

DIEGO BERMEJO (ED.)

# Pasión por la vida Passion for Life

Homenaje a Francisco J. Ayala  
en su 85 cumpleaños  
Homage to Francisco J. Ayala  
on his 85th Birthday

ALIANZA EDITORIAL

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A BRIEF HISTORY  
OF EVOLUTION AND CREATION  
(LYRICAL SCRIPT  
FOR A HIP-HOP MUSICAL PLAY)

JOHN C. AVISE

**Backdrop:** In the early 1980's, Francisco J. Ayala chaired a National Academy of Sciences "Committee on Revising Science and Creationism." What emerged was a landmark booklet entitled *Science, Evolution, and Creationism*, which became a touchstone document for open-minded people of diverse backgrounds who find themselves embroiled in debates about biological evolution.

FJA has been aptly described as a Renaissance Man, fearlessly exploring both the art and science of the human condition at levels ranging from molecules to souls. I hope that my highly unorthodox chapter will be received in this same spirit of adventure, because the hallmark of scientists and artists alike is fresh creativity, with both types of artisans gallantly exploring where no-one has ventured before.

This chapter presents my newly-written lyrics for a theatrical hip-hop-style screenplay (partly inspired by the Broadway Musical *Hamilton*) on the history of evolutionary genetics and Creationism,

from the time of Carolus Linnaeus (1758) to the ongoing genomics revolution. I have phrased the lyrics for each of 22 Songs or Acts in a quasi-poetic RAP style, arranged in historical sequence. Throughout my Screenplay, first-person lyrics personify (through the voices of about a dozen major historical figures) the recurring tension between Scientists and Creationists about the source of life's variety. This lyrical material is historically correct and hopefully offers a scientifically informative as well as entertaining departure from the standard public discourse between "believers" and "non-believers" regarding the origins of biological diversity.

### *ACTS (or RAP SONGS)*

*Carolus Linnaeus* on Taxonomy (1758)  
*William Paley* on Natural Theology (1802)  
*Jean-Baptiste Lamarck* on Evolution (1809)  
*Charles Lyell* on Gradualism (1830)  
*Charles Darwin* Aboard the Beagle (1831-1836)  
*Alfred Russel Wallace* on Natural Selection (1858)  
*Emma Darwin* on Religiosity (1858)  
*Charles Darwin* on Natural Selection (1859)  
*Gregor Mendel* on Genetics (1865)  
*Charles Darwin* on Sexual Selection (1871)  
*Alfred Russel Wallace* on Biogeography (1876)  
*Sir Archibald Garrod* on Human Inborn Disorders (1909)  
 One Long Debate (throughout the early 1900's)  
 On the Origin of Population Genetics (1930's)  
 Expansion of the Modern Evolutionary Synthesis (1940's)  
*James Watson and Francis Crick* on DNA (1953)  
 The Molecular Revolution (early 1960's)  
 Selectionists versus Neutralists (1960's and beyond)  
 Molecular Clocks (1960's and beyond)  
 Pheneticists versus Cladists (1960's and beyond)  
 From Genetics to Genomics (2001)  
 Scientists versus Creationists (continuing today)



*THE CAST*  
(in order of appearance)

Narrator (i.e., the Master of Ceremonies)  
 Carolus Linnaeus (at age 51)  
 Religious Choir (a small group of 3 or 4 religious singers)  
 Reverend William Paley (at age 59)  
 Jean-Baptiste Lamarck (at age 55)  
 Scientist Choir (a small group of 3 or 4 scientist singers)  
 Charles Lyell (at age 33)  
 Charles Darwin (age in early 20's at first; then at age 50; then at age 62)  
 Captain Robert Fitzroy (age in late 20's)  
 Alfred Russel Wallace (age 35 at first; then at age 53)  
 Emma Darwin (at age 40)  
 Gregor Mendel (at age 43)  
 Sir Archibald Garrod (at age 52)  
 Mendelians (a small chorus)  
 Biometricians (a small chorus)  
 Mathematicians (Fisher, Wright, Haldane) (all aged in their 40's)  
 Theodosius Dobzhansky (Doby) (at age late 30's)  
 Founders of Modern Synthesis (Huxley, Mayr, Simpson, Rensch, Stebbins)  
 (all in their late 40's)  
 James Watson and Francis Crick (at ages 24 and 36, respectively)  
 Neutralists (a small chorus)  
 Selectionists (a small chorus)  
 Pheneticists (a small chorus of mild-mannered gentlemen)  
 Cladists (a small chorus of quit acerbic people)  
 Creationists (a big chorus, joined by Linnaeus, Paley, Fitzroy, and Emma Darwin)  
 Scientists (a big chorus, joined by many of the principal actors listed above)  
 Final Chorus (an amalgamation of all actors in the play)

*NARRATOR*

This is a play on grand ideas in evolution, religion, and genetics.  
 The viewer's job throughout is to distinguish between conformists and heretics.  
 So, take a close look—and good luck!

*CAROLUS LINNAEUS*  
*ON TAXONOMY (1758)*

All the glories of God's creation, require organization;  
 Into some categorical format; that's where I'm at,  
 On this biological matter.  
 Why does it matter? Because...  
 From snails to whales; from bees to trees; from gnats to bats;  
 From larks to sharks; from tortoises to porpoises; and from shrews to gnus,  
 We need to sanctify, and thereby glorify, venerate and celebrate,  
 All of God's organic handiwork.  
 But how would my scheme work?

Every type of creature should feature a formal name.  
 The nomenclature, to be sure, should be simply framed.  
 Here's what I propose. Suppose, that each Latin cognomen  
 Consists of two parts: "species" preceded by "genus",  
 Like a surname followed by given name, isn't that genius?  
 For example, the forest gorilla would be *Gorilla gorilla*,  
 With the genus capitalized and the whole name italicized.

Animals of a similar type, such as brown bear, black bear,  
 And panda bear would all bear the same generic appellation;  
 To indicate their likeness of design under God's formulation.  
 I will then proceed upward through a taxonomic hierarchy;  
 No more anarchy.  
 For example, snakes and lizards share scales and long flanks  
 So, I will jointly scale them at higher taxonomic ranks;  
 All kinds of fish I will classify into a Class;  
 And birds of a feather I will order into a taxonomic Order.  
 And to celebrate God's wisdom, I will place animals and plants in two  
 Kingdoms.  
 My scheme all seems so rational, logical, you might say "bio-logical".

