"Nature, Red in Tooth and Claw", So What?

Tennyson wrote his famous line with evolution in mind, but he was basically wrong

KENNETH M. WEISS

A young Alfred Tennyson (Fig. 1A) arrived at Cambridge University in 1827. He became fast friends with another student, Arthur H. Hallam (Fig. 1B). Both were aspiring poets and Arthur helped Alfred with his budding efforts, coming strongly to his defense when his first books were attacked by reviewers. Their families became close and, in 1832, Arthur became engaged to Tennyson's sister Emilia. But the following year and without warning, Hallam, still in his early 20s, suffered a brain hemorrhage and died.

Tennyson was devastated. He vented his shattered emotions in verse, which he continued to augment until the result was finally published 17 years later as his long masterpiece, *In Memoriam A.H.H.* (1850).[1]

The public actually read poetry in those days, and Tennyson became so popular that he succeeded the great William Wordsworth as Britain's poet laureate in the year *In Memoriam* was published. Proclaimed to have an incredible "ear" and to be one of Britain's greatest poets ever, he is known for several major works, but perhaps none so much as his ode to his lost friend. That's where he wrote, "Tis better to have loved and lost, than never to have loved at all."

Another line from *In Memoriam* that's still in circulation is Tennyson's characterization of "Nature, red in tooth and claw." This is still widely used to describe the ruthless way that Nature daily dispenses with individuals and, over eons, with species as well. Could it be, asked Tennyson, that even Man,

> *Who trusted God was love indeed*
> *And love Creation's final law—*
> *Tho' Nature, red in tooth and claw*
> *With ravine, shriek'd against*
> *his creed—*
>
> *Who loved, who suffer'd countless ills,*
> *Who battled for the True, the Just,*
> *Be blown about the desert dust*
> *Or seal'd within the iron hills?*[1]

Evolution was on Tennyson's mind as he worked on *In Memoriam*. When he began writing the poem in 1833, Charles Darwin was early in his voyage on the *HMS Beagle*. Though they were born in the same year, and were contemporaries at Cambridge, they may never have met, because Darwin spent most of his time hunting. Although the poem was finished in 1850, well before Darwin's *Origin of Species* (1859), Tennyson was brooding on the cruelty of Nature because the realization of gradual change in the earth and in life was "in the air" in intellectual circles in Britain.

Tennyson read many of the same works as Darwin did, and eventually read Darwin's work itself. Both were influenced by Charles Lyell's *Principles of Geology*,[2] which appeared in

Figure 1. Poetic partners. A. Alfred Lord Tennyson (1809–1892), by G. F. Watts. B. Arthur H. Hallam (1811–1833), artist unknown. Source: public domain: Wikimedia. (Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.)

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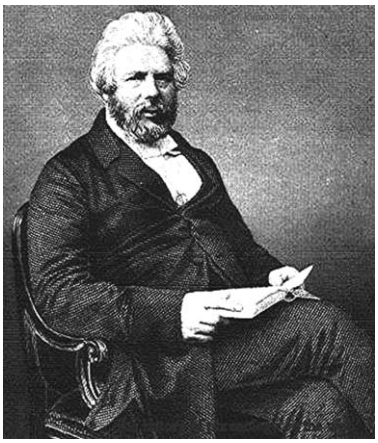

Figure 2. Robert Chambers (1802–1871). Source: public domain.

several volumes around the time of Hallam's death. Lyell described the geological processes by which the earth's features very slowly ground along in a relentless, purely material way, which Tennyson, in *In Memoriam*, described as the "streams that swift or slow/Draw down aeonian [aeons-old] hills, and sow/The dust of continents to be". Then, in 1844, about halfway between Hallam's death and the completion of *In Memoriam*, a new book appeared that was so startling that its author refused to identify himself.

A BOOK "COMPOSED IN SOLITUDE"

Robert Chambers (1802–1871, Fig. 2) was a Scottish journalist and publisher. Though not a professional scientist, he was curious, widely read, and well aware of the ideas of organic as well as geologic change that were building in England at the time.

