A Primer on Evolution

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1 Introduction

The goal of this work is part of a personal search to seek a deepened and improved understanding to theories on the origin of life on Earth, widely known as the "Theory of Evolution," and to summarize that understanding in a brief essay. This is a subject that most people feel they understand well enough anyway. Either one believes that the Earth is about 6,000 years old and that all species were set upon it, unchanged and immutable, in one act by a transcendent being, or one believes that life has evolved and has slowly modified to take the many forms it has today. If your are of the former, you will not find anything here to confirm your beliefs. If you are of the latter, then stick around. You may be shocked to find that a theory of evolution is not so straightforward. Most people having this point of view believe that the business is quite simple. Like the song says, "Only the strong survive."[1] End of story. Why read a dead person's book? Why read any book when you can find a miniseries or video about practically anything on the internet?

The ultimate source for information on the evolution of life is the *Origin of Species* by Charles Darwin[2]. Reading *Origin of Species*, however, is like reading the Bible, or Shakespeare[3]. Darwin's thoughts follow a very complicated path, and here and there he rambles on. Often, sentences are almost as long as paragraphs. He wrote in the grand style of the natural philosophers of the 19$^{\text{th}}$ century. Darwin's prose would have made my college English teacher apoplectic. Here is

[1] Jerry Butler, 1968.

[2] The complete title is "The Origin of Species by Means of Natural Selection or The Preservation of Favoured Races in the Struggle for Life"

[3] Suggested by Ali Alhaddad.

a two-sentence example in which he explains how natural selection could bring about "organs of extreme perfection," such as the eye:

> To suppose that the eye, with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree. Yet reason tells me, that if numerous gradations from a perfect and complex eye to one very imperfect and simple, each grade being useful to its possessor, can be shown to exist; if further, the eye does vary ever so slightly, and the variations be inherited, which is certainly the case; and if any variation or modification in the organ be ever useful to an animal under the changing conditions of life, then the difficulty in believing that a perfect and complex eye could be formed by natural selection, though insuperable to our imagination, can hardly be considered real.

Clearly, prose styles have changed in 150 years. Perhaps the mode of thought has as well. Today, we prefer not to overanalyze anything lest this makes us appear pedantic, or worse, dull. Today's preferred style is more journalistic and phobically nonpedantic. We all know the drill: Each paragraph must have a topic sentence, and each sentence should be short and to the point. And please, no Latin or foreign words or phrases, or anything that might smack of too much booksmarts. Of course, much pleasing prose is written in this style, as in the productions of Ernest Hemingway or E. B. White.

But 19^{th} century philosophers, the Bible, and Shakespeare have their appeal. Shakespeare comes alive when read out loud. The Bible, too, seems more dramatic when given voice. Likewise, it occurred to a small circle of friends who wanted to better understand the Theory of Evolution and *Origin of Species* to read it out loud to each other. Thus began our reading circle in Baltimore.

The experience was most rewarding for me. The wordy passages, instead of inducing sleep, came alive. The thoughts lept from the page and we all enjoyed the readings and all felt that our understanding of the Theory was greatly improved. We were deeply impressed with the precision of thought and the scientific rigor Darwin employed to support each claim.

There was an unexpected downside for me: I became aware of just how incompletely and imperfectly I had understood the Theory. My reliance on the pop evolution served up on nature shows and 'evolution lite' served up in high school biology class had not served me well. And in the larger society, there seemed to be a widespread belief in 'evolution lite'. Part of that incomplete comprehension stems from the intimidating writing of 19^{th} century philosophers, not just Darwin,

and some of that incomprehension stems from the widely held view that evolution is based mostly on common sense anyway.

This popularly accepted common sense notion is that only the strong survive. Strictly speaking this is a simplistic view. The reality is more nuanced. This viewpoint is also known as Social Darwinism. Social Darwinism, however, precedes Darwin by several decades if not millenia. Ruling elites have used this rationalization to justify their economic burden and political domination of human societies for centuries and still do. Social Darwinists also like to have you believe that the inheritance underlying this supposed superiority is relatively fixed and immutable. Thus Social Darwinists combine the 'best' of a scientific theory with elements of the creation story.

2 Darwin's locus in time and space

The magnitude of the scientific achievement can only be understood in relation to the historical setting of the 1830's when Charles Darwin was beginning his life's work.