I won't be satisfied until all forms of life are classified:  
 From whelks to elks, rats to bats, ferns to terns, carrots to parrots; eels

to seals, skinks to skunks, moths to sloths, lice to mice, stoats to goats, ants to elephants.  
I will assign them all proper places in God's foresight of design.

*RELIGIOUS CHOIR*

This is big, really big  
To name all of God's Creation.  
Jubilation, jubilation!

*WILLIAM PALEY  
ON NATURAL THEOLOGY (1802)*

Incredibly, indelibly, undeniably,  
God deemed it His duty  
To impress inexpressible beauty  
Into every feature of each type of creature  
On planet Earth; in a marvelous birth of life  
During a special Creation—  
His supernatural form of recreation,  
An immaculate concept of conception:  
In a miraculous play played out across a few days;  
Exactly as the Bible says.  
And you better believe it!

Suppose you found a working timepiece on the ground;  
Surely it had a creator, a motivator, a skilled watchmaker.  
Its complex design provides sure sign that its sprockets and springs  
Had sprung from a conscious agent with an agenda.  
So too we can say, life was crafted that same way:  
By an intelligent being, that being of course, God Himself.  
Exactly as the Bible says.  
And you better believe it!

Every bird in the sky, every butterfly fluttering by; every vertebrate eye;  
 Every species of tree, every fish in the sea, I can clearly see  
 Was crafted precisely as it is now: all at once and once-and-for-all,  
 By our supreme Lord. Are we all aboard?  
 Don't be oblivious; it's observably obvious...  
 Exactly as the Bible says.  
 And you better believe it!

*RELIGIOUS CHOIR*

This is big, really big  
 To glorify all of God's Creation.  
 Jubilation, jubilation!

*JEAN-BAPTISTE LAMARCK  
 ON EVOLUTION (1809)*

*LAMARCK (speaking to Paley)*

Please, reverend Paley—not so fast. I'm aghast  
 That you've rejected, or at least neglected  
 A natural force in a counterproposal  
 That I hereby place at your disposal.  
 Here, for your attention, is my novel contention:

Life has always evolved and changed, constantly rearranged  
 By the direct effects of use and disuse. Each environmental abuse,  
 I theorize, directly reorganizes  
 Organs and tissues; so here are the real issues:  
 Is nature's course natural or supernatural, dear sir?

Let me explain using a sample from ample examples  
 That argue for my revolutionary evolutionary idea.  
 Consider the neck of a giraffe, which like a flagstaff, raises its head to  
 feed;

Much the better to meet the animal's culinary need. Indeed,  
 As the neck stretches, it naturally fetches— more food,  
 Which of course is good, for the beast's health.  
 The taller the animal gets, the more it begets this trait to its offspring.  
 Over evolutionary time the creature's features thereby elongate;  
 Who knows how long it may take? But make no mistake,  
 The process is natural and gradual.

In the end, my thesis depends—I admit—  
 On how acquired traits transmit... across generations.  
 But until science processes  
 How transmission progresses,  
 I stand by my theory of: "Lamarckian inheritance".

*SCIENTIST CHOIR*

This is big, really big  
 A form of natural Creation.  
 Jubilation, jubilation!

*PALEY (responding to Lamarck)*

I can't refrain from expressing distain  
 For such silly thoughts from your brain.  
 God's intelligent design can better explain all this stuff.  
 Exactly as the Bible says,  
 And you better believe it!

*CHARLES LYELL ON GRADUALISM (1830)*

Catechism holds that each Biblical cataclysm,  
 Such as a worldwide flood teaches a moral lesson...  
 Via its impactful impact; like the famous forty-day deluge  
 That forced Noah to frame a huge ark for survival;

Two-by-two of each kind of animal for species revival.  
 Of course, any such sudden upheaval would surely as well  
 Impact all things geological.  
 Isn't that logical?  
 So, as a practicing geologist, I decided to get things right  
 As seen in quite a different light by writing...  
 Principles of Geology,  
 In which I make a case for gradualism, not catastrophism.

I propose that slow-acting forces —like erosion by wind or rain—  
 In nature must always have reigned;  
 And thereby remained part of God's plan for the planet.  
 Geological actions now in operation —like those of a vast historical past—  
 Leave lasting impressions on the Earth's surface.  
 That's my impression, which I give full expression  
 In Principles of Geology.  
 Where I make a case for uniformitarianism, not catastrophism.

For geological gradualism, here's the basic realism:  
 Rivers and waves slowly erode canyons and shoreline caves,  
 Lava flows locally from volcanos;  
 Lowly mountains uplift slowly;  
 Without clemency, rocks weather by inclement weather;  
 Erratic boulders ride erratically on slow-paced glaciers;  
 Sediments incessantly deposit on river deltas.  
 Such sentiments and more, I proffer  
 Offer sensible, defensible, comprehensible notions.  
 I implore you to explore,  
 This core of uniformitarian lore,  
 In my book. Please take a look.

*SCIENTIST CHOIR.*

This is big, really big  
 Gradual, natural Creation.  
 Jubilation, jubilation!

*CHARLES DARWIN  
ABOARD THE BEAGLE (1831-1836)*

*THE NARRATOR*

Charles Darwin did more than just look —  
He read Lyell's book from cover to cover,  
Over and over,  
And hovered over every inspiring word.

The prose gave Darwin pause:  
Might the kinds of gradual change  
That Lyell espoused for geology  
Be somehow exposed for biology too?  
Who knew? But it started Darwin thinking,  
Tinkering with radical thoughts not so  
Blindly bound to standard Creationist mantra.

*DARWIN*

I'm sick of all these ocean swells;  
They often make me feel like hell.  
But I also have time to contemplate  
Nature's bountiful bounty and fate.  
I seem almost destined to generate,  
Entirely new perspectives on nature.  
After all, I'm the ship's naturalist!

From Patagonian fossils and llamas;  
To Galapagos finches and tortoises;  
There seems to be no special purposes.  
For where and how life is arranged.  
Am I deranged?

Perhaps there's another explanation  
Besides God's special creation

Let me think and rethink all this over,  
And over, and over.  
Might there be gradual, natural forces  
Forcing life to arrange as it does?

*CAPTAIN ROBERT FITZROY*  
*(speaking to Darwin)*

I can't refrain from expressing disdain  
For such silly thoughts from your brain.  
God's intelligent design can better explain  
All this stuff  
Exactly as the Bible says,  
And you better believe it!

*DARWIN*

OK, at least for now, but how  
Do you know with such certainty?  
I certainly need to think all this over,  
And over, and over.