Chambers assembled his thoughts into a book, *The Vestiges of the Natural History of Creation*.[3] (For discussion of his views see Eisely[4], and Gould[5] as well as Wikipedia: Vestiges of the Natural History of Creation.) In its conclusion, Chambers described his book as "composed in solitude...for the sole purpose ... of improving the knowledge of mankind, and through that medium their happiness."[3] But despite these good intentions, he published anonymously because he knew that his ideas would stir a cultural hornet's nest. Indeed, they certainly did!

Chambers was profoundly influenced by Lyell and the evidence of slow geological change, as well as by Jean Lamarck's theory that biological species changed gradually, inheriting adaptive traits that their parents had acquired during life.[6] Chambers argued that the universe had initially been created by God, a cosmos Tennyson characterized as "a fluid haze of light" (from *The Princess*[1]). In making his creation, God imposed natural laws on the universe, which thereafter motored along—evolved—on its own without further divine intervention. This world view is called deism and was, of course, a direct threat to the established church view in which God was very much with us. In Chambers' view, evolutionary processes ineluctably led to improvement, wending their way toward a final state with a "nobler type of humanity, which shall complete the zoological circle on this planet, and realize some of the dreams of the purest spirits of the present race."[3]

Although Chambers' book was a public sensation, it was heavily criticized, partly for what Darwin characterized in the preface to the *Origin of Species* as "little accurate knowledge and a great want of scientific caution."[7] But even Darwin went on to acknowledge that Chambers had done "excellent service in this country in calling attention to the subject, in removing prejudice, and in thus preparing the ground for the reception of analogous views."[7]

Chambers both followed Lamarck and anticipated Darwin by saying that a species rose to higher form or became degraded "by the influence of the physical conditions in which it lives."[3] This is the familiar theory of use and disuse that both Lamarck and Darwin espoused, which, if properly phrased in modern terms, we have no problem with today: "use" means preserved by selection and "disuse" means that a trait not maintained by selection will gradually mutate away. In anthropology, Loring Brace later referred to this as the "probable mutation effect."[8]

The year *Vestiges* was published, 1844, was remarkable not just because Chambers' book made a public splash, but also because that year Darwin privately drafted a tentative chapter called "Natural Selection",[9] in which he first explicitly outlined his evolutionary ideas—so explicitly, indeed, that an extract of the chapter was introduced to the Linnaean Society in 1858 to prove Darwin's priority over Wallace in developing a modern theory of how biological variation evolved.

HAECKEL (P)REDUX?

By the early nineteenth century, vertebrate embryologists had found that "Each animal has been found to pass, in the course of his germinal history, through a series of changes resembling the *permanent forms* of the various orders of animals inferior to it in the scale." For example, a four-stage progression had been suggested, that went from fish, to reptiles, to birds, to mammals and, of course, humans.

This quote will probably seem familiar to you. The idea was the basis of the German evolutionist Ernst Haeckel's "biogenetic law" that "ontogeny recapitulates phylogeny." First stated in Haeckel's book *General Morphology* in 1866,[10] this was an oft-repeated central pillar in his staunch defense of Darwinism. Haeckel's catchphrase is still heard today.

But the quote is not from Haeckel! It's from Chambers, in 1844. His was probably the most widely read statement of these findings, which were well-known at the time, until Haeckel took the stage. But even earlier,[11] in 1832, in *The Palace of Art*, Tennyson had built the same embryological facts into a remarkable evolutionary statement about the human brain[1]:

"From shape to shape at first within
the womb
The brain is modell'd," she began,
"And thro' all phases of all thought
I come
Into the perfect man."

All nature widens upward. Evermor
The simpler essence lower lies:
More complex is more perfect,
owning more
Discourse, more widely wise.

Here, Tennyson sees in comparative embryology a natural view of the progression of the complex human

Figure 3. ``The Ape despite his razor keen, Was the apiest Ape that ever was seen!'' From *Princess Ida*. Drawing by W.S. Gilbert (signed as ``Bab'').

brain from simpler ancestors, so that we are now able to control our own destiny and overcome nasty Nature. The biogenetic laws is taken to its extreme.

