (I. 301–2). One may suspect that Darwin was questioning the human practice of monogamy by implying that it was rare in nature. Moreover, the numerous lascivious episodes of the poem presumably enhanced sales (King-Hele 1963, 115).

The final three cantos of 'The Loves of the Plants' continue the botanical catalogue but with more frequent and longer flights of reverie not solely of the romantic kind. Although science and technology are not the dominant subjects in final three cantos of 'The Loves of the Plants', Darwin does offer some of the technical insight that so thoroughly characterizes 'The Economy of Vegetation'. The flying seeds of thistle recall ballooning: 'So on the shoreless air the intrepid Gaul/ Launch'd the vast concave of his buoyant ball' (II. 25–6). The cotton plant with its 'vegetable wool' prompts complex descriptions of spinning machines (II. 34). Darwin then goes on to extol the Peruvian bark and foxglove for their capacities to restore health (II. 378). The third canto introduces the nightshade, laurel, and upas tree as somber characters in a rather melancholy canto. The final canto finishes the poem on a light note. A gnat that carries pollen from stamen to the 'secret cave' of the pistil fertilizes a wild fig (III. 428). Darwin concludes the canto with *Adonis*, in which many males and females live together in the same flower: 'A hundred virgins join a hundred swains/ And fond Adonis leads the sprightly trains' (IV. 423–4).

Evolution and Darwin's Theory of Organic Happiness

Darwin's second long poem, *The Temple of Nature*, was published after his death, in 1803. In this poem Darwin propounded a theory of evolution that was more complete than any earlier model and came quite close to the modern theory initiated by his grandson, Charles. Erasmus placed less emphasis than earlier models on the transmission of acquired characteristics, and he astutely estimated the temporal scale of evolution as millions of years. The elder Darwin, however, failed to produce the empirical evidence that his grandson would furnish in becoming one of the world's most esteemed scientists (King-Hele 1968, 182).

If Darwin lacked a mathematical vehicle to give credence to a theory of evolution, he found an imagination-based one in poetry. Personifications of nature, love, and death preside over the poem. An impressive portrait of the Temple of Nature unfolds. The Priestess of Nature, Urania, who resides in the Temple of Nature, narrates most of the story. Through this second long poem, he asserted the idea that life originated as microscopic specks in primeval seas and gradually, under evolutionary pressures, developed its present forms. As is the case for his first long poem, *The Temple of Nature* conveys his scientific theory to the public through skilled couplets. Unlike the rather pell-mell *Botanic Garden*, however, Darwin's second long poem provides a coherent chronological structure based on evolutionary progression. *The Temple of Nature* had all the makings of a second best seller but was frozen in its tracks by Darwin's contention that evolutionary processes go on without assistance from any deity. The public was especially sensitive at a time when they were relying on 'the Deity' to help them resist Napoleon's encroachment on the southern coast of England (King-Hele 1968, 152).

Despite its contentiousness, *The Temple of Nature* presents a picture of evolution over fifty years before it came to be accepted by scientists. The first canto shows the origin of life and the evolution of aquatic organisms to land creatures. The main theme of this cantos the slow evolution of microscopic life in primeval oceans with the subsequent transition to amphibious forms and finally to terrestrial life. Darwin is certain that complex life developed over enormous periods of time from the simplest forms to the most sophisticated, including humanity:

> Organic life beneath the shoreless waves
> Was born and nurs'd in Ocean's pearly caves;
> First forms minute, unseen by spheric glass,
> Move on the mud, or pierce the watery mass;
> These, as successive generations bloom,
> New powers acquire, and larger limbs assume; (I 295–300).

Darwin tacitly parallels evolutionary development to the progress of an embryo from the 'waves' of the amniotic fluid to post-natal land as a 'dry inhabitant of air':

> Thus in the womb the nascent infant laves
> Its natant form in the circumfluent waves;
> With perforated heart unbreathing swims;
> Awakes and stretches all its recent limbs…
> Gives to the passing gale his curling hair,
> And steps a dry inhabitant of air. (I 389–393, 399–400).

These insinuations were probably at the core of the public's rejection of *The Temple of Nature*:

> The second canto deals with asexual, hermaphroditic, and finally sexual reproduction. Darwin contends that asexual reproduction came first: 'The Reproductions of the living Ens/Form sires to sons, unknown to sex, commence' (II. 63–4). The inadequacy of asexual reproduction became evident as:
>
> The feeble births acquired diseases chase
> Till Death extinguish the degenerate race…
> Or till, amended by connubial powers
> Rise seedling progenies from sexual flowers (II. 165–6, 175–6).