*ALFRED RUSSEL WALLACE*  
*ON NATURAL SELECTION (1858)*

*WALLACE (writing to Darwin)*

Esteemed esquire:  
Good day sir, let me first say, sir, that I greatly admire, sire  
Your long devotion and heartfelt emotion  
Regarding nature's secretive ways.  
Five years and endless days aboard the Beagle,  
Must have given you an eagle's eye  
By which to spy on...



Life's many plays  
In the evolutionary theatre.

You barely know my name, but I too have travelled widely,  
Throughout the tropics, as well as on topics within my brain.  
Whence during a bout of malarial fever, I chanced to gain  
A deduction about a natural force  
That may have shaped the course of...  
Life's many plays  
In the evolutionary theatre.

Let me beg your attention as I briefly put forth  
My deeply held conviction:  
All creatures struggle to stay alive, and thrive  
In settings where they happen to arise; that's no surprise.  
But as vastly more are hatched  
Than can possibly be matched  
To available resources,  
Nature only endorses  
Those who survive, to revive  
And repopulate each population.  
This cull-of-the-wild naturally orchestrates...  
Life's many plays  
In the evolutionary theatre.

*SCIENTIST CHOIR*

This is big, really big  
A form of natural Creation.  
Jubilation, jubilation!

*DARWIN (responding to Wallace)*

Sir, your letter has been received; but, alas,  
It affords me no solace.  
There's insight in what you've written,

But I'm not the least smitten.  
 Instead, I'm aghast and chagrined because  
 I've silently championed this same cause  
 For more than 20 years: tallying data, rallying thoughts, and generally  
 dallying;  
 Before my intended release  
 Of a monumental treatise  
 On the origin of species via natural selection;  
 Now, I feel complete and abject dejection!  
 Through the unanticipated circumstance of your letter;  
 I feel almost bitter; have I lost all claim to fame,  
 As the discoverer of the natural composer of...  
 Life's many plays  
 In the evolutionary theatre.

*DARWIN (contemplating to himself)*

What can I say? No more delay.  
 I must finish my opus right away.  
 And make it apparent  
 That I own the patent  
 For seeing the action of natural selection  
 In life's many plays  
 In the evolutionary theatre.

#### *EMMA DARWIN ON RELIGIOSITY (1858)*

*EMMA (Speaking to her husband Charles)*

My dearest darling and husband of nigh 20 years  
 Let me kindly express to you my deepest fears.

If you follow through on your daring plan to publish  
 Your notions about evolution and natural selection,

Some people might see it as mere rubbish.  
 Or worse; they might take it as blasphemy against God's will  
 And worse even still, you might end up in Hell, and we forever would  
 be apart.

So, I wish to do my small part, while there's still a chance to save our  
 romance.

We've always been open about our divergent views; that's not news.  
 But I fear, my dear, that you may have become an agnostic or even an atheist.  
 Heaven forbid!

Yes, we've always had this philosophical void between us  
 Which I've tried to avoid, but now wish to discuss.  
 Please be careful how you proceed, because what you write people may read  
 As blasphemous discourse, of course. So be fully aware and duly careful.  
 I say this with great love and devotion;  
 Because, it's my sincere emotion.

*CHARLES (replying to Emma)*

My cherished sweetheart, I take to heart your kindly expressed concerns.  
 They somewhat concern me too, and always have;  
 Hence in part the delay to relay my ideas in print.  
 Now I might be scooped in what I've longed for so long to write;  
 Which I don't really see as atheistic blasphemy.  
 So, I will proceed; please wish me well;  
 And I really don't think I'll forever be damned in Hell.  
 By any munificent God who may have enacted natural laws.

*CHARLES DARWIN  
 ON NATURAL SELECTION (1859)*

*DARWIN (reflecting on his work)*

Neither Heaven nor Hell,  
 Evolution is the solution.

Phylogenetic trees, genealogies—  
 Where we've been, where we're going;  
 Pathways that are well worth knowing.  
 Can't you see? Don't you agree?

Ancestor to descendent, progeny from parent,  
 All dependent on hereditary inheritance,  
 On long-term evolutionary continuance;  
 A nuanced mix of chance and necessity.  
 That's my stand  
 And I stand by it.  
 Can't you see? Don't you agree?

I knew it was true,  
 And I could show it;  
 I wrote the book on it.  
 A treatise on natural selection—the latest section  
 In humanity's long quest for self-understanding.  
 Philosophy and biology, joined at the hip,  
 Whose countless sages through the ages  
 Had sought to find the missing link  
 Between the what and why of the organic experience:  
 Stubborn persistence, dogged insistence against extinction.  
 The driving force shaping all life.  
 Can't you see? Don't you agree?

Reaction to my theory was far from dreary:  
 Some antagonists were pissed and called me an atheist;  
 Others offered initial rejection, then closer inspection, circumspection,  
     introspection, apprehension, comprehension, appreciation, admira-  
     tion, and —dare I say it?— even some adoration.  
 All in my lifetime.  
 Skeptics, politics, lunatics, yes, I took many licks.  
 But I kept on ticking, kicking, licking my wounds, and picking my  
     fights,  
 Because I knew I was right,

And I could show it;  
I wrote the book on it.

When life was thought to be born of divine providence,  
We "knew" that God's caring motives held firm in the firmament;  
Or was there something far less benign,  
Perhaps to be denied and maligned,  
Somehow allied and aligned, with objective science?  
The answer had eluded prejudiced eyes until...  
From unconscionable to plausible to irresistible,  
Adaptation by selection was cast in a natural light.

Across generations, a molding of flesh to ecological circumstance;  
That was my stance.  
Survival of the fittest, nature red in tooth and claw,  
All of this and more I first deeply saw.  
Can't you see? Don't you agree?

*SCIENTIST CHOIR*

This is big, really big  
The nature of natural Creation.  
Jubilation, jubilation!

*GREGOR MENDEL ON GENETICS (1865)*

Yet dilemmas remained, as Darwin unexplained  
By invoking Lamarckian gemmules as a lame  
Excuse for heredity, the nature of which, he simply couldn't have  
known.  
Until his contemporary —yours truly— made an extraordinary  
Find of the kind that challenged the mind,  
And altered the course of history:  
Of genetics.  
Who would have guessed?

My thoughts were pure but my hands were dirty  
 As I painstakingly staked and planted my plants  
 In the monastery's vegetable garden, pardon  
 But I had no idea what to expect, excepting the unexpected.

Counting hundreds of peas I was pleasantly pleased —  
 That they sorted into ratios of the simplest of sorts,  
 Like coherent cohorts of 3:1. Such tremendous fun!  
 Who would have guessed?