> Geologists had only recently determined that the age of the Earth must be several tens of millions of years if not longer.
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> Mendel's laws of inheritance would soon emerge as the agent that could pass modifications from one generation to the next.
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> Louis Pasteur had deduced the germ theory of life by the 1860's. His conclusion that "only life can beget life," overturned the classical notion that life can spontaneously generate from soil or decaying matter.
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> The Atomic Hypothesis, or the theory that all matter consisted of indivisible atoms, and on which all modern scientific theories rest, was still unproven and very controversial in the 1830's.

Charles Lyell published *The Principles of Geology* in 1830. Mendel's laws were not published until 1865 and both Wallace and Darwin were not aware of this work. Natural philosophers had no explanation for why the sun has apparently supplied light and heat for the millions of years the earth has existed. Theories or speculations about electrical energy were just beginning to take shape. Michael Faraday and Joseph Henry both independently worked out the *law of induction* linking time-varying electric and magnetic fields in 1831. Mendeleev's periodic table of the elements did not appear until 1869. Dalton's theory of chemistry was firmly anchored in the atomic hypothesis, but it was more alchemy than chemistry.

The Atomic Hypothesis was not confirmed until 1911 by Rutherford, Marsden, and Geiger. And the fuel sources of stars were not understood until the 1930's, with the invention of nuclear physics.

The theory of evolution, as given complete form in *Origin of Species* is a secular theory, in that it does not call upon a transcendent being for its justification or expression. As a secular theory, it ultimately rests on Atomic Theory, first proposed by Democritus in ancient Greece. In Atomic Theory, an infinite number of identical particles interact independently in an infinite void to produce all of the creations of nature. Thus, as these atoms combine to form the nearly infinite variety of life forms inhabiting the face of the Earth, these beings are equal in some real sense: they all are built out of the same atoms. The atoms comprising a nematode are the same as the atoms comprising the philosopher Richard Dawkins. Therefore, the power of action possessed by the atoms of the nematode is the same power possessed by Dawkins' atoms. It is as if the neamtode rears up and shouts at Dawkins, "My DNA is equal to your DNA, at least on the fundamental subatomic level!" Democritus and his atomic theory have enabled the slave and the serf to step out from underneath the shadow of the aristocrat. Atomic theory eventually gave impetus to the scientific method and modern atomic physics. But it was not without a grand struggle that began with Democritus himself who died a pauper. He was scorned by the elites of his day, including Plato, who burned all his works and that of other atomists. Democritus had concluded that his atomic theory compelled him to oppose slavery. In ancient Greece, opposition to slavery meant your grants did not get funded, and maybe even get you killed.

Darwin's grandfather, Erasmus Darwin, formulated an early theory of evolution. The late 18^{th} century was part of the Age of Reason, the American and French revolutions. The mathematician and natural scientist Pierre Maupertuis formulated an early but incomplete theory of natural selection. The Biologist Jean Lamarck formulated a complete theory of natural selection, even going so far as to propose that the environment can have a direct effect on the modification of an organism. However, he was not able to produce the scientific evidence needed to support his theory.

Thomas Malthus, too, had a profound influence on Darwin. In the introduction to *Origin of Species*, he credits some others in his development of the theory. He lists Alfred Wallace as a co-founder of the theory of natural selection and the theory of evolution that he presents.

2.1 Order of Darwin's Works

Voyage of the Beagle: 1839.

Origin of Species: 1859.

The Descent of Man, and Selection in Relation to Sex: 1871.

The voyage itself took place in 1831. With much irony, we note that the young Mr. Darwin was hired as the ship's biologist and chief science officer for an expedition taken for the purpose of finding evidence to confirm the biblical version of the creation story. This curious fact underscores the competition between the creation story and established scientific version of the story that has been taking place for almost 200 years and has not been entirely confined to the red states.

When on the west coast of South America, he experiences an earthquake that caused the land to rise five feet. He asked the locals how often this happened, and they told him that an earthquake of this magnitude occurred about every 100 years. Earlier he had been hiking in the Andes and at 12,000 ft. he found fossils of sea shells that he estimated as being about 2 to 5 million years old. He then computed that a 5 foot rise in elevation every 100 years would raise the land 12,000 ft in 2.5 million years. Thus, here was confirmation that the Earth was very old, that major geological features could form slowly over millions of years, and that life has existed on Earth for millions of years.