Of course we have long known that mammal embryos do not go through the *adult* stages of earlier vertebrate species (and certainly not birds!). Nonetheless, it's easy to see how the apparent evolutionary advance of the human brain immediately led to an extension of evolutionary thoughts beyond the confines of geology and biology, to anthropology and human affairs more broadly.

"THE APIEST APE THAT EVER WAS SEEN!"[12]

Tennyson's description of nature as red in tooth and claw reflected a bleak, increasing awareness that the cruelty of the industrial revolution and the expanding Empire showed the world not to be the warm creation of a loving God, but instead to be impersonal, material, and strictly physical. Like it or not, Nature was a hammer of destruction. But was that all? Was Hallam's death totally without purpose or even meaning? Or could there be more?

That "more" might be found in the human mind. Following on the eighteenth-century Enlightenment period of utopian hopes that knowledge and science would improve society, not only Chambers, but also materialists like sociologist Herbert Spencer and of course Karl Marx and their followers, were rumbling, often in diametrically opposed ways, about how *social* evolution must also follow scientific laws. Even the biologists, Darwin and Wallace and their followers, notably including Darwin's advocate Thomas Huxley, concluded that because of our brain power humans could now, finally, overcome biological selection and engineer society to our liking.

Among Victorian fiction writers, Tennyson probably kept most abreast of scientific thinking. This was regularly reflected in his work. In fact, Huxley praised him as the only nonscientist of the century who really understood the penetrating importance of the issues. Huxley even praised *In Memoriam* for its insight into the methods of science.[13] However, Tennyson's interest was in the implications of biological evolution for social advancement. His humorous 1847 poem *The Princess* concerns "A talk of college and of ladies' rights," in which a group of Victorian-vintage feminists establish a women-only college, where women are allowed to be educated and achieve equality, to read and actually think, even of mathematics and science!

The Princess was humorously veiled advocacy of equality for women. It exemplifies the threat that evolutionary theory, in the hands of social progressives, posed to the prevailing stuffy order of British society. It became the basis of Gilbert and Sullivan's 1884 comedic operetta, *Princess Ida*.[12] At one point in the play, a Maid was wooed by an Ape who, "with a view to rise in the social scale," tried to disguise himself by shaving, docking his tail, and dressing in a suit (Fig. 3). But she saw through this at once, because Man "sprung from an Ape, is an ape at heart" and "A Darwinian Man, though well-behaved/At best is only a monkey shaved." Even in the theater, satire showed evolution's general currency at the time.

But the works I've discussed do not just constitute a set of nineteenth-century anecdotes. They reflect a serious conceptual problem, and one that is still around. The remorseless march of death and destruction, of tooth and claw, on which these views were based, may be a fact but, in fact, does not imply what was claimed of it.

A DESCRIPTION OF NATURE, BUT WHAT DOES IT MEAN?

Every creature dies, and most of us will die in grim ways we would not choose. In the animal and plant world, it usually means being torn apart while still alive. Even those who escape big predators are often taken down by microbial ones who eat us alive from the inside out, needing neither teeth nor claws to do it. Nature is certainly as Tennyson described it.

The nastiness in Nature, and its equivalent in the grinding social misery that Darwin and Wallace knew of both at home in the UK and in other countries, were the centerpiece of Thomas Malthus' idea of the cruelty visited on people by overpopulation, which finally pushed both Darwin and Wallace to their theories of natural selection. In Tennyson's words, Nature was "so careless of the single life...that of fifty seeds/She often brings but one to bear". (from *In Memoriam*[1]). In his 1844 chapter, Darwin said that Nature is "the doctrine of Malthus applied in most cases with tenfold force."[9] "Can it be doubted from the struggle each individual has to obtain subsistence," he asked, "that any minute variation in structure, habits or instincts, adapting that individual better to the new conditions, would tell upon its vigor and health?"[9:49] Fifteen years later, he continued this theme, ending the *Origin of Species* by listing several "laws acting all around us", including the inherent "Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection."[7:425]

But that is false reasoning, and it's persisted rather uncritically up to our own time. The remorseless cruelty of Nature certainly provides an *opportunity* for, but doesn't imply, natural selection. Rather than having a talon for fine-tuning, much if not most of nature's mayhem is indiscriminate. If life is tragic, it's largely a universal tragedy.

