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Source: *Journal of the History of Ideas*, Vol. 32, No. 2 (Apr. - Jun., 1971), pp. 247-264
Published by: University of Pennsylvania Press
Stable URL: https://www.jstor.org/stable/2708279
Accessed: 03-03-2019 22:32 UTC

ERASMUS DARWIN'S VIEW OF EVOLUTION

By James Harrison

Every historian of evolutionary ideas dutifully acknowledges Erasmus Darwin's distinguished right to be included in the roll of those who anticipated *The Origin of Species* in some way; even his grandson includes him in a footnote to his prefatory *Historical Sketch*.

> It is curious how largely my grandfather, Dr. Erasmus Darwin, anticipated the views and erroneous grounds of opinion of Lamarck in his "Zoonomia" (vol. I, pp. 500–510), published in 1794.[1]

Most, however, follow Charles Darwin in describing his grandfather as purely Lamarckian in his views, without any very extensive examination of what Erasmus Darwin actually wrote. The latest full-length study of him,[2] while making more than ample amends in some respects, still does not do him adequate justice in all. And recently published articles in learned periodicals seem preoccupied either with his influence on and reception by others,[3] or with aspects to his work other than the precise nature of the theory of evolution he propounded.[4] Lamarckian he undoubtedly was, as can be shown on better evidence than the quotations habitually used can furnish, but this is by no means all there is to say on the subject of his evolutionary beliefs. It is the purpose of this article to examine those beliefs fully, using all his relevant writings.

It is perhaps scarcely necessary to recall how, throughout much of the eighteenth century, what A. O. Lovejoy calls the "temporalization" of the Great Chain of Being[5] was taking place, its finely graduated links being increasingly recognized as evidence of a process rather than a hierarchical system. Lovejoy quotes extensively from such writers as Buffon, Diderot, and Robinet in support of his thesis, and

[1] C. Darwin, *The Origin of Species* (6th ed., London, 1900), XXn.

[2] Desmond King-Hele, *Erasmus Darwin, 1731–1802* (London, 1963).

[3] N. Garfinkle, "Science and Religion in England, 1790–1800: the Critical Response to the Works of Erasmus Darwin," *JHI*, XVI (1955), 376–88: R. F. Gustafson, "The Upas Tree: Pushkin and Erasmus Darwin," *PMLA*, LXXV (1964), 58–76: R. L. Chamberlain, "George Crabbe and Darwin's Amorous Plants," *J. Engl. & Ger. Philol.*, LXI (1962), 833–52.

[4] P. C. Ritterbush, "Erasmus Darwin's Second Published Poem," *R. Engl. Stud.*, XIII (1962), 158–60; Irwin Primer, "Erasmus Darwin's *Temple of Nature:* Progress, Evolution, and the Eleusinian Mysteries," *JHI*, XXV (1964), 58–73.

[5] A. O. Lovejoy, *The Great Chain of Being* (Cambridge, Mass., 1936).

makes it abundantly clear that the concept of some kind of evolution (the mechanism being as yet unspecified) antedates Lamarck's *Philosophie Zoologique* (1809) by at least half a century. Nevertheless, there were at least two important tenets of contemporary biology which, despite the accumulating evidence in their disfavor, militated strongly against any such evolutionary hypothesis.

First, there was preformationist embryology, to which most eighteenth-century naturalists and doctors subscribed. According to this doctrine the unfertilized embryo (or the sperm; opinion varied) was a minute homunculus, perfectly formed and complete, needing only to unfold and grow. As Sir Richard Blackmore, an earlier poet-physician,[6] expressed it:

> When the crude embryo careful Nature breeds, VI: 280
> See how she works, and how her work proceeds;
> While through the mass her energy she darts,
> To free and swell the complicated parts,
> Which only does unravel and untwist
> Th'invelop'd limbs, that previous there exist.

The logical extension of such a doctrine, since its *raison d'être* was to obviate the difficulty of conceiving how each new life comes into being in the first place, was to assert that, within the homunculus, there are still more minute homunculi destined to become the next generation, and so on back to Adam or his equivalent. As Blackmore continued:

[6]The eighteenth century seems to have run to such a breed. In 1744 Mark Akenside published both his M.D. thesis on the epigenesis (or non-preformationist) theory of embryology (reverting, in fact, to something like William Harvey's conception of a gradually developing embryo, as expressed in *Exercitationes de Generatione Animalium*, 1651), and also *The Pleasures of Imagination*, a philosophical poem that Erasmus Darwin must almost certainly have known and which included a justly renowned exposition of an apparently evolutionary principle at work throughout animated nature [II, 337–63. See G. R. Potter, "Mark Akenside a Prophet of Evolution," *Mod. Philol.*, XXIV (1926), 55–64]. In fact Akenside's version of biological progress is both Platonic and curiously static. It envisages a natural order where the whole range of species, having been called into being entire, as the palpable manifestation of a Platonic ideal, has since that first moment in time been in a state of continual aspiring development towards God, yet without its overall composition being in any way changed. The lowest echelons are constantly replenished by divinely ordained spontaneous generation, those in the middle merely aspire after forms of being already in existence, while at the top man has infinite scope for improvement towards a "perfection half divine" (I, 225) without ceasing to be man. Thus Akenside is able to regard Nature as the embodiment of a Platonic ideal (Lovejoy's perfect plenitude) without having to deny the possibility of individual or "specific" betterment (as, argues Lovejoy, many others did) within this "best and fairest ... of worlds" (II, 335).