My results opposed what everyone had supposed  
 About inheritance being fully miscible, indivisible,  
 Like the blending of fluids or paints.  
 But all that's visible sometimes ain't  
 What it may seem, necessarily.  
 I mean, one must proceed warily.  
 In this case the peas violated all decrees of my era.  
 So, I thought there must be some grave error, a fatal flaw  
 That no one saw in the standard view of heredity.  
 Such heresy from an Augustinian monk!  
 Who would have guessed?

Without further dally I published the tally,  
 And discovered they fit a model in which  
 Whatever passed from parent to progeny  
 Seemed to remain intact. In fact,  
 They behaved like particulate particles.  
 Thus, whatever granted the peas I had planted  
 Their various shapes and sizes,  
 Offered surprises: no compromises  
 Between shoots short and tall, or seeds round and wrinkled.  
 Such heresy stemming from an Augustinian abbey!  
 Who would have guessed?

Now fast-forward across four decades  
 To the dawn of my growing accolades:

After others rediscovered what I had uncovered,  
 And thereby rescued my name from obscurity.  
 The particles I had found  
 Got renamed and renowned as "genes",  
 and I became known as the father of genetics.  
 Not bad for an Augustinian friar.  
 Who would have guessed?

*SCIENTIST CHOIR*

This is big, really big  
 The particles of Creation.  
 Jubilation, jubilation!

*CHARLES DARWIN  
 ON SEXUAL SELECTION (1871)*

The ivory tusks of an elephant or walrus;  
 The antlers of a buck; bright feathers of a duck; the horns of a bighorn sheep;  
 The sweet melody of a meadowlark, the nuptial flight of a skylark;  
 A swallow's deeply forked tail; a peacock's lustrous train;  
 What scientific tales do such spectacular spectacles tell?  
 A cardinal's crest, and all the rest of its brilliant red plumage;  
 Present quite an image, but toward what logical end?  
 A bluebird's lovely blue and many the hue of a coral reef fish;  
 Made me wish I had an answer for their colorful evolutionary stories.

Or the sweet sight and smell of a flower, with its enduring power to lure  
 An insect who arrives to prospect for nutritious nectar,  
 Thereby spreading a plant's precious pollen both near and far.  
 From the pheromones of a stink beetle or a silky moth  
 To the raging hormones of a preposterously horny rhinoceros.  
 Or a guppy's showy fins; or the blaring evening dins of a cicada or a  
 katydid;

A springtime chorus of frogs on logs; an incessant chirping of crickets  
 in thickets;  
 The lovely love song of a songbird, or from the male of a humpback  
 whale;  
 What scientific tales do such spectacular spectacles tell?  
 The showy feathers of a bird-of-paradise; Is that evolutionarily wise?  
 And how did such exuberant features arise, and proliferate? Was it sur-  
 real fate?

A prairie chicken's dances; a stork's funny romances by clacking bills;  
 A redwing's scarlet epaulets; a drake's stunning plumage. Of what  
 usage?  
 A hummingbird's iridescent throat or crown; a bowerbird's pretty  
 bower;  
 What creative power lies behind such dazzling characteristics? It's puz-  
 zling.  
 Most of these creatures' exaggerated features and many more  
 Would seem to attract predators or competitors, and therefore  
 Should be maladaptive and strongly disfavored  
 By natural selection.

Until, I began to distill the essence of such phenotypes.  
 They all play a reproductive role: rolling genes and genotypes  
 Into succeeding generations; thereby reseeding populations,  
 Through male-to-male battle for mating rights;  
 Or via female choice based on olfaction, sounds, or visual sights.  
 I called it all sexual selection, in contradistinction to natural selection  
*per se*.

#### SCIENTIST CHOIR

This is big, really big  
 More on natural Creation.  
 Jubilation, jubilation!



*ALFRED RUSSEL WALLACE  
ON BIOGEOGRAPHY (1876)*

*WALLACE (writing to Darwin)*

Your bodies of work are compelling, telling, profound, and best-selling.  
And I bare you no grudge for the acclaim you've received.  
You learned for it, yearned for it, earnestly earned much credit for it;  
You've well served and forever preserved the field of evolution,  
Through the resonance and eloquence of your words and thoughts.  
On the Origin was truly an original and seminal guide to....  
Life's many plays  
In the evolutionary theatre.

But history will also save a special place for me;  
As more than a footnote, or anecdote,  
To your celebrated name, I proclaim;  
I'm more than your mere accomplice;  
For I too have accomplished  
Much that will forever associate my name with...  
Life's many plays  
In the evolutionary theatre.

Like you, my ideas were partly theoretical, patently heretical,  
And far more than parenthetical with respect to understanding...  
Life's many plays  
In the evolutionary theatre.

It's all in my biography:  
The subject is biogeography.  
How species are arrayed and displayed  
Across the surface of planet Earth;  
Much of which I managed to unearth,  
Via my extensive travels and travails.  
Four years in the Brazilian Amazon;  
Where I found a brazenly amazing

Array of creatures all actively acting in...  
Life's many plays  
In the evolutionary theatre.

Then I moved on to Malaysia in southeastern Asia;  
Where I spent eight years  
Studying how and why life resides where it does;  
All because... I wanted to better appreciate  
How species spread and eventually speciate, during...  
Life's many plays  
In the evolutionary theatre.

After much adversity in this natural university;  
I learned much about life's evolutionary diversity.  
For example, no single species arises twice, which is nice;  
And geographical partitions promote biological additions,  
To the species pool; isn't that cool?  
All this and more I fully explore  
In a written tome for which I will become best known:  
The Geographical Distribution of Animals;  
Another intrepid way to interpret...  
Life's many plays  
In the evolutionary theatre.

*SCIENTIST CHOIR*

This is big, really big  
More on natural Creation.  
Jubilation, jubilation!

*SIR ARCHIBALD GARROD  
ON HUMAN INBORN DISORDERS (1909)*

Mendelian traits in peas? Please! PULL-EASE!  
Who the heck gives a darn, or dares to assert

That such herbaceous trivia might someday insert  
Into every biology textbook? Just look!

But if these corporeal things, soon to be named genes,  
Proved to be omnipresent in *Homo sapiens* too;  
They'd present quite a different worldview.  
Genes might be biotic matter that really matters to...  
The complex metabolism within each of us.

Therein lies my headline, my professional storyline:  
An industrious, illustrious career in biochemistry and medicine;  
During which time I spent many years analyzing tantalizing  
Evidence evidently evidencing...  
The complex metabolism within each of us.

