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On the Limits of Natural Selection:

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http://www.evolutionnews.org/2016/07/in_terror_of_ch103021.html

http://www.evolutionnews.org/2016/07/scientific_inac103022.html

Relevance of the Topic: Most central principle of modern evolutionary biology (modern synthesis). No scientific criticism allowed.

1. The Original Article:

The text below is from the following encycopedia: W. Edward Craighead & Charles B. Nemeroff (eds.): THE CORSINI ENCYCLOPEDIA OF PSYCHOLOGY & BEHAVIORAL SCIENCE, Vol. 3, 3rd Edition, pages 1008-1016.

At the end of March 2016 the ensuing article of 2001 was checked/re-examined. All the facts and arguments presented here (not least those for ***a strong element of randomness in natural selection***) are not only still up-to-date, but in the face of emphatically retold neo-darwinian assertions to the contrary ("When will people understand that …natural selection is a NONRANDOM process", Dawkins 2016, see here) **all the more relevant and valid now.**

NATURAL SELECTION

With a growing number of distinguished evolutionists - including Ernst Mayr, Edward O. Wilson, and Francisco Ayala - I believe that Darwinism is more than just a scientific theory. It is the basis for a full world view, a Weltanschauung.

Michael Ruse 1986, p. 513

NATURAL SELECTION: A DEFINITION

A typical definition of the term "natural selection" reads as follows (Parker, 1997, p. 312): "Darwin's theory of evolution, according to which organisms tend to produce progeny far above the means of subsistence; in the struggle for existence that ensues, only those progeny with favorable variations survive; the favorable variations accumulate through subsequent generations, and descendants diverge from their ancestors." A definition concentrating on evolution by "differential survival and reproduction of the members of a population" (Catania, 1994) deviates in an important point from that just given. The progeny which differentially survives is not necessarily the fittest, a point best illustrated by island populations endangered by more or less closely related intruders worldwide.

AREA OF APPLICATION: STRONGLY DIFFERENT OPINIONS AMONG SCIENTISTS

Apart from a few exceptions (Lima-de-Faria, 1988; Chauvin, 1997), most contemporary biologists and other scholars accept natural selection as a real process in nature. However, as to the extent of the effects of natural selection on the differentiation and the origin of new species and higher systematic categories, the differences of opinion are enormous; see, for example, Bell (1997), Catania (1994), Cziko (1995), Dawkins (1986, 1995, 1987/1996, 1998), Dennett (1995), Mayr (1997, 1998), Ruse (1996), versus Behe (1996), Berlinski (1996), Dembski (1998a), Junker and Scherer (1998), Lönnig and Saedler (1997), ReMine (1993), and Schützenberger (1996). The first group of authors firmly believes that natural selection is the key process for the origin of all life forms on earth, whereas most scientists of the second group are entirely convinced that the action of natural selection is only of limited significance and that it is largely incompetent to explain the origin of life's major features from biochemistry to systematics, especially the origin of higher systematic categories. Both groups claim that scientific reasons are the basis of their position in biology. 'Missing links' representing nearly all possible shades between the views of these two groups may also be found; see, for instance, Chandebois (1993), Denton (1985, 1998), Gould (1996, 1997), Ho and Saunders (1984), Kauffman (1993), Prothero (1998), and Stanley (1998).

SOME BASIC PROBLEMS

The Reproductive Powers of Living Beings and the Survival of the Fittest

Dobzhansky's 1937 work *Genetics and the Origin of Species* is generally viewed as the crystallization point for the origin and growth of the modern synthesis or neo-Darwinian theory of evolution (Lönnig, 1999a). There is hardly a better example to illustrate the key message (and, at the same time, the weaknesses) of the modern theory of natural selection than the following quotation from this pioneering work of Dobzhansky (p. 149):