And as each vital speck, in which remains
Th'entire, but rumpled animal, contains
Organs perplext, and clues of twining veins;
So every foetus bears a secret hoard,
With sleeping, unexpanded issue stor'd;
Which numerous, but unquicken'd progeny,
Clasp'd and inwrapt within each other lie;
Engendering heats these one by one unbind,
Stretch their small tubes, and hamper'd nerves unwind:
And thus, when time shall drain each magazine,
Crowded with men unborn, unripe, unseen,
Nor yet of parts unfolded; no increase
Can follow, all prolific power must cease.[7]

Such a theory is not only preposterous; it is, of course, irreconcilable with any form of evolutionary belief.

Darwin himself summarized such views, in order to refute them, in *Zoonomia* (1794–96), and interestingly used the word "evolve" in one of its common eighteenth-century senses, which was to refer to the unfolding and growth in the embryo or homunculus of that which already existed there in miniature.

Many ingenious philosophers have found so great difficulty in conceiving the manner of the reproduction of animals, that *they have supposed all the numerous progeny to have existed in miniature in the animal originally created*; and that these infinitely minute forms are only evolved or distended, as the embryon increases in the womb.[8]

At the time he was writing Part I of *The Botanic Garden (The Economy of Vegetation*, 1791), however, it is far from certain that Darwin did not, in part at least, credit such a notion. The following lines clearly suggest seeds which contain seeds which contain seeds.

Lo! on each SEED within its tender rind
Life's golden threads in endless circles wind;
Maze within maze the lucid webs are roll'd,
And, as they burst, the living flame unfold.
The pulpy acorn, ere it swells, contains
The Oak's vast branches in its milky veins;
Each ravel'd bud, fine film, and fibre-line
Trac'd with nice pencil on the small design.
The young Narcissus, in its bulb compres'd,
Cradles a second nestling on its breast;
In whose fine arms a younger embryon lies,
Folds its thin leaves, and shuts its floret-eyes;

[7]Sir Richard Blackmore, *Creation* (2nd ed., London, 1712), 281–82.
[8]Erasmus Darwin, *Zoonomia*, II (3rd ed., London, 1801), 245.

Grain within grain successive harvests dwell,
And boundless forests slumber in a shell.[9]

On the other hand, only a page or two further on in the same poem are lines which present a picture of the "evolving" embryo that is much less clearly that of an "entire but rumpled" crocodile which "only does unravel and untwist/ Th'invelop'd limbs, that previous there exist."

—So from his shell on Delta's shower-less isle
Bursts into life the Monster of the Nile;
First in translucent lymph with cobweb-threads
The Brain's fine floating tissue swells, and spreads;
Nerve after nerve the glistening spine descends,
The red Heart dances, the Aorta bends;
Through each new gland the purple current glides,
New veins meandering drink the refluent tides; IV: 430
Edge over edge expands the hardening scale,
And sheathes his slimy skin in silver mail.[10]

As already indicated, some four or five years later, in *Zoonomia*, Darwin is unequivocal in his rejection of all such preformationist versions of embryology, and by the time he comes to write *The Temple of Nature* (1803), he uses the fact that relatively advanced forms of life, including man, pass in embryo through more primitive, aquatic forms, as confirmatory evidence (as did many in the nineteenth century) of evolution's having taken place, and in particular of its having begun in water and moved at some stage to dry land.

Still Nature's births enclosed in egg or seed
From the tall forest to the lowly weed,
Her beaux and beauties, butterflies and worms,
Rise from aquatic to aerial forms.
Thus in the womb the nascent infant laves
Its natent form in the circumfluent waves; I: 390
With perforated heart unbreathing swims,
Awakes and stretches all its recent limbs;
With gills placental seeks the arterial flood,
And drinks pure ether from its Mother's blood.
Erewhile the landed Stranger bursts his way,
From the warm wave emerging into day;
Feels the chill blast, and piercing light, and tries
His tender lungs, and rolls his dazzled eyes;
Gives to the passing gale his curling hair,
And steps a dry inhabitant of air.[11]

[9]E. Darwin, *The Botanic Garden*, Pt. I (*The Economy of Vegetation*) (London, 1791), 191–93.
[10]*Ibid.*, 195–96.
[11]E. Darwin, *The Temple of Nature* (London, 1803), 35–36.