As a scientist and practicing physician, I was in great position, you see;  
To seize upon and tease apart at least a part of family pedigrees,  
Which to various nefarious degrees, harbored hereditary diseases:  
Such as alkaptonuria, which with respect to physiological effect  
Is a horrible, deplorable, yet explorable genetic defect,  
In the biochemical pathway for phenylalanine and tyrosine —how obscene!  
It was a recessive Mendelian trait —simply amazing!  
I'll spare you the many technicalities yet realities of  
Such cellular proclivities that my research activities uncovered in...  
The complex metabolism within each of us.

After nearly five decades, I won accolades;  
For showing that humans house Mendelian particles too.  
They often dictate who's fatally fated, or at least debilitated  
By inherent inherited foul-ups in...  
The complex metabolism within each of us.

For what I found, I gained renown as a founder  
Of biochemical genetics and metabolomics.  
In 1918, I was delighted to be knighted, for my work that highlighted...  
The complex metabolism within each of us.

*ONE LONG DEBATE*  
*(throughout the early 1900's)*

*THE MENDELIAN REFRAIN*  
*(always led by the group's spokesperson)*

Mendel, you are our hero; and we have zero  
Doubt about your lasting historical clout  
Regarding the nature of heredity and evolution.

The particles you inferred, now referred to as genes,  
Must permeate life, so why is there recently such strife,  
Regarding the nature of heredity and evolution?

*THE BIOMETRICIANS*  
*(always led by the group's spokesperson)*

We accept Mendel's basic precept. We can't  
Deny that it may apply to tall versus short pea plants.  
Thus, we fully acknowledge that Mendel added knowledge  
About this peculiar instance of particulate inheritance.  
And we question neither his veracity nor his capacity  
To count and account for round versus wrinkled seeds.  
But that certainly doesn't mean we need to cede  
The case for many other kinds of genetic attributes.

*THE MENDELIAN REFRAIN*

Mendel, you are our hero; and we have zero  
Doubt about your lasting historical clout  
Regarding the nature of heredity and evolution.

*THE BIOMETRICIANS*

But now please wait, if each organismal trait  
Is encoded by genes with such major effect, doesn't that mean

That evolution proceeds by discontinuous jumps and jerks —  
Like short to tall, or round to wrinkled— or are those just quirks  
Of your imagination?

*THE MENDELIAN REFRAIN*

Mendel, you remain our hero; and we have zero  
Doubt about your lasting historical clout  
Regarding the nature of heredity and evolution.

*THE BIOMETRICIANS*

But in truth most characters, such as body weight or size,  
Can be characterized along a seamless phenotypic continuum,  
Like from smart to humdrum to dumb, so let's further plumb  
The implied implications  
Regarding the nature of heredity and evolution.

*THE MENDELIAN REFRAIN*

Mendel, you remain our hero; and we have zero  
Doubt about your lasting historical clout  
Regarding the nature of heredity and evolution.

*THE BIOMETRICIANS*

Darwin's revolutionary catechism  
Entailed evolutionary gradualism:  
The notion that deep organic schisms—  
Sudden and major lifeform transitions—  
Seldom if ever occur. We fully concur.

With Darwin we agree, but we fail to see  
How to reconcile Darwin's notion  
With all this growing commotion  
About particulate Mendelian factors

Being the prime vectors of inheritance.  
 If mutations always have large effects,  
 How effective can natural selection be  
 In affecting a gradual course for evolution?

*THE MENDELIAN REFRAIN*

Mendel, you remain our hero; and we have zero  
 Doubt about your lasting historical clout  
 Regarding the nature of heredity and evolution.

*NARRATOR*

Gentlemen, please.  
 Call a lasting truce before you let loose  
 Another bombastic, histrionic barrage.  
 History shows that your dilemma was only a mirage!  
 Statisticians fully accommodated and conciliated,  
 Both Darwinian and Mendelian views. Once-and-for-all.  
 The answer was quite technical, and for its time rather heretical.

Suppose multiple genes interact to impact a trait. That's a common  
 fact, Jack!  
 Then their additive and non-additive interactions give traction  
 To a statistically sound conclusion —and it's no delusion—  
 That discreet Mendelian genes can underlie gradual Darwinian evolution.  
 That's simply a fact, Jack!  
 Regarding the nature of heredity and evolution.

*SCIENTIST CHOIR*

This is big, really big  
 Such a natural Creation.  
 Jubilation, jubilation!

*ON THE ORIGIN  
OF POPULATION GENETICS (1930's)*

*NARRATOR*

Microevolution is frequently defined  
As a change in frequency through time  
Of different alleles or genotypes  
In the "gene pool" of a population.

Mutation, migration, selection, recombination,  
And random drift, often act in tandem to shift...  
Such a populational gene pool. That's the cardinal rule  
Now taught in any school, in each population genetics class.  
But alas, the math can be taxing, vexing, perplexing;  
Very tough stuff; a rough path to follow, even for fellow  
Statisticians and mathematicians—who may seem like magicians—  
When they improvise, revise, improve, and prove each complex  
equation.  
It's their preferred mode of persuasion;  
Their proffered code for communication.

Modern-like population genetic theories began in the 1930's,  
When three preeminent historical figures figured prominently:  
Ronald Fisher, Sewell Wright and J.B.S. Haldane all achieved fame  
By mathematically showing how populations evolve.

For example, Wright was probably right  
When he gave much weight to random drift —  
In conjunction with selection, of course—  
As a statistically inevitable stochastic force  
In the evolution of small populations.  
Whereas Fisher supposed that selection imposed its  
Pure will on populations that typically were much larger.  
And Haldane generally was an iconoclastic revolutionary  
Who cast his large shadow across many ideas evolutionary.

Then in 1937 —thank Heaven!— Theodosius Dobzhansky (“Doby”)  
 Translated the theories these men had sought to investigate;  
 Into a simpler language that more biologists could appreciate.  
 Doby notably added empirical examples,  
 Biological species concepts, and exemplary prose  
 To the growing evolutionary tale.  
 But that’s far from the tail end of the story.

SCIENTIST CHOIR

This is big, really big  
 A synthesis on natural Creation.  
 Jubilation, jubilation!

EXPANSION  
 OF THE MODERN EVOLUTIONARY SYNTHESIS (1940’s)

NARRATOR

Doby’s 1937 treatise was a *précis*:  
 The first act, one might say, in a longer play  
 Termed the “modern evolutionary synthesis.”  
 In 1942, the popularizer Julian Huxley coined this hook  
 In his synthetic book: *Evolution, The Modern Synthesis*.  
 But what Doby had initiated, others were better situated  
 To extend in further directions during the ensuing decades.  
 And the task continues to this day.