Indeed, when environments become too harsh, there may simply be no way out for anybody, a level of stress that overwhelms any "minute variation". Not every species can respond to changes in conditions. It may be that none of its individual members bear genetic variation that can withstand an environmental onslaught. In fact, many, if not most species, go extinct. Not only that, but evolutionary ecologists have found evidence that lack of appropriate genetic variation may help explain the curious long-term stasis of many species, sometimes even in the face of environmental change.[14–16]

Conversely, it takes only the most superficial of observations to see that as a rule most organisms have plenty of chance to reproduce. Rarely is each individual wobbling on the thin edge of survival, ready to perish if it can't secure every available calorie. Such a state of affairs better describes times of famine, not normality. The danger of too heavy a bludgeon was one reason Darwin repeatedly stressed the slowness and gradual nature of natural selection. Ironically, it could be that times of plenty provide more plentiful times for variation to compete for success.

In being captivated by the blunt harshness of Nature, we have rather consistently made a similar mistake, along with Darwin, in regard to his ultimate purpose, which was to show that natural selection is the means by which new species evolved. That, too, is false reasoning. Natural selection does not, by itself, lead to speciation. One finch can have a genotype for a bigger beak that allows it to eat larger seeds than another finch can, but that does not mean they can't mate. There is great diversity in the traits of human beings around the world, and much of it seems to be adaptive to local environmental and cultural circumstances. Classical examples are resistance to malaria, light skin pigmentation that allows vitamin D to be produced in people adapted to northern climates, or the adaptive ability of adults to digest milk. Yet, despite this considerable adaptive variation, populations at the ends of the earth, Cape Horn and the Cape of Good Hope, are able and willing to mate and produce fertile offspring.

In Chapter IV of the *Origin of Species*, Darwin used the only figure in the book to describe his idea that the descendants of a common ancestor would gradually diverge, specializing to varying environments as they did so. In the most hand-waving of hand-waving terms, he simply asserts that after some few thousand generations, this divergence would lead to the formation of different "varieties," as they were called. Then, after many more thousands of generations, this divergence would lead to different species. Darwin did not support this by any kind of evidence about species *per se*, much less anything quantitative or related, say, to ideas of genetic incompatibility (though that is perhaps implicit in later chapters where he considers the problem of hybrid viability). The degree to which selection is the direct means by which reproductive isolation has arisen is still a lively topic,[17,18] but even when selection is involved it doesn't imply that the losers die more brutally or yearn to mate more often than do the winners.

I am not denigrating the inspired deftness with which Darwin amassed a stunning diversity of evidence to support his idea that species arise through a history of natural processes. Everything we know supports his intuition, which we continue to reinforce with the same kinds of evidence that Darwin used. However, from his time to the present, we have misperceived the unquestionable coldness of mortality and fertility differences as being necessarily systematic and force-like, using that perception to view selection as more refined and discriminating than it usually seems to be and then equating the resulting divergence with mating incompatibility, the usual definition of species.

Darwin's theory of speciation was based on long-term extrapolation of the undeniable cruelty of population pressure and the well-established effectiveness of short-term *agricultural* selection. But Nature's cruelty and the formation of species are separate issues. Meanwhile, Darwin's extrapolation was nothing compared to the leap of faith by which Tennyson and many others saw, in Nature's brutality, evidence of a driving *purpose*.