The second feature of contemporary biological thought which militated against evolutionary ideas was the working definition of species arrived at in the early part of the eighteenth and the late seventeenth century by Ray and Linnaeus. Their chief criterion, naturally enough, was that species breed true. They recognized that there might be important variations of color, size, etc., but were compelled to insist that species could not vary or mutate so as to form other species. This meant that all existing species had come into being in their present form on the third, fifth, or sixth days of creation. However, in his later years, largely as a result of observing the extent of hybridization it was possible to obtain under greenhouse conditions, Linnaeus preferred not to be so dogmatic on this point, and even postulated that the number of species originally created might have been relatively limited, these giving rise to intermediate ones by means of hybridization. Something like this view was shared by Buffon[12] and others, and it is referred to by Erasmus Darwin in his preface to Part II (published before Part I) of *The Botanic Garden (The Loves of the Plants)* in 1789.

> The illustrious author of the Sexual System of Botany, in his preface to his account of the Natural Orders, ingeniously imagines, that one plant of each Natural Order was created in the beginning; and that the intermarriages of these produced one plant of every Genus, or Family; and that the intermarriages of these Generic or Family plants, produced all the Species: and lastly, that the intermarriages of the individuals of the Species produced the Varieties.[13]

This is still a long way from an evolutionary theory which sees advanced forms of life as having developed from the most primitive. Variation and hybridization were just as likely to have taken place in a downward as an upward direction. Indeed, Buffon refers to degeneration at least as often as to improvement. So far as this uniformly upward kind of evolution was concerned, Darwin does not commit himself at the time of writing *The Botanic Garden*, though he seems aware of the idea. The poem itself makes no reference to such a possibility, and all the evidence is to be found in the voluminous notes. A footnote to *The Loves of the Plants* refers to rudimentary organs or parts found in certain species, and takes these as evidence that some kind of adaptation towards a more perfect form may be taking place.

> *Curcuma.* Turmeric. One male and one female inhabit this flower; but there

[12]Buffon seems to admit of variations other than those resulting from hybridization, and was at least aware of the idea that no more than one species need initially have been created. See Lovejoy; also J. S. Wilkie, "The Idea of Evolution in the Writings of Buffon," *Annals of Science*, XII (1957), nos. 1, 3, 4.

[13]E. Darwin, *The Botanic Garden*, Pt. II (*The Loves of the Plants*) (Lichfield, 1789), Preface.

are besides four imperfect males, or filaments, without anthers upon them. . . . In like manner the florets, which form the rays of the flower of the order frustraneous polygamy of the class syngenesia, or confederate males, as the sunflower, are furnished with a style only, and no stigma: and are thence barren. There is also a style without a stigma in the whole order dioecia gynandria; the male flowers of which are thence barren. Perhaps all the productions of nature are in their progress to greater perfection? an idea countenanced by the modern discoveries and deductions concerning the progressive formation of the solid parts of the terraqueous globe, and consonant to the dignity of the Creator of all things.[14]

There is clearly here a progressive quality associated with the power or tendency of species to change their forms which is not present in Linnaeus' speculations, but no perception that what Darwin calls rudiments may in some cases be remnants of formerly functioning parts—that overall advance may entail incidental loss. A subsequent note to *The Economy of Vegetation*[15] does admit this latter feature, in the rather different form of extinctions, to be a possible aspect to evolution.

It is curious that some of the most common fossil shells are not now known in their recent state, as the cornua ammonis; and on the contrary, many shells which are very plentiful in their recent state, as limpets, sea-ears, volutes, cowries, are very rarely found fossil. . . . Were all the ammoniae destroyed when the continents were raised? Or do some genera of animals perish by the increasing power of their enemies? Or do they still reside at inaccessible depths in the sea? Or do some forms of animals change their forms gradually and become new genera?

Easily the most comprehensive assemblage to be found in *The Botanic Garden* of evidence pointing in the direction of evolution occurs in the following note.

From having observed the gradual evolution of the young animal or plant from its egg or seed; and afterwards its successive advances to its more perfect state, or maturity; philosophers of all ages seem to have imagined, that the great world itself had likewise its infancy and its gradual progress to maturity; this seems to have given origin to the very ancient and sublime allegory of Eros, or Divine Love, producing the world from the egg of Night, as it floated in Chaos. See 1. 419 of this Canto.[16]

The external crust of the earth, as far as it has been exposed to our view in mines or mountains, countenances this opinion; since these [*sic*] have evidently for the most part had their origin from the shells of fishes, the decomposition of vegetables, and the recrements of other animal materials, and

[14]*Ibid.*, 7n. [15]*The Botanic Garden*, Pt. I, 120n.