The voyage was not without other risks. In *Origin of Species*, there is a drawing of the Beagle completely beached by an outrunning tide. Darwin got off the ship and took samples from the tidal pools while waiting for the tide to return. Darwin undertook an overland trip through what is today Argentina in the middle of a war with native Americans. He reports coming across a settlement that had been burned to the ground just hours before and where people had been killed.

The Galapagos Islands offered Darwin the opportunity to study natural selection in an environment extremely isolated from continental influence. The Galapagos Islands are 500 miles west of Ecuador. There are no other islands nearby. The islands themselves are isolated from each other by cold, swift ocean currents. Each island had its own variety of finch and Darwin was able to carefully document how each variety had become modified to fill an existing niche. The Galapagos Islands are the most isolated island archipelago on Earth.

Darwin's most important work is *Origin of Species*. In it, he systematically assembles the evidence by exhaustively and objectively studying all life forms and carefully extracting the generalized principles that conect all life.

In *Descent of Man*, Darwin cannot seem to escape the notion that European Man is superior and is obligated to aid the inferior races.

So in this sense it is flawed and has probably contributed more to the controversy surrounding Darwin than any of his other works. Darwin, however, was not a racist and did not believe in colonialism. Darwin, like many 19th century Europeans, loses all objectivity when the species under discussion is the human species. His greatest regret was that *Origin of Species* was used to justify European colonialism. In the section on *Selection in Relation to Sex*, Darwin regains his objectivity and discusses the role that sex plays in natural selection. It really belongs in *Origin of Species*.

3 The Bare Bones of the Theory of Evolution

3.1 Natural Selection

The law of Natural Selection is supported by three equally important propositions or laws. The first law we all know and intuitively understand:

> The environment acts as an editor to differentially select those individuals that have modifications best suited for the present environment.

It is important to note that in *Origin of Species*, modifications are almost never described as improvements. Indeed, the environment (in the absence of climate change caused by humans) is simply changing. It is not improving or worsening. Likewise, individuals that have some modification more suitable to the new conditions will be differentially favored in the struggle for existence, and cannot be said to be improvements in some absolute, final sense. For instance, Darwin records a certain moth, a tree that it lived on, and how both were changed by industrial pollution in northern England. In response to industrial pollution, the tree changed the color of its bark from grey to mottled white and grey. The moth was originally grey and changed its color to mottled grey and white to match the color of the tree. Was this more of an improvement or modification? To the modified moth and its descendants, it is clearly an improvement because their numbers increased. But what if there is already a plague of moths upon the world? Or what if the color of the moth was originally a beautiful emerald green? Is this modification an improvement?

Adaptation by modification can only lead to increased numbers of a certain species or variety and so it seems that the law of natural selection is a very general and powerful type of scientific law called a variational principle, or a principle of least action.

To those not familiar with the principle of least action, let me illustrate it with a few examples. The principle of least action was first invented by Pierre Maupertais, the French mathematician and philosopher of the late 18th century, in connection with the path that light takes when propagating through a complex medium. We all know that if you half-submerge a rod into a pond of water, so that one end is below the surface and the other above, the rod will appear to be bent by the surface of the pond. The speed of light in water is slower than the speed of light in air. The path that the light takes from the rod to your eye is the path that would require the *least time* for the journey, given that part of the path is through the water and part of the path is through the air. Maupertais called this phenomenon the *principle of least action.* This principle is seen in many places in nature. For instance, the curve that a rope takes when hanging between two poles is called a *catenary* curve. This curve can be determined mathematically by requiring that the curve of the rope assume the least potential energy (or energy of position) in a uniform gravitational field. It would seem that having gone to the trouble of removing the Prime Mover from the picture by creating a universe of atoms, we have allowed him or her to return by a back door. For that reason, the principle of least action is sometimes called a *teleological* principle. The word teleological comes from the Greek word *telos*, meaning goal or puprose.

The hydrogen atom at rest is another exmple of a principle of least action. The atom always assumes the lowest energy state, or gound state, predicted by quantum mechanics, unless perturbed by outside energy. There are so many instances of teleological systems that they are almost universal. Are they the evidence of some higher transcendental power? I submit not. The hydrogen atom, or any atomic system, would naturally tend to the lowest energy state because when an atomic system is in a higher energy state, there is an almost certain likelihood that it spontaneously emit a photon (unit of light energy) and change to a lower state. Likewise, in the case of the rod, if the light did not take the least time to travel to your eye, would the light ever reach your eye? And in the case of the rope hanging between two poles, if it were not to take the position dictated by least potential energy, then what position would it take? Would it fly around in the air?