What about taxonomy, nomenclature, Linnean ranks, and such?  
 Clearly there was much, that remained to be explained  
 And incorporated into the modern evolutionary synthesis.  
 In 1942, the systematist Ernst Mayr took a long look  
 In his seminal book: *Systematics and the Origin of Species*.  
 And the task continues to this day.



What about fossils, paleontology, the geological record, and such?  
Clearly there was much, that remained to be explained  
And incorporated into the modern evolutionary synthesis.  
In 1944, paleontologist George Gaylord Simpson took a long look  
In his seminal book: *Tempo and Mode in Evolution*.  
And the task continues to this day.

What about adaptive radiations, speciations, extinctions, and such?  
Clearly there was much, that remained to be explained  
And incorporated into the modern evolutionary synthesis.  
In 1947, the German biologist Bernard Rensch took a long look  
In his English-translated book: *Evolution Above the Species Level*.  
And the task continues to this day.

What about botany, cytology, hybridization, introgression, and such?  
Clearly there was much, that remained to be explained  
And incorporated into the modern evolutionary synthesis.  
In 1950, the botanist G. Ledyard Stebbins took a long look  
In his seminal book: *Variation and Evolution in Plants*.  
And the task continues to this day.

What about microbiology, anthropology, and many other "ologies"?  
Which (with all due apologies), I won't even attempt to list as such  
But clearly there is much that remains to be explained  
And incorporated into the modern evolutionary synthesis.  
And the task continues to this day.

And what about biochemistry, the molecular makeup of proteins,  
genes, and such?  
In the 1940's, these remained a mystery, someday to be explained  
And incorporated into the next major phase of the modern evolutionary  
synthesis.

*JAMES WATSON AND FRANCIS CRICK  
ON DNA (1953)*

*NARRATOR*

During the 1940's and before  
Most biochemists who explored  
The topic had a rather myopic view:  
They "knew", and insisted steadily,  
That proteins were the molecules of heredity.

Until, around 1950, when several nifty  
Experiments on bacteria and phages turned the pages  
Of history. Alfred Hershey, Martha Chase, and Oswald Avery  
Very cleverly verified, that nucleic acids are the stuff of heredity.  
What remained unexplained was DNA's molecular makeup.

*WATSON AND CRICK*

OMG, DNA; what did you say?  
DNA: deoxyribonucleic acid.  
Quick, give everyone an antacid!  
No, wait, it's quite easy to digest.  
Strings of A, T, C, and G; OMG!

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

The bases adenine, thymine, cytosine, and guanine  
Interspersed with simple phosphates and sugars.

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

Two long strands, don't you understand?  
Embraced in a beautiful double helix;  
Each A paired with T, and each C with a G.

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

So simple and yet so infinitely complex,  
It can encode nearly any message or text,  
Just like the Morse code.

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

To replicate it splits into two, to itself renew,  
By incorporating a new set of nucleotides.  
And so on-and-on, potentially ad infinitum.

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

And perhaps best of all, DNA  
is essentially universal  
To all life as we know it, on Earth.  
That's what science has since unearthed.

OMG, DNA, DNA, DNA, hooray, hooray!  
We just can't seem to stop  
Shouting it from the rooftops; Oh my gosh!

In 1962, to no-one's great surprise,  
We each won a Nobel prize  
(As did our colleague Maurice Wilkins).

OMG, DNA, DNA, DNA, hooray, hooray!  
 We just can't seem to stop  
 Shouting it from the rooftops; Oh my gosh!

*THE MOLECULAR REVOLUTION*  
*(early 1960's)*

*NARRATOR*

After geneticists learned what genes are,  
 They yearned to go farther by far.  
 Or should I say nearer, which would be clearer  
 To what was basically done, which was fun.  
 Each gene codes an enzymatic or other protein, so  
 What became a standard laboratory routine  
 Was to separate forms called allozymes  
 Through an electrophoretic gel; and if all went well,  
 A researcher could describe whether each animal  
 Was heterozygous or homozygous at each specific locus.  
 Yes, it took terrific focus. But there was no magic hocus-pocus.

What emerged were population-genetic data, piled and compiled into a  
 Statistic called heterozygosity; scientific ecstasy!  
 This is exactly what was needed to address, and put to rest, a long debate  
 Between two imposing opponents: the so-called "classicists"  
 Versus proponents of the balance view, which was newer.

The classicists claimed that mutations and other genetic variations  
 Were basically bad and imposed a burden; a "genetic load" on populations.  
 Thus, most would be eliminated, terminated, and eradicated...  
 From the gene pool.

Whereas proponents of the balance view viewed polymorphisms as  
 good;

Something to be understood as a proud production of natural selection.  
 Many variants would thus be maintained, sustained, and retained...  
 In the gene pool.

So, when it was ascertained that variants were unambiguously ubiquitous,  
 You might think it was ridiculous to continue the argument.  
 But you'd be wrong; quite the reverse,  
 As explained in the next song and verse.

### *SELECTIONISTS VERSUS NEUTRALISTS* *(1960's and beyond)*

#### *THE NEUTRALISTS* *(always led by the group's spokesperson)*

We can't deny that molecular variants are everywhere, but where is the  
 evidence  
 Evincing natural selection. What's the causal connection? We're not  
 witless!  
 Here's our contention: most polymorphisms are neutral with respect to  
 fitness;  
 As is borne witness by their sheer, queer ubiquity, and antiquity.

#### *THE SELECTIONIST REFRAIN* *(always led by the group's spokesperson)*

Darwin, you are our hero; and we have zero  
 Doubt that natural selection can account for  
 Most polymorphisms seen through the prisms  
 Of molecular biology.

#### *THE NEUTRALISTS*

We don't deny that molecular variants are everywhere, but where is the  
 evidence

Evincing natural selection. What's the causal connection? We're not witless!

In any event, we will invent an eloquent mathematical construct  
That will deconstruct your silly notion that invariably puts in motion  
some

Unspecified form of selection to account for molecular genetic variation.

#### *THE SELECTIONIST REFRAIN*

Darwin, you are our hero; and we have zero  
Doubt that natural selection can account for  
Most polymorphisms seen through the prisms  
Of molecular biology.

#### *THE NEUTRALISTS*

Our neutral theory is explicit: and it is not complicit  
With selective factors being prime actors in molecular evolution.  
Instead, selection is essentially dead.  
Mutation, migration, and genetic drift —if you catch our drift— are  
prime forces  
Forcing and reinforcing the course of evolution at the molecular level.