[16]An early instance of Darwin's fondness for seeing his modern ideas on progress and evolution reflected or foreshadowed in early mythology. See Irwin Primer, *loc. cit.*, n.1.

must therefore have been formed progressively from small beginnings. There are likewise some apparently useless or incomplete appendages to plants and animals, which seem to show they have gradually undergone changes from their original state; such as the stamens without anthers and styles without stigmas of several plants, as mentioned in the note on Curcuma, Vol. II of this work.[17] Such as the halteres, or rudiments of wings of some two-winged insects; and the paps of male animals; thus swine have four toes, but two of them are imperfectly formed, and not long enough for use. The allantoide in some animals seems to have become extinct; in others is above tenfold the size, which would seem necessary for its purpose. . . . Perhaps all the supposed monstrous births of Nature are remains of their habits of production in their former less perfect state, or attempts towards greater perfection.[18]

It appears that the last sentence is acknowledging that a move towards "greater perfection" may temporarily mean greater imperfection, involve losing as well as gaining parts, and therefore that some imperfect parts may be remnants rather than rudiments. This interpretation would certainly seem to be supported by the word "extinct" immediately above. Thus Darwin is not only suggesting a possible evolutionary process at work throughout creation and time; he is within striking distance, in 1791, of the twin Lamarckian hypotheses of unused parts wasting and much used parts developing, especially in view of the strongly Lamarckian ring to "attempts towards greater perfection."

Neither in those sections corresponding to the above notes, nor elsewhere in the poem itself, however, does he broach even a tentative evolutionary thesis. One suspects that at this time Darwin did not quite have the courage of his evolutionary doubts, and preferred to fly his few kites in the notes only.

It is apparent from the above passages, and from other similar sources, that the idea that biological variation could be viewed as progressive in tendency, rather than merely bifurcating and spreading, was arrived at by analogy from other developmental processes, such as cosmic or geological or ontogenetic or historical and social evolution, all of which were at this time in process of being seen to have a markedly progressive character. This is more openly acknowledged in the following passage from *Zoonomia*, the work in which Darwin makes his best known, and first unequivocal, evolutionary pronouncements.

The late Mr. David Hume. . .concludes that the world itself might have been

[17]Quoted above. Some of the further instances cited here, of "rudimentary" parts in insects and animals, were included in the note on Curcuma in *The Loves of the Plants* (3rd ed., Dublin, 1790), 7n.

[18]*The Botanic Garden*, Pt. I, 5–6n.

generated, rather than created;[19] that is, it might have been gradually produced from very small beginnings, increasing by the activity of its inherent principles, rather than by a sudden evolution of the whole by the Almighty fiat.—What a magnificient idea of the infinite power of THE GREAT ARCHITECT! THE CAUSE OF CAUSES! PARENT OF PARENTS! ENS ENTIUM!

For if we may compare infinities, it would seem to require a greater infinity of power to cause the causes of effects, than to cause the effects themselves. This idea is analogous to the improving excellence observable in every part of creation; such as in the progressive increase of the solid or habitable parts of the earth from water; and in the progressive increase of the wisdom and happiness of its inhabitants; and is consonant to the idea of our present situation being a state of probation, which by our exertions we may improve, and are consequently responsible for our actions.

Thus it would appear, that all nature exists in a state of perpetual improvement by laws impressed on the atoms of matter by the great CAUSE OF CAUSES; and that the world may still be in its infancy, and continue to improve FOR EVER AND EVER.[20]

Once evolution in a uniformly upward direction was substituted for random variation, the question had to be answered as to why this should be the case. For whereas no one yet presumed to offer a mechanism for variations themselves, and whereas variations as likely to be downward as upward could as easily have their direction attributed to chance as to anything else, variations consistently in the direction of complexity and perfection required an agent or mechanism to fulfil the role played by, for instance, human selection in the breeding of do-

[19]In fact Hume attributed this hypothesis to Philo, one of the three protagonists in his *Dialogues Concerning Natural Religion*, whose beliefs may largely but not entirely be assumed to be Hume's. Moreover, Philo advances these and other views not necessarily as his considered version of the truth of the matter, but so as to show that there exist alternative accounts of the world's origin at least as tenable as his opponent's, *viz.*, that it was clearly designed and created by an intelligence superior but comparable to human intelligence. The idea that the world might have been generated he justifies on the grounds that it is manifestly more closely analogous to an organism (i.e., that which springs from a seed or egg) in its design and workings than to a typical product of human intelligence such as a machine. Then, in the next Part (VIII) of the *Dialogue*, Philo speculates as to whether the momentum of the Epicurean atoms might not be presumed to have led, sooner or later, by pure chance, to those more stable combinations and organizations of matter known as life, and this is offered, not apparently as a further development of the generation theory above, but as an alternative to it. [*Hume's Dialogues Concerning Natural Religion*, ed. Norman Kemp Smith (2nd ed., Edinburgh, 1947), 176–81, 182–85.] Darwin may also have derived the initial argument of his second paragraph, a standard one in Cartesian vs. Newtonian debates [see especially *The Leibniz-Clarke Correspondence*, ed. H. G. Alexander (Manchester, 1956), 11–30], from the same author [*Enquiries Concerning the Human Understanding and Concerning the Principles of Morals*, ed. L. A. Selby-Bigge (2nd ed., Oxford, 1962), 71], Darwin's formulation of it being noticeably nearer to Hume's than to Leibniz's.

[20]*Zoonomia*, II, 245–46.

mestic animals or plants. It was realized that there must be some form or other of "natural selection."