I see these 'laws' as examples of the self-organization of matter, time, and space. Without self-organizing properties, a universe of atoms would be a very chaotic place. These same self organizing properties allow atoms to form crystals, which are a basic kind of self-replication, or reproduction. The crystals formed represent the atoms in a state of least energy with respect to each other. In the same sense, the law of natural selection is a principle of least action that allows for the maximum replication of life with the least investment of energy or complication. Any other law of natural selection that required more energy would not have survived!

The second law of Natural Selection is Malthus' Law that states that the geometric increase of individuals with only a linear increase in the ability of the environment to sustain that increase always results in the destruction of individuals at some stage of life, usually the very young or very old. There *will be* destruction of individuals. Darwin, from his scientific experiments and observations, was able to refine this view. To Darwin, an individual of a particular variety or species faced destruction most often, not from a predator, but from an individual most resembling him, from his own variety. That was due to the fact that the more alike individuals are, the more similar are their needs. Since the niches that nature provides are limited and increase at a much slower rate, this implies that the competition in the struggle for life is greatest among individuals and varieties that are most similar.

> The dependency of one organic being on another, as of a parasite to its prey, lies generally between beings remote in the scale of nature. This is often the case with those which may be strictly said to struggle with each other for existence, as in the case of locusts and grass-feeding quadrupeds. But the struggle almost invariably will be most severe between the individuals of the same species, for they frequent the same districts, require the same food, and are exposed to the same dangers. In the case of varieties the struggle will generally be almost equally severe.

How often we have seen this at play in our own lives! How often have we seen our colleagues sent to professional oblivion by the calculated actions of a competitor! Sometimes oblivion is deserved, but often it is not.

And on this point, popular science has mislead us! How often is the nature show about how the wiley deer outwits the coyo-wolf, or vice-

versa, how the coyo-wolf cunningly stalks his or her prey. Never do we see a show on how wolves compete ruthlessly with each other for territory and mates. It seems the struggle between two males for the attention of a female always ends with the loser slinking away with "minor wounds - the males don't really hurt each other," we are reassured by the narrator. That, sadly, is not true. The vanquished, more often than not, has been fatally weakened. He may linger, but death is almost certain from the wounds.

The third law of Natural Selection is not so obvious, but makes perfect sense:

> Individuals with the same slight modifications tend to select each other for reproduction, thereby producing descendants ever so slightly more modified.

Thus the same slight modification in the character of each parent tends to be differentially amplified in the progeny. This eventually leads to the divergence of species.

It also has other profound implications for the divergence of life under natural selection. As soon as slight differences appear in the descendants of a particular species or variety, these individuals tend to separate and go their different ways. These differences may be so slight as to be almost unobservable. Eventually, the descendants become so diverse that they have become different species. Thus, selection for reproduction strengthens and reinforces the influence of the environment, and tends to accelerate the divergence of life forms.

The action of Natural Selection has many consequences, some of which reduce the intensity of the struggle for life, and others which may exacerbate it. In order to maintain a sensible equilibrium about the consequences of Natural Selection, we must keep foremost in our minds that a scientific theory is not a value judgement. The implications of a theory may just as likely be repellent as it is pleasing to us. And this is the case with the Theory of Evolution. It attempts to provide us with an accurate picture of what nature is, not what we may want it or imagine it to be.

It effectively lays to waste the romantic, idealized view of nature. Consider a bubbling stream, and a small island of rock and weeds in the middle of it. Never again will I consider it a small universe of harmony and peace, for the Theory informs us that the plants growing on this small rock are struggling against their siblings and cousins for a little

more soil, a little more access to moisture and sun. The success of an individual will spell certain destruction for his brother.

And so Darwin would have been appalled that the Theory has been used to justify slavery, exploitation and colonialism. He was a gentle and spiritual person. He did not believe in God because he did not believe that God could be responsible for so much suffering and pain in the natural world. The wasp *Tachytes nigra* paralyses an insect larvae and stores it alive with its eggs. When the wasps hatch, they eat the larvae alive. He did not think that God could be so cruel and therefore he did not believe that God existed. Had he lived, he would have been disappointed that his grandson and namesake was a eugenicist. The Theory remains controversial today because its implications to society remain so profound. Darwin's goal was not to radicalize society or moral relations among humanity. His goal was to accurately construct a general theory explaining the origin of life, and no more.