> With consummate mastery Darwin shows natural selection to be a direct consequence of the appallingly great reproductive powers of living beings. A single individual of the fungus *Lycoperdon bovista* produces 7 x 10^{11} spores; *Sisymbrium sophia* and *Nicotiana tabacum*, respectively, 730,000 and 360,000 seed; salmon, 28,000,000 eggs per season; and the American oyster up to 114,000,000 eggs in a single spawning. Even the slowest breeding forms produce more offspring than can survive if the population is to remain numerically stationary. Death and destruction of a majority of the individuals produced undoubtedly takes place. If, then, the population is composed of a mixture of hereditary types, some of which are more and others less well adapted to the environment, a greater proportion of the former than of the latter would be expected to survive. In modern language this means that, among the survivors, a greater frequency of carriers of certain genes or chromosome structures would be present than among the ancestors...

For agreement on and further documentation of the principle of natural selection, see the group of authors cited above, beginning with Bell (1997). However, in the 1950s, French biologists, such as Cuénot, Tétry, and Chauvin, who did not follow the modern synthesis, raised the following objection to this kind of reasoning (according to Litynski, 1961, p. 63):

> Out of 120,000 fertilized eggs of the green frog only two individuals survive. Are we to conclude that these two frogs out of 120,000 were selected by nature because they were the fittest ones; or rather - as Cuenot said - that natural selection is nothing but blind mortality which selects nothing at all?

Similar questions may be raised for the 700 billion spores of *Lycoperdon*, the 114 million eggs multiplied with the number of spawning seasons of the American oyster, for the 28 million eggs of salmon and so on. King Solomon wrote around 1000 BC: "I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong,...but time and chance happeneth to all of them" (KJV 1611).

If only a few out of millions and even billions of individuals are to survive and reproduce, then there is some difficulty believing that it should really be the fittest who would do so. Strongly different abilities and varying environmental conditions can turn up during different phases of ontogenesis. Hiding places of predator and prey, the distances between them, local differences of biotopes and geographical circumstances, weather conditions and microclimates all belong to the repertoire of infinitely varying parameters. Coincidences, accidents, and chance occurrences are strongly significant in the lives of all individuals and species. Moreover, the effects of modifications, which are nonheritable by definition, may be much more powerful than the effects of mutations which have only "slight or even invisible effects on the phenotype" (Mayr 1970, p. 169, similarly 1976/1997; see also Dawkins, 1995, 1998), specifying that kind of mutational effects most strongly favored for natural selection and evolution by the neo-Darwinian school. Confronting the enormous numbers of descendants and the neverending changes of various environmental parameters, it seems to be much more probable that instead of the very rare "fittest" of the mutants or recombinants, the average ones will survive and reproduce.

Natural Selection, Population Genetics, and the Neutral Theory

Despite the impossibility to produce a strictly deterministic model for natural selection in the face of myriad varying parameters, there have been several attempts to quantitatively assess this problem. Fisher, perhaps the most important forerunner of the neo-Darwinian theory, has calculated (1930) that new alleles with even 1% selective advantage (i.e., more than is usually expected by neo-Darwinian theorists), will routinely be lost in natural populations. According to these calculations the likelihood of loosing a new allele with 1% advantage or no advantage is more than 90% in the next 31 generations (Fisher, 1930/1958; Dobzhansky, 1951; Schmidt, 1985; see also ReMine, 1993; Futuyma, 1998; Maynard Smith, 1998). Considering genetic drift, i.e. random fluctuations of gene frequencies in populations, Griffith and colleagues state in agreement with these authors (1999, p. 564):

> Even a new mutation that is slightly favorable will usually be lost in the first few generations after it appears in the population, a victim of genetic drift. If a new mutation has a selective advantage of S in the heterozygote in which it appears, then the chance is only $2S$ that the mutation will ever succeed in taking over the population. So a mutation that is 1 percent better in fitness than the standard allele in the population will be lost 98 percent of the time by genetic drift.