The passage just quoted attributes such progress to more or less teleological "laws impressed on the atoms of matter" by an unspecified First Cause—on a sort of principle of progress inherent in the universe. And this, in fact, continued to be Darwin's view on the matter throughout his life. Part of the peroration of the above passage, from "all nature exists" to "CAUSE OF CAUSES," is repeated word for word nearly eighty pages further on in *Zoonomia*,[21] and the closing paragraph of the Additional Note on Reproduction in *The Temple of Nature*, literally Darwin's last words on evolution, reads as follows:

> But it may appear too bold in the present state of our knowledge on this subject, to suppose that all vegetables and animals now existing were originally derived from the smallest microscopic ones, formed by spontaneous vitality? and that they have, by innumerable reproductions, during innumerable centuries of time, gradually acquired the size, strength, and excellence of form and faculties, which they now possess? and that such amazing powers were originally impressed on matter and spirit by the great Parent of Parents! Cause of Causes! Ens Entium![22]

Scientifically speaking, of course, this is a mere evasion of the issue—a substitution of a final for an efficient cause. But there is some doubt as to just how seriously we should take Darwin's overinsistence on a "CAUSE OF CAUSES," or his seeming to cite this life's being a probationary period leading to the next as an additional support for an evolutionary theory.[23] He was never an out and out materialist, in that his thinking remained within some sort of teleological frame-

[21] *Ibid.*, 318.

[22] *The Temple of Nature*, 37 of Additional Notes.

[23] Coleridge was in no doubt as to what his real views were, and the impression of skepticism remains strong even after one has made any necessary allowance for overstatement. "Jan. 27, 1796 ... Dr. Darwin possesses, perhaps, a greater range of knowledge than any other man in Europe. He thinks in a *new* train on all subjects except religion. He bantered me on the subject of religion. I heard all his arguments, and told him that it was infinitely consoling to me, to find that the arguments which so great a man adduced against the existence of God and the evidences of revealed religion were such as had startled me at fifteen, but had become the objects of my smile at twenty.... Dr. Darwin would have been ashamed to have rejected Hutton's Theory of the earth without having minutely examined it..., but *all at once he makes up his mind* on such important subjects, as whether we be the outcasts of a blind idiot called Nature, or the children of an all-wise and infinitely good God; whether we spend a few miserable years on this earth, and then sink into a clod of the valley, or only endure the anxieties of mortal life in order to fit us for the enjoyment of immortal happiness. These subjects are unworthy a philosopher's investigation. He deems that there is a certain self-evidence in infidelity, and becomes an atheist by intuition." [*Collected Letters of Samuel Taylor Coleridge*, ed. Earl Leslie Griggs, I (Oxford, 1956–59), 99.]

work. But it seems likely that such stylistic quirks in his writings as block capitals and rhetorical questions were his way of sheltering behind a conventional and unexceptionable deism while hinting at fundamental principles at work here which were essentially materialistic and of a nature undreamed of as yet.

The passage below, again from *Zoonomia,* is the oft-quoted one, which, taken in conjunction with others that follow it and argue that reptiles, fish, insects, and even plants, may also have descended from the same, single, "living filament," is used as evidence not only of Darwin's belief in evolution, but also of his subscribing to the same mechanism for such biological advance as Lamarck was to propound. This largely on the strength of the phrases "directed by irritations, sensations, volitions, and associations" and "possessing the faculty of continuing to improve by its own inherent activity."

> From thus meditating on the great similarity of the structure of the warm-blooded animals, and at the same time of the great changes they undergo both before and after their nativity; and by considering in how minute a portion of time many of the changes of animals above described have been produced; would it be too bold to imagine, that in the great length of time since the earth began to exist, perhaps millions of years before the commencement of the history of mankind, would it be too bold to imagine, that all warm-blooded animals have arisen from one living filament, which THE GREAT FIRST CAUSE endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations; and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end![24]

Desmond King-Hele[25] argues cogently that the phrases in question are far from conclusive as evidence. The whole of *Zoonomia* was constructed to a thesis that life in all its manifestations and activities is governed by four kinds of stimulus, which Darwin calls irritations, sensations, volitions, and associations, so the inclusion here of the word "volitions" has no markedly Lamarckian significance. As for "possessing the faculty of continuing to improve by its own inherent activity," this may be no more than a further insistence on the view already encountered in Darwin (and Hume) that, once called into being, the universe is autonomous and self-regulating. In other words, we are to understand that when the GREAT FIRST CAUSE set life in motion, there was set in motion at the same time a sufficient cause or mechanism, to be found within the nature of that life itself, to account for its successive improvements, and therefore no subsequent intervention was necessary. Undoubtedly certain Lamarckian or Ur-Lamarckian assumptions underlie the passage, but taken as a whole

[24] *Zoonomia*, II, 240.

[25] King-Hele, 72.

it is neither as exclusively nor as conclusively Lamarckian as is sometimes suggested.