One of the esthetically pleasing or harmonious implications of Natural Selection is that the diversity of life reduces the competition among individuals for a niche. Diverse individuals require different niches and thus tend to stay out of conflict with each other.

On the other hand, while these modified descendants still share much in common, they are in intense competition with each other. This is why there are so many "missing links" in the tree of life. The modified descendants of the parent species or variety come into intense competition with the unmodifed descendants of the parent species, bringing about their destruction. Thus the Cro-Magnons did not "shoulder aside" the Neanderthals, as was recently suggested in a National Geographic special. The Cro-Magnons most likely destroyed the Neanderthals directly by genocide or indirectly by competition.

The third law leads to something truly consequential for all life, but especially human life. Because members of a particular variety socialize and mate only with those having the same slight modifications, barriers between similar varieties quickly appear. The Raven does not mate or bond with the Crow, though they are practically indistinguishable to human observers. The third law causes a certain 'racism', though that term is appropriate only for humans, to arise. The laws of Natural Selection cause all of nature's productions to be hard-wired to seek out those with the same slight modifications for bonding and reproduction. For humans, this behavior often leads to racism, and the bloody human history of ethnic cleansings, pogroms or outright extermination.

Now that we are aware of the consequences of these laws, we are in a position to counteract or moderate their consequences. It would be tragic if humanity, having discerned the laws of natural selection, allow themselves to succumb to its more barbaric implications. We are in the unique position to mitigate its worst implications. Yes, we are children of nature, and no, we do not have to act as if we are a pack of primates taking war and destruction to a rival pack of primates simply because we are hard-wired by natural selection to do so.

3.2 micro-dynamics of evolution as practiced in the propagation of domestic productions, or Variation under Domestication

Charles Darwin was a biologist by training and a keen observer of nature. As is fitting to his station as an upper-class Englishman, he was a pigeon fancier. Unlike an upper-class Englishman, he conducted biological experiments, kept detailed notes, and made it his life's work to understand the origin of life. All creation theories always allow for variation under domestication. The ones based on religion always assume that the species are immutable, but that mankind may, by domestication, vary these forms and create new productions that are superficially different. The evolutionists, on the other hand, saw in domestication a micro-evolution process that could explain a macro-evolution process. He noted further that animal and plant breeders were aware for the most part of only superficial characteristics and so tended to create new productions with only superficial differences. They rarely paid attention to qualities like endurance under conditions of thirst, hunger or ill weather, or intelligence and cunning in the face of adversity.

Darwin also keenly noted that propagation of all domesticated species except one were under the firm control of the human. That exception was the domestic cat. Here, Darwin permits himself a little humor. Because of the feline's "noctural, rambling habits," and its ability to escape any enclosure that might be devised for it, it's reproduction could not be controlled. All breeds of domestic cats are hybrids. Show me a cat that has been kept indoors, and I will show you a cat that escaped many times, only to return at its leisure. Cats have some wildness that we have not been able to breed away, as we have with other domestic species.

3.3 Variation under Nature

If humankind could produce new varieties with relative ease, then Nature, with many more experimental subjects and vast lengths of time, should be capable of producing much more variation.

3.4 The Fossil Record is Necessarily Incomplete

No matter how long or assiduously paleontologists and archaeologist toil, they will never find a complete fossil record anywhere on Earth. Fossils are formed only when water recedes, not when it is rising or at a stationary level.

> I am convinced that all our ancient formations, which are rich in fossils, have thus been formed during subsidence. Since publishing my views on this subject in 1845, I have watched the progress of Geology, and have been surprised to note how author after author, in treating of this or that great formation, has come to the conclusion that it was accumulated during subsidence. I may add, that the only ancient tertiary formation on the west coast of South America, which has been bulky enough to resist such degradation as it has as yet suffered, but which will hardly last to a distant geological age, was certainly deposited during a downward oscillation of level, and thus gained considerable thickness.
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> All geological facts tell us plainly that each area has undergone numerous slow oscillations of level, and apparently these oscillations have affected wide spaces. Consequently formations rich in fossils and sufficiently thick and extensive to resist subsequent degradation, may have been formed over wide spaces during periods of subsidence, but only where the supply of sediment was sufficient to keep the sea shallow and to embed and preserve the remains before they had time to decay. On the other hand, as long as the bed of the sea remained stationary, thick deposits could not have been accumulated in the shallow parts, which are the most favourable to life. Still less could this have happened during the alternate periods of elevation; or, to speak more accurately, the beds which were then accumulated will have been destroyed by being upraised and brought within the limits of the coast-action.