"NOT A WORM IS CLOVEN IN VAIN" (FROM *IN MEMORIAM*)

The death of Arthur Hallam seemed an obvious consequence of a coldly mechanical universe, but Tennyson, like Chambers, found solace in a deist perspective. He yearned to see Hallam again, and his poem concluded with a Chambers-like resolution in which that reunion would eventually happen, in the presence of or in unity with God. In "In Memoriam," he saw the cruelty of Nature and of human society as a kind of pilgrim's progress plodding steadily, if brutally, towards an ultimate, comforting end "No longer half-akin to brute," in company of "one God, one law, one element." And specifically of Hallam, Tennyson wrote:

> *Whereof the man, that with me trod*
> *This planet, was a noble type*
> *Appearing ere the times were ripe,*
> *That friend of mine who lives in God.*

In his grief, Tennyson found hope in the idea of embryological recapitulation. If Nature is a hammer, it is a progressive force that destroys to improve: the brains of earlier, more primitive species, evolved toward the more noble structure that we bear. Eventually, a perfected mind would be united with the God who had started it all. To Tennyson, Hallam was an early representative of that nobler creature through which Nature would eventually be defanged.

In fact, Tennyson and almost everyone of his time shared a notion of progress that they saw in both the biological and social evidence.[19] Darwin is often said to have been an exception because he stressed divergence where the only sense of progress was adaptive improvement of organisms to their current local circumstances. But he can only partly be exonerated, as a glance at his treatment of human race and culture in *Descent of Man* (1871) easily shows. There, Darwin goes to some length to speculate about how local

selection led to steady cultural as well as biological advance among the human populations, as savages led to civilizations.[20]

In nineteenth century Britain, it did not require a religious perspective to see Nature as inherently progressive. It was too bad that the poor have to suffer today, but it is Nature's way to make society better tomorrow. Social progress was, after all, why European societies were dominant in the world: not because they were nice, but because they had evolved to be *better*. At the same time, social egalitarians such as the socialists saw in the conflicts of evolution the ability, or even the *destiny*, of society to become more rather than less humane—a materialistic substitute for deism.

These notions rested entirely on extrapolations, and strange ones at that. Tennyson and the social scientists somehow used their observation that Nature was, and presumably always had been, inherently bloody, to extrapolate a benign and final end. But just as Nature, red in tooth and claw in and of itself implies neither selective adaptation nor speciation, it is only by the stretch of a poet's imagination that it implies any kind of end-stage, much less deist progress toward such an end. Only if we naively look backward in time and compare how terrific we fancy that we are today relative to our primordial ancestral slime can we attain the illusion that we, like Arthur Hallam, are near the omega of history. Yet even today it is not uncommon to hear leading thinkers declare that, except for the artifact of genetic engineering, human biological evolution is over.

All the nineteenth-century evolutionary theorizers were staring Nature's same harsh realities in the face. To Tennyson, bloody fangs and talons were like the stations of the cross: The apparent meaninglessness of earthly life is a journey to eventual rapturous reunion with God. To Darwin, the truth was strictly mundane, a subject for empirical science, not theology. As he wrote to his contemporary August Weisman, "No doubt there remains an immense deal of work to do" on the problem of speciation due to natural selection (Darwin letters, 2/29/1872 from http://www.darwinproject.ac.uk/). Ever modest, he went on to say, "I have only opened a path for others to enter, and in the course of time to make a broad and clear high-road" to understanding.

That has certainly happened in the years since we embarked on the path Darwin helped to open for us. But the problem of understanding how species arise at the gene level has not been solved, unless the answer is "by all sorts of genomic differences, sometimes large, sometimes small." It also is not clear how natural selection, which the evidence suggests is, as Darwin thought, usually very slow and based mainly on slight fitness differences, actually works to spread its effects from the very local to the species-wide, or to create new species. With the understanding we now have, thanks to Darwin's initial inspiration, we can see that his ideas, whetted by Nature's cruelty, were very powerful, but oversimplified both natural selection and speciation. That leaves us much interesting work to do. But Tennyson and the social thinkers strayed much farther from the truth when they inferred that Nature's red fangs pointed to a rosy end. Their extrapolation doesn't seem to open a road to anywhere.

As far back as 1839, even Darwin had cautiously noted, at the end of his *Voyage of the Beagle*, that there is "a constant tendency to fill up the wide gaps of knowledge, by inaccurate and superficial hypotheses."[21:532–533] That's a lesson that scientists, though perhaps not poets, need to learn.

NOTES

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