Hymen then announces Cupid and Psyche, 'the Deities of Sexual Love'. Darwin, in keeping with his stated intention to amuse and entertain, follows this up with many comical examples of married bliss or strife in the natural world: 'The Lion-King forgets his savage pride/ And courts with playful paws his tawny bride' (II. 357–8).

The third canto follows the evolution of the mind from its origin as a nexus of nerves to its present complexity in humans. Urania tells the Muse how the human faculty of reason developed. Darwin emphasizes two physical attributes that facilitated human evolutionary progress-hand and eye: 'Nerved with fine touch above the bestial throngs/ The hand, first gift of Heaven! to man belongs' (III. 121–2). Sight is described as 'the mute language of the touch' (III. 144). Darwin, quintessentially jumping among topics, then offers a philosophy of art and science, which he thinks can be explained in terms of imitation:

> Hence to clear images of form belong
> The sculptor's statue, and the poet's song,
> The painter's landscape, and the builder's plan,
> And imitation marks the mind of man (III 331–4).

His idea is that we merely imitate what we see or what others have done; such imitations, in the hands of an artist or scientist, occasionally achieve meaning.

The fourth canto, 'Of Good and Evil', describes, in grim terms, the struggle for existence and the survival of the fittest, then relishes the pleasures of life and outlines the organic theory of happiness. The beginning of the canto has images of the wolf tearing the helpless lamb, the eagle rending the innocuous dove, the lamb and dove grazing the young herb or seedling, and the owl diving for the glowing worm, 'Who climbs the green stem, and slays the sleeping flower (IV. 17–28). The world is 'one great Slaughter-house' (IV. 66). Balancing out the troubles of humans, the triumphs of science include the sublime concepts of Newton and the practical insights of Archimedes. Darwin postulates that these innovations in science are the precursors to skyscrapers, traffic, and piped water:

> Bid raised in air the ponderous structure stand,
> Or pour obedient rivers through the land
> With cars unnumber'd crowd the living streets,
> Or people oceans with triumphant fleets (IV 315–18).

Despite the inevitable disastrous effects of excessive overbreeding, Darwin proposed a theory of organic happiness as part of his evolutionary ideas. The theory of evolution became a scientific hypothesis that served as a basis of Erasmus Darwin's philosophy of life, including all organic life (King-Hele 1963, 90). He suggests that as a product of the system of reproduction and death, 'Happiness survives' (IV. 452–3); amidst the potential strife of overpopulation, a fundamental happiness will prevail. He saw hopeful patterns controlling the perpetual massacre. Darwin's theory of organic happiness, which most fully is expressed in this final canto, suggests that, since the beginning, species have been enhanced by evolution. The survival of the fittest has been the prolongation of the best species or members of species. Darwin also believed that life is an essentially enjoyable process and that the happier organism has a better chance of surviving the struggle for existence. As we all have a common microscopic ancestor, we should view the animals, insects, and plants as our relatives: 'His brother emmets, and his sister worms" (IV. 427–8). While alive, an organism contributes to the sum total of happiness; when it dies the animal or plant brings happiness to other organisms.

The elder Darwin presents an optimistic take on evolution, a process more typically associated with the unsympathetic substitution of one species for another in the perpetual battle to survive. The summon bonum of evolution, as expressed toward the end of *The Temple of Nature*, is the happiness and interrelation of all life. His consistent declarations that his poetry should be taken as light amusement could reflect his penultimate realization that more complex life, though established through suffering, affords more substantial happiness. Hence, he chose to write up his evolutionary conjectures in poetry as an expression of his personal contribution to organic happiness. His poetry, through its levity and whimsicality, represents his whittling of a niche in the evolutionary scheme, so to speak.

Sneaking in Scientific Exposition: The Footnotes Scheme

The final idea relating to why Erasmus Darwin chose to write up his scientific findings in poetry ties in with the first suggestion that poetry allowed the author to broadcast his empirically unsubstantiated claims to a wide audience. Darwin used voluminous explanatory notes to supplement the verse. These notes were obviously written in prose form, which according to Darwin's theory of poetry is best suited to didacticism. The tone of the notes is ponderous, as one would expect of a scientific treatise; there are no nymphs, sylphs, or dryads, no romantic innuendoes, no triumphant goddesses of nature. The sheer length of the notes suggests that these were not mere supplements to the verse, intended to clarify abstract scientific concepts. Unlike the poetry,

the prose notes are serious and Darwin may have thought that they were necessary to advance his theories even further. Inserting them under the cover of poetry was a tactical decision that also reflects the choice *not* to submit them as separate scientific papers.