#### *THE SELECTIONIST REFRAIN*

Darwin, you are our hero; and we have zero  
Doubt that natural selection can account for  
Most polymorphisms seen through the prisms  
Of molecular biology.

#### *THE NEUTRALISTS*

Our beautiful equations show what we know to be true about our neutrality view;  
It's really reality, if only you knew too, the whole controversy would be history.

*THE SELECTIONIST REFRAIN*

Darwin, you are our hero; and we have zero  
Doubt that natural selection can account for  
Most polymorphisms seen through the prisms  
Of molecular biology.

*THE NEUTRALISTS*

Our neutrality hypothesis is a rock-solid mathematical framework  
That we contest can test the bedrock of evolution at the molecular level.  
It constitutes a grand null hypothesis, whose thesis must be falsified  
Before anyone can be satisfied that selection has played a major role.

*THE SELECTIONIST REFRAIN*

Darwin, you are our hero; and we have zero  
Doubt that natural selection can account for  
Most polymorphisms seen through the prisms  
Of molecular biology.

*THE NEUTRALISTS*

Selection, we freely admit, has permitted adaptations in organismal  
phenotypes,  
But here we're talking explicitly about molecular genotypes.  
So please don't typecast us as some type of anti-evolutionist or Cre-  
ationist.

*THE SELECTIONIST REFRAIN*

Darwin, you are our hero; and we have zero  
Doubt that natural selection can account for  
Most polymorphisms seen through the prisms  
Of molecular biology.

*THE NEUTRALISTS*

We don't deny that molecular variants are everywhere, but where is the  
evidence  
Evincing natural selection. What's the causal connection? We're not  
witless!

*NARRATOR*

Though it may be hard to swallow  
This debate went unabated for decades to follow.  
With each new molecular technology, with each new type of genetic  
data.  
The controversy got reinvigorated, reinvestigated, and reintegrated into  
the Burgeoning discipline of evolutionary genetics.

Perhaps to no-one's real surprise  
The field finally settled on a compromise:  
Some genes are neutral and some are selected  
As might have been expected, right from the start.

*MOLECULAR CLOCKS (1960's and beyond)*

*NARRATOR*

Tick-tock, tick-tock, tick-tock,  
Goes the molecular clock.  
The heady idea that proteins and DNA  
Evolve at a rather steady rate  
Must rate among the finest finds  
Of the molecular revolution in evolution.

Tick-tock, tick-tock, but it's not a metronome;  
Instead, each genome tends to gain mutations



In a general way that mirrors radioactive decay.  
Tick-tock-tick, tick-tick tock; it's a stochastic clock.  
That can be used to roughly mark the passage of time.

Tick-tock, tock-tock-tick, scientists were quick  
To spot imperfections in the molecular clock.  
But they were not dismayed. To this day,  
They still use molecular timepieces to date  
Speciation events and the splitting of lineages  
Through time's illimitable geologic ages.  
These inimitable scientific sages;  
Research and assemble phylogenetic trees  
That in the ensemble closely resemble  
Real arboreal trees, all properly rooted in time;  
By the tick-tick tock of a molecular clock.

*SCIENTIST CHOIR*

This is big, really big  
A time-frame for natural Creation.  
Jubilation, jubilation!

*PHENETICISTS VERSUS CLADISTS  
(1960's and beyond)*

*NARRATOR*

In 1963, Robert Sokal and Peter Sneath broached Numerical Taxonomy  
As a "phenetic" approach to organismal phylogeny.  
In 1966, an English translation of Willi Hennig's Phylogenetic  
Systematics  
Likewise caused a sensation by laying a foundation for "cladistics".

*THE PHENETICISTS*

*(always led by the group's spokesperson)*

Organisms should be organized  
According to these specified rules:  
Quantify as many attributes as possible,  
Then assign them a numerical score before forming  
A taxonomic cluster. That's all there is to it, Buster!

*THE CLADISTS*

*(always led by the group's spokesperson)*

Hennig, you are our hero, and we have zero  
Interest in other stances on taxonomy.  
No numeric yardstick  
Is worth a cow's lick about phylogenetics.  
No such plan is worth a damn;  
No phenetic tinkering can command a tinker's dime.

*THE PHENETICISTS*

Our goal is simply to organize life, not cause such strife.  
What could possibly be wrong with overall similarity,  
As a simple taxonomic guide, despite its apparent unpopularity?

*THE CLADISTS*

Hennig, you are our hero, and we have zero  
Interest in other stances on taxonomy.  
No numeric yardstick  
Is worth a cow's lick about phylogenetics.  
No such plan is worth a damn;  
No phenetic tinkering can command a tinker's dime.  
Quit wasting our time!

*THE PHENETICISTS*

We apologize for eliciting such strong emotion,  
Such commotion; we merely have a simple notion.  
Quantify lots of traits to help get straight  
How organisms might be related, simply stated.

*THE CLADISTS*

Hennig, you are our hero, and we have zero  
Interest in all this simplistic taxonomic crap.  
It's just a phenetic trap  
No numeric yardstick  
Is worth a cow's lick about phylogenetics.  
No such plan is worth a gall damn;  
No amount of phenetic tinkering can command a tinker's dime.  
For the third time, quit wasting our time!

*PHENETICISTS*

We're sorry for the harsh direction of this story,  
We sought no great glory. We merely wished to point out  
That without a doubt, systematics was in disarray;  
Because there was no standardized way to erect a taxonomy.

*THE CLADISTS*

Hennig, you are our hero, and we have zero  
Interest in all this phenetic garbage, so  
We must continue our verbal barrage.  
Pheneticists, don't be so hapless or fickle  
Your ideas aren't worth a plugged nickel.  
So, we state for a fourth time, quit wasting our time!

Synapomorphies define clades, period.  
 Not apomorphies, symplesiomorphies,  
 Or any other fanciful phenetic stories.  
 So, get it all straight before it's too late:  
 Join the Hennigian Society and attend its meetings;  
 Join the Crusade or we'll rally to really rain on your parade.  
 For the fifth and last time, quit wasting our precious time!

*THE PHENETICISTS*

We meant no mean intent;  
 We were quite content to inject  
 A bit of introspect about how taxonomy  
 Had often been conducted too haphazardly.

*THE CLADISTS*

Oh, shut up! Give it up! And go to... Well,  
 We really don't care where.