On the other hand, King-Hele is too insistent that Erasmus Darwin was no more Lamarckian, perhaps even less, than his grandson Charles. The next passage, for instance, takes Lamarckian views to be so axiomatic as scarcely to need emphasizing.

> Some nations of Asia have small hands, as may be seen by the handles of their scymetors; which with their narrow shoulders show, that they have not been accustomed to so great labour with their hands and arms, as the European nations in agriculture, and those on the coasts of Africa in swimming and rowing. Dr. Manningham, a popular accoucheur in the beginning of this century, observes in his aphorisms that broad-shouldered men procreate broad-shouldered children. Now as labour strengthens the muscles employed, and increases their bulk, it would seem that a few generations of labour or of indolence may in this respect change the form and temperament of the body.[26]

Moreover, though that extract does not specifically link the inheritance of acquired characteristics with an overall evolutionary theory, the next one,[27] which King-Hele takes as evidence of Erasmus Darwin's having in large measure forestalled Charles on the subject of natural selection, carefully refers the reader back, in its first and highly Lamarckian paragraph (not quoted by King-Hele), to precisely the above passage.

> Fifthly, from the first rudiment, or primordium, to the termination of their lives, all animals undergo perpetual transformations; which are in part produced by their own exertions in consequence of their desires and aversions, of their pleasures and pains, or of irritations, or of associations; and many of these acquired forms, or propensities, are transmitted to their posterity. See Sect. XXXI, i.
>
> As air and water are supplied to animals in sufficient profusion, the three great objects of desire, which have changed the forms of many animals by their exertions to gratify them, are those of lust, hunger, and security. A great want of one part of the animal world has consisted in the desire of the exclusive possession of the females; and these have acquired weapons to combat each other for this purpose, as the very thick, shield-like, horny skin on the shoulder of the boar is a defence only against animals of his own species, who strike obliquely upwards, nor are his tushes for other purposes, except to defend himself, as he is not naturally a carnivorous animal. So the horns of the stag are sharp to offend his adversary, but are branched for the purpose of parrying or receiving the thrusts of horns similar to his own, and have therefore been formed for the purpose of combatting other stags for the exclusive possession of the females; who are observed, like the ladies in the times of chivalry, to attend the car of the victor.
>
> The birds, which do not carry food to their young, and do not therefore marry, are armed with spurs for the purpose of fighting for the exclusive

[26] *Zoonomia*, II, 13–14.

[27] *Ibid.*, 236–38.

possession of the females, as cocks and quails. It is certain that these weapons are not provided for their defence against other adversaries, because the females of these species are without armour. The final cause of this contest amongst the males seems to be, that the strongest and most active animal should propagate the species, which should thence become improved.

The extract veers, of course, between Lamarckianism and what should properly be termed sexual selection, the needs and even in some unspecified way the efforts, of animals being invoked to account for the development of spurs, horns, "tushes," and sexual selection to promote the general health and vitality of the species. Moreover, sexual selection is seen as ministering to a final cause; in other words, both Lamarckian innovations and the general toning-up effect of sexual selection are seen as partial manifestations of those teleological "laws impressed on the atoms of matter by the great CAUSE OF CAUSES," with Lamarckian innovations very much the more important so far as the development of new and fitter species is concerned. Whereas, though Charles Darwin was admittedly compelled to introduce more and more Lamarckian aids to natural selection in the later editions of *The Origin of Species* (largely in answer to Kelvin, whose erroneous but at that time unanswerable calculations were bidding fair to deny him the geological time-scale his theory needed), these always remained ancillary to his primary thesis of the origin and evolution of species by natural selection.

It is also, of course, inaccurate to equate sexual selection with natural selection, however closely allied or complementary they may be. Erasmus Darwin rightly points to the selective importance of competition between males of the same species to acquire mates, but he fails to extend the idea to the selective importance of competition merely to stay alive, and thus continue breeding—competition which takes place between both males and females of the same species, and also between one species and another.

This is not to say that Erasmus Darwin was unaware of this kind of competition; indeed, it had become something of an eighteenth-century commonplace. The lines below from *The Temple of Nature* emphasize the way different species have specialized so as to survive either by eating, or by not being eaten by, other species. (The closing lines seem on the brink even of forestalling A. R. Wallace's clear perception that, once *homo sapiens* had evolved the human hand and the human brain, his survival in the face of competition from other species was assured without any need for further biological adaptation.)[28]

[28]A. R. Wallace, "The Origin of Human Races and the Antiquity of Man Deduced from the Theory of Natural Selection," *Anthropological Review*, II (1864), 158–87.