The footnotes to 'The Economy of Vegetation' are longer than the poem itself and cover almost every branch of science and technology. To supplement the footnotes, there are about 50,000 words of additional notes on such diverse subjects as meteors, primary colors, colored clouds, comets, the sun's rays, heat, the steam engine, electricity, oil on water, and glaciers. One of the Notes is a 9000-word discourse on winds, including a meteorological journal. The essay speculates about the worldwide circulation of air. Darwin demonstrates full awareness of the role of vertical motions and horizontal winds. The notes on the Earth's interior spanned 15,000 words and include a summary of the geological history of the planet. Darwin's geological expositions in *The Botanic Garden*, which form a 15,000 word treatise, contrast to all the faulty catastrophic theories of the time. Moreover, Darwin's secular geological discourse excels his contemporary theorists who sought the divine wisdom in their ideas.

The footnotes to *The Temple of Nature* speculate with equal breadth on all branches of science. In the first note, Darwin discusses spontaneous vitality. He believes that microscopic life can in certain instances arise from non-living matter within a few days. The experiments on which he bases his hypothesis were later discredited and spontaneous generation became an abandoned issue. However, as is the case for many of Darwin's other speculations, the idea has been revitalized recently. We even see the beginnings of a germ theory:

> Thus one grain of variolous matter, inserted by inoculation, shall in about seven days stimulate the system into unnatural action; which in about seven days more produces ten thousand times the quantity of a similar material thrown out on the skin in the postules! (*Temple of Nature,* Additional Notes, p. 38).

Darwin appreciated the importance of microscopic 'animalcules' and the exponential nature of successive reproduction. Further in the Additional Notes of the poem, Darwin offers a two-fluid theory of electricity and magnetism. Also, in propounding his theory of evolution, Darwin offers numerous, extensive notes to amplify the argument:

> After islands or continents were raised above the primeval ocean, great numbers of the most simple animals would attempt to seek food at the edges of the shores of the new land, and might thence become amphibious…Those situated on dry land, and immersed in dry air, may gradually acquire new powers to preserve their existence… (I 327 Note).

It is clear that Darwin's notes were not intended to be typical footnotes, in the sense of minor adjunctive explanations. The prose notes may have been designed to offer an alternative reading to those who were suspicious of the intermingling of mythology and science. Darwin may have been trying to maintain his scientific credibility by including rather formal scientific treatises scattered throughout the whimsical cantos.

However, as I have tried to suggest, Darwin probably knew that many of his scientific theories lacked adequate empirical bulwarking. Part of Darwin's wide-ranging treatment of scientific findings in imaginary contexts reflects the fact that his forward thinking outpaced the development of explanatory techniques. A different view is that Darwin was simply a man of 'breadth' rather than 'depth'. Evolutionary theory, once again, is a quintessential example. Erasmus could only speculate about the progression of simple animals seeking 'food at the edges of the shores of the new lakes' who then became amphibious and finally creatures of 'dry air [with] new powers to preserve their existence'. Charles Darwin later found in the Galapagos and elsewhere the much-needed evidence to substantiate these conjectures. Aware of the shortcomings of his speculative theories, accurate nonetheless, Darwin chose to use poetry as a disguise.

Erasmus Darwin spread his extraordinary talents across the spectrum of human knowledge as many *Renaissance men* do. The consequence: a mind-boggling range of subjects converging in his poetry but a conspicuous scientific inadequacy characterizing many. Much of his scientific theorizing has been overlooked, or, more tragically, successive scientists have been credited for the theories. For example, Erasmus Darwin was correct in recognizing that the aurora was an electrical phenomenon of the outermost atmosphere above 35 miles from the surface of the Earth. Yet, the auroral measurements in the International Polar Year of 1882 were fruitless because the stations were situated according to the assumption that the aurora was only 5 miles high (King-Hele 1968, 190).

Conclusion: Speculating About Darwin's Versification of Science

The doctor's motive to convey his scientific findings to the public through poetry was probably a mixture of the three suggestions. Instructing the people in science through poetry related to his life's work as a general physician, as one at service to the public. Through this simultaneous entertainment and instruction of the people, Darwin manifested his organic happiness in keeping with the theory of evolution. In a different and less light-hearted sense, Darwin probably knew he lacked the palpable evidence to adequately propel his theories to respectability. Thus, on one level, Darwin was entirely serious about setting science to verse and including exceedingly long prose notes since the poetic artifice could amuse the reader as a cover for his lack of empirical depth. The simple answer can only be as complex as Darwin himself.

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