3.5 Continental Varieties are more vigorous than Island Varieties

For a widely established species scattered over continents and islands, the continental varieties are more vigorous than island varieties. When continental varieties are introduced to islands, they quickly displace the island varieties.

> To sum up the circumstances favourable and unfavourable to natural selection, as far as the extreme intricacy of the subject permits. I conclude, looking to the future, that for terrestrial productions a large continental area, which will probably undergo many oscillations of level, and which consequently will exist for long periods in a broken condition, will be the most favourable for the production of many new forms of life, likely to endure long and to spread widely. For the area will first have existed as a continent, and the inhabitants, at this period numerous in individuals and kinds, will have been subjected to very severe competition. When converted by subsidence into large separate islands, there will still exist many individuals of the same species on each island: intercrossing on the confines of the range of each species will thus be checked: after physical changes of any kind, immigration will be prevented, so that new places in the polity of each island will have to be filled up by modifications of the old inhabitants; and time will be allowed for the varieties in each to become well modified and perfected. When, by renewed elevation, the islands shall be re-converted into a continental area, there will again be severe competition: the most favoured or improved varieties will be enabled to spread: there will be much extinction of the less improved forms, and the relative proportional numbers of the various inhabitants of the renewed continent will again be changed; and again there will be a fair field for natural selection to improve still further the inhabitants, and thus produce new species.

In the superior vigor of continental varieties over island varieties, Darwin saw confirmation of the Principle of Natural Selection. On continents, there will be more competition and more opportunities for individuals to widely roam and find niches favorable to their survival.

Thus there are more opportunities on continents than islands for natural selection to act.

4 Lamarck and the Direct Action of the Environment

Darwin was very impressed with the work of Jean Baptiste Lamarck[4], who had lived 60 years before Darwin. Like Darwin, he believed that life evolved gradually over a long stretch of time and that the modifications of the parents were passed down to the offspring. Unlike Darwin, he believed that the direct effect of the environment could be passed on to the offspring. The elephant acquired a longer trunk by trying to reach for food that was just out of reach. In struggling against his environment, the elephant lengthened his trunk and was able to pass that adaptation to his progeny. Here, Darwin disagreed with Lamarck. In light of the progress that genetics has made recently, the controversy between Darwin and Lamarck needs to be revisited.

Darwin wanted to develop a theory for which the scientific knowledge and methodology of the day would allow him to prove or disprove the set of hypotheses he was testing. There were so many controversies surrounding a theory of evolution that Darwin, where possible, wanted to make progress and not risk overstepping or ourrunning the scientific methodology of the day. Although Darwin may have been fascinated by the possibility of direct action, I believe he felt it was simply beyond the capability the contemporary knowledge and methodology.

First of all, it is not implausible that an individual might be able to pass some inherited advantage to his offspring that was the result of the environment acting directly on the individual. It is clear that if any organism had this ability, it would be at a great advantage by allowing the individual and his descendants to adapt more quickly. Life forms that had this capability would soon overtake organisms that did not. So direct action coupled with Darwinian natural selection would be a more powerful principle of least action than natural selection alone.

These last remarks do not constitute a proof, however. The recent discovery of *gene expression*, in which genes are turned on or off in response to the demands of the individual's environment, is nothing less than the mechanism by which direct action would work. It is still not clear to me how these modified gene expressions are transferred to

[4]Theory of Inheritance of Acquired Characteristics, J. B. Lamarck, 1801.

progeny, but it seems to me that the adaptability of an individual does not depend in a static way solely on the genetic modifications passed on by his parents.

Unfortunately, Lamarckism in the 19th century found itself in the center of an ideological struggle as well as a scientific controversy. Defenders of the established order sought to refute Lamarck, whereas defenders of new socialist ideologies sought to uphold him. It is not fitting that a scientific controversy should be politicized. Let up hope that the ruling elites of today, however distasteful they may find a new paradigm, do not repress its free investigation, as Plato did with Democritus' atomic theory. Conversely, let up hope that the ruling elites do not press an untrue scientific hypothesis upon us in the name of an ideology or political agenda.