On rapid feet o'er hills, and plains, and rocks,
Speed the scared leveret and rapacious fox;
On rapid pinions cleave the fields above
The hawk descending, and escaping dove;
With nicer nostril track the tainted ground
The hungry vulture and the prowling hound;
Converge reflected light with nicer eye
The midnight owl, and microscopic fly; III: 100
With finer ear pursue their nightly course
The listening lion, and the alarmed horse.
The branching forehead with diverging horns
Crests the bold bull, the jealous stag adorns;
Fierce rival boars with side-long fury wield
The pointed tusk, and guard with shoulder-shield;
Bounds the dread tiger o'er the affrighted heath
Arm'd with sharp talons and resistless teeth;
The pouncing eagle bears in clinched claws
The struggling lamb, and rends with ivory jaws; 110
The tropic eel, electric in his ire,
Alarms the waves with unextinguish'd fire;
The fly of night illumes his airy way,
And seeks with lucid lamp his sleeping prey;
Fierce on his foe the poisoning serpent springs,
And insect armies dart their venom'd stings.

Proud Man alone in wailing weakness born,
No horns protect him, and no plumes adorn;
No finer powers of nostril, ear, or eye,
Teach the young Reasoner to pursue or fly,— 120
Nerv'd with fine touch above the bestial throngs,
The hand, first gift of Heaven! to man belongs;
Untipt with claws the circling fingers close;
With rival points the bending thumbs oppose,
Trace the nice lines of Form with sense refined,
And clear ideas charm the thinking mind.[29]

The next extract underlines even more clearly the harsher aspects of such competitiveness, and sees it as operating in the vegetable as well as the animal world.[30]

Herb, shrub, and tree, with strong emotions rise
For light and air, and battle in the skies;
Whose roots diverging with opposing toil
Contend below for moisture and for soil;
Round the tall Elm the flattering Ivies bend,
And strangle, as they clasp, their struggling friend;
Envenom'd dews from Macinella flow

[29] *The Temple of Nature*, 90–93. [30] *Ibid.*, 132–34.

And scald with caustic touch the tribes below;
Dense shadowy leaves on stems aspiring borne
With blight and mildew thin the realms of corn; IV: 50
And insect hoards with restless tooth devour
The unfolded bud, and pierce the ravell'd flower.
In ocean's pearly haunts, the waves beneath,
Sits the grim monarch of insatiate Death;
The shark rapacious with descending blow
Darts on the scaly brood, that swims below;
The crawling crocodiles, beneath that move,
Arrest with rising jaws the tribes above;
With monstrous gape sepulchral whales devour
Shoals at a gulp, a million in an hour. 60
—Air, earth, and ocean, to astonish'd day
One scene of blood, one mighty tomb display!
From hunger's arm the shafts of Death are hurl'd,
And one great slaughter-house the warring world.

Moreover, even as early as *The Economy of Vegetation*, Darwin had shown himself aware in yet another footnote of that prodigality and wastefulness of nature which is so necessary if the competitiveness of species and individuals is to operate selectively.

> Nature would seem to have been wonderfully prodigal in the seeds of vegetables, and the spawn of fish; almost any one plant, if all its seeds should grow to maturity, would in a few years alone people the terrestrial globe. Mr. Ray asserts that 1012 seeds of tobacco weighed only one grain, and that from one tobacco plant the seeds thus calculated amounted to 360,000! The seeds of the ferns are by him supposed to exceed a million on a leaf. As the works of nature are governed by general laws this exuberant reproduction prevents the accidental extinction of the species, at the same time that they serve for food for the higher orders of animation.[31]

Finally, in a footnote already quoted from the same poem, Darwin suggests that some form of natural selection may have led to extinctions. ("Or do some genera of animals perish by the increasing power of their enemies?")[32] In just the same way, Lyell in his *Principles of Geology* was able to postulate that biological competitiveness might have this effect, but lacked the further insight to perceive its positive potential.

Thus it appears that Erasmus Darwin had in his grasp all, or almost all, the constituent parts of the full theory of evolution by natural selection—*viz.* the earth was immeasurably ancient and had arrived at its present form by a process of gradual development, life too had evolved or developed, species could mutate, sexual competition improved the strain, species and individuals competed for sur-

[31] *The Botanic Garden*, Pt. I, 189n. [32] *Ibid.*, 120n.

vival, the weakest went to the wall, nature was prodigal in her reproductive arrangements—without ever piecing them together in the way his grandson was able to. Instead he relied, specifically, on Lamarckian mechanisms, with some assistance from sexual selection, and in a non-specific way (indicating, perhaps, his belief that other important factors remained to be discovered) on a vague, teleological principle of progress built into the very texture of creation, to carry out the evolutionary process. As for the wastefulness, the prodigality, and the carnage of nature at work, these are seen as aspects of quite another kind of overall design or harmony.

> When thus a squadron or an army yields,
> And festering carnage loads the waves or fields;
> When few from famines or from plagues survive,
> Or earthquakes swallow half a realm alive;—
> While Nature sinks in Time's destructive storms,
> The wrecks of Death are but a change of forms;
> Emerging matter from the grave returns,
> Feeds new desires, with new sensations burns;
> With youth's first bloom a finer sense acquires, IV: 400
> And loves and Pleasures fan the rising fires.—
> Thus sainted PAUL, "O Death!" exulting cries,
> "Where is thy sting? O Grave! thy victories?"[33]

Drawing a veil over what Saint Paul, or Voltaire for that matter, would have made of such lines, let us return to Darwin's role as an evolutionary biologist. And rather than dwelling regretfully on the synthesis he did not achieve, let us briefly look further at the very real insights this eclectic amateur did arrive at. First, he describes life as having its origin in the sea at a time when there was no dry land, and having as its principal cause the effect of the sun's warmth on complex chemical chains—an insight only partially nullified by the inadequacy of either Darwin's chemistry or his poetic technique to represent such an operation convincingly.