Hennig, you remain our hero, and we have zero  
 Interest in any other extraneous evolutionary garbage.  
 Phenograms are so *passé*, we say.  
 And cladograms are here to stay!

*NARRATOR*

History will declare that this taxonomic war  
 Rudely raged on for an unduly long time.  
 For some reason, some cladists had a mean demeanor,  
 You might call it a rather sadistic cladistic manor.  
 They flavored their favored ideas with religious-like fervor.  
 The cladists certainly raised a stink, so what do other biologists  
     think  
 About this whole sordid affair? Did it get sorted out fairly?

Despite all the spite and acrimony, cladism led to parsimony:  
A phylogenetic criterion on which most people are in harmony.  
And likewise, most everyone now agrees that cladistic decrees  
About shared-derived traits (synapomorphies),  
And for basing taxonomies on true phylogenies,  
Were concepts insightful and valid:  
Two key ingredients in a mixed salad  
Of historical evolutionary inference. So yes, in their defense,  
The cladists did make a difference.

### *FROM GENETICS TO GENOMICS (2001)*

#### *NARRATOR*

Evolutionary science has evolved in many ways:  
Sometimes through reasoned or spicily seasoned debates:  
Selectionists, neutralists, pheneticists, cladists;  
Mendelians, biometricians, Lamarckians, Darwinians;  
Empiricists, theoreticians.  
But sometimes a technological or logical breakthrough  
Planted a needed seed that really enabled science to proceed.

In the late 1900's,  
By the tens of hundreds,  
Geneticists invented countless molecular tools  
To use however they might choose:  
Electrophoresis, complement fixation, thermal denaturation,  
Various form of blotting, 2-D gels, and DNA hybridization.  
It seems like no-one must have gone on vacation!

DNA fingerprinting, sequencing, and barcoding,  
Are especially worth noting.  
Restriction digests, and other unique techniques, all attest,  
To these geneticist's genuine ingenuity.

Most such methods initially focused on just one locus or class of genes  
at a time:

Ribosomal DNA, mitochondrial DNA, chloroplast DNA, mobile  
DNA.

LINE's, SINE's, LTR's, SSR's, and other DNA's,

All had their respective respectable heydays.

Minisatellites, microsatellites, exons, introns, transposable elements,

All were key elements in the quest for molecular markers.

And what a quest it was, and is; who would have guessed?

Then, in 2001, something was done that would stun the scientific  
world:

The sequence was published of a whole human genome:

All 3.2 billion base pairs, on the 23 chromosomes

That our 30,000 structural genes call home.

What a milestone, in the history of science!

#### *SCIENTIST CHOIR*

This is big, really big

On humanity's Creation.

Jubilation, jubilation!

#### *NARRATOR*

The three-billion-dollar project had taken 10 years,

A few vials of blood, lots of sweat and tears.

What it yielded was magnificent —almost Heaven-sent!

And, like the moon-shot, it got a lot of endorsement.

Now fast-forward 20 years, to 2020,

When our genomic vision is nearing 20-20.

A genome can now be sequenced in a day to two,

For several hundred dollars, at most.

Soon, millions of living species (plus a few fossil ghosts)

Will have their full DNA put on display.

Phylogeneticists will have a field-day.  
 Reconstructing the tree of life, entirely.  
 After which they can simply retire.

What about other "big-data" genetic fields? What can they yield?  
 Metagenomics, transcriptomics, proteomics, metabolomics,  
 canceromics and epigenomics are among the many "omics"  
 That almost comically were named after these disciplines  
 Were found and founded by their founders.  
 And none has floundered; at least not yet;  
 Instead, they all seem to get  
 Incorporated into updated versions of...  
 The ever-more modern evolutionary synthesis.

### *SCIENTISTS VERSUS CREATIONISTS* *(continuing today)*

#### *NARRATOR*

We started this play with two self-avowed Creationists:  
 Linnaeus and Paley, who wowed us their biological insights.  
 The monk Mendel too, was obviously cut of a strong religious hew.  
 Thus, simply being God-fearing  
 Has no insurmountable bearing  
 On whether a person can contribute significantly to science;  
 That's nonsense; and it would be wise to think otherwise, I advise.

But at the same time, I'd be out of line  
 Not to remind that religion and science don't always align;  
 With each other, about the underlying nature of nature's design.  
 Oh brother!  
 Science adheres to empirical evidence and testable theories;  
 Whereas religion often hears literal truth in Biblical stories.

*THE CREATIONISTS REFRAIN*

*(a Bible-toting chorus of all ages, joined also by Linnaeus,  
Paley, Fitzroy, and Emma Darwin)*

Lord God, you are our hero; and we have zero  
Doubt about your Special Creation, of life.  
Supernatural intelligent design.  
Just as the Bible says,  
And we'd better believe it.  
In Jesus' name lies our salvation. Amen!

*THE SCIENTISTS REFRAIN*

*(a scientific chorus of all ages, joined also by Lyell,  
Wallace, Darwin, etc.)*

Science, you are our hero; and we have zero  
Doubt about your objective account of how  
Life arose and diversified.  
By natural evolutionary processes.  
And we strongly tend to believe it. Amen!

*THE CREATIONISTS REFRAIN*

Lord God, you are our hero; and we have zero  
Doubt about your Special Creation, of life.  
Supernatural intelligent design.  
Just as the Bible says,  
And we'd better believe it.  
In Jesus' name lies our salvation. Amen!

*THE SCIENTISTS REFRAIN*

Science, you are our hero; and we have zero  
Doubt about your objective account of how  
Life arose and diversified.



By natural evolutionary processes.  
And we strongly tend to believe it. Amen!

NARRATOR

Oh brother! Why even bother,  
To favor one view or the other?  
It's gone too far; no more war;  
Can't we all just call a truce?

In today's climate of climatic change,  
And extensive biotic extinctions,  
Please put aside your distinctions;  
And agree not to disagree on one overarching sentiment:  
Whatever its source, we all, of course,  
Love and respect the awesome nature of life.

EVERYONE (*all of the cast joining in chorus*)

Nature, you are our hero; and we have zero  
Doubt that, however formed,  
Your bounty and beauty,  
Are both fascinating and fantastic;  
Inspirational and spiritual;  
Wondrous and wonderful.  
Hallelujah! Hallelujah! Hallelujah!

(repeat...)

Nature, you are our hero; and we have zero  
Doubt that, however formed,  
Your bounty and beauty,  
Are both fascinating and fantastic;  
Inspirational and spiritual;  
Wondrous and wonderful.  
Hallelujah! Hallelujah! Hallelujah!

THE END