> Ere time began, from flaming chaos hurl'd
> Rose the bright spheres, which form the circling world;
> Earths from each sun with quick explosions burst,
> And second planets issued from the first. I: 230
> Then, whilst the sea at their coeval birth,
> Surge over surge, involved the shoreless earth;
> Nurs'd by warm sun-beams in primeval caves
> Organic life began beneath the waves.
> First HEAT from chemic dissolution springs,
> And gives to matter its eccentric wings;
> With strong Repulsion parts the exploding mass,

[33] *The Temple of Nature*, 161.

Melts into lymph, or kindles into gas.
ATTRACTION next, as earth or air subsides,
The ponderous atoms from the light divides,
Approaching parts with quick embrace combines,
Swells into spheres, and lengthens into lines.
Last, as fine goads and gluten-threads excite,
Cords grapple cords, and webs with webs unite;
And quick CONTRACTION with ethereal flame
Lights into life the fibre-woven frame.—
Hence without parent by spontaneous birth
Rise the first specks of animated earth;
From Nature's womb the plant or insect swims,
And buds or breathes, with microscopic limbs.[34]

All the cheerful paucity of fact which so irritated Charles Darwin about the writings of his grandfather[35] is evident in these lines. Yet it is certainly no more surprising that biochemistry was inaccessible to Erasmus than that Mendelism was to Charles. And if over-reliance on speculative ingenuity prevented Erasmus Darwin from taking his theories further, it is at least arguable that, in his particular case, it served him better than the reliance on fact, so beloved by his grandson, would have done.

Next, Erasmus Darwin sees improvements taking place, and in particular the move from sea to land and air, in response to changes in environmental conditions—changes which he describes as having, in important respects, been brought about by the very existence of life itself.

Now in vast shoals beneath the brineless tide,
On earth's firm crust testaceous tribes reside;
Age after age expands the peopled plain,
The tenants perish, but their cells remain;
Whence coral walls and sparry hills ascend
From pole to pole, and round the line extend. I: 320

Next when imprison'd fires in central caves
Burst the firm earth, and drank the headlong waves;
And, as new airs with dread explosion swell,
Form'd lava-isles, and continents of shell;
Piled rocks on rocks, on mountains mountains raised,
And high in heaven the first volcanoes blazed;
In countless swarms an insect-myriad moves
From sea-fan gardens, and from coral groves;

[34] *Ibid.*, 19–22.

[35] Francis Darwin, ed., *The Life and Letters of Charles Darwin*, I (New York, 1896), 34.

Leaves the cold caverns of the deep, and creeps
On shelving shores, or climbs on rocky steeps.
As in dry air the sea-born stranger roves,
Each muscle quickens, and each sense improves;
Cold gills aquatic form respiring lungs,
And sounds aerial flow from slimy tongues.[36]

Lastly, in bold perspective, we are shown the whole process of life evolving, by whatever mechanism, from microscopic *ens* to man.

ORGANIC LIFE beneath the shoreless waves
Was born and nursed 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: 300
Whence countless groups of vegetation spring,
And breathing realms of fin, and feet, and wing.

Thus the tall Oak, the giant of the wood,
Which bears Britannia's thunders on the flood;
The Whale, unmeasured monster of the main,
The lordly Lion, monarch of the plain,
The Eagle soaring in the realms of air,
Whose eye undazzled drinks the solar glare,
Imperious Man, who rules the bestial crowd,
Of language, reason, and reflection proud, 310
With brow erect who scorns this earthy sod,
And styles himself the image of his God;
Arose from rudiments of form and sense,
An embryon point, or microscopic ens![37]

It is noteworthy to what an extent these later, bolder examples of almost intuitive insight into the evolutionary process itself, or into what were later to prove supporting fields of evidence, are given their only, or their fullest, expression in the verses of *The Temple of Nature*—that Darwin should have chosen, in fact, to write of evolution, late in life and at far greater length than previously, in the form of a poem. (The footnotes in this case are merely an expansion, rather than—as at times in *The Botanic Garden*—a precursor of the text.) A careful analysis of the various stylistic devices and mannerisms which, consciously or unconsciously, Darwin tended to resort to would reveal, I suspect, that this decision gave him the same sort of freedom, only a good deal more completely, as

[36] *The Temple of Nature*, 28–30.
[37] *Ibid.*, 26–28.

he sought through the rhetorical ruses of his prose—the freedom to speculate and to assert as boldly as he wished, and yet to avoid, when it suited him, having to commit himself too precisely. But that is another story.

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