Nevertheless, it appears that if such a mutation occurred at a constant rate in a large population, it would have a fair chance to become established after an average occurrence of about 50 times. However, such estimates are made on exceedingly imperfect assumptions biased in favor of the modern synthesis. Note that the basis of these calculations are dominant mutant alleles with 1% fitness increase in the *heterozygous* state. In the plant kingdom, however, more than 98% of all the mutations are recessive and more than 99.99% of the dominant (as well as homozygous recessive) mutants in the plant and animal kingdoms are lowering fitness. Modifications, juvenile stages, and the endlessly varying environmental parameters are not (and hardly can be) taken into account, nor is the objection of the French biologists quoted above addressed. Dobzhansky's "death and destruction of a majority of the individuals" occurs mainly before sexual maturity - as can be seen, for instance, each spring when billions of tree-seedlings appear, of which only an extremely low minority will ever become adult or full-grown trees: obviously the environment is far more relevant than a 1% genetic advantage.

Most importantly, the calculations are invalid for *small* populations where most of the evolutionary novelties are said to have arisen according to the neo-Darwinian theory of evolution and punctuated equilibrium alike (Gould & Eldredge, 1993; Mayr, 1976/1997, 1998; Stanley, 1999). In a small population the rate of advantageous mutations is extremely low (if they appear at all; aeons of time are needed to obtain the average 50 identical advantageous dominant mutations for one success) and genetic drift is almost totally substituting natural selection. Also, it is not possible in nature to raise mutation rates indefinitely since error catastrophe occurs when the mutation rate is too high, thereby terminating the existence of the population.

Neutral, slightly deleterious and moderately favorable alleles all have nearly equal chances to spread in diploid populations - as the neutral theory of population genetics has definitely shown (Kimura, 1983; ReMine, 1993; see already Fisher, 1958). The neutral theory "contends that at the molecular level the majority of evolutionary changes and much of the variability within species are caused neither by positive selection of advantageous alleles nor by balancing selection, but by random genetic drift of mutant alleles that are selectively neutral or nearly so" (Li, 1997, p. 55). Hence, the net result of larger numbers of gene mutations can mean overall degeneration of a species instead of ‘upward‘ evolution. Moreover, the costs of the many substitutions necessary for neo-Darwinian evolution to function successfully in large populations can quickly surpass the adaptive possibilities of a species (see the discussions of *Haldane’s Dilemma* by Dobzhansky et al., 1977; and especially ReMine, 1993.)

Selection and Neutral Structures on the Morphological Level

On the morphological and anatomical level, there are many structures in nature for which no selective advantages can be found. For example, what could be the selective advantage of a plant displaying leaves with entire margins compared to one having dentate leaves or a plant with dentate leaves compared to one with serrate or doubly serrate leaves? A caterpillar would probably be quite happy finding more starting and attachment points for eating such leaves, which could be a decisive selective disadvantage for the plant. Also, many hypertrophic structures have appeared in the history of life (as in the cases of the enormous canine teeth of saber-toothed tigers, the burden of weighty antlers in prehistoric deer) which seem to have led to the extinction of the affected species. Why did natural selection not select genes that would in time diminish such structures? Sexual selection will hardly solve these problems but constitutes a problem of its own (Lönnig, 1993).

DOES NATURAL SELECTION EXIST AT ALL?

The remarks made so far, however, do not refute the occurrence of natural selection. In spite of the problems just mentioned, it is self-evident that physiologically, anatomically, and ethologically damaged mutants and recombinants (to speak again in the contemporary genetic language of these individuals) will be at a disadvantage in many situations (lame prey in relation to their predators and *vice versa).* It is only on islands with loss or diminution of stabilizing selection that processes of degeneration may occur quickly (for further discussion of the topic, see Lönnig, 1993, 1998; Kunze et al., 1997). Furthermore, survival of the fittest evidently takes place, for example, in cases of alleles and plasmids with strongly selective advantages, as in the cases of multiple resistance in bacteria and resistance to DDT in many insect species. After pointing out that Darwin knew hardly any cases of natural selection, Mayr asserts (1998, p. 191): "Now, there are hundreds, if not thousands, of well-established proofs, including such well-known instances as insecticide resistance of agricultural pests, antibiotic resistance of bacteria, industrial melanism, the attenuation of the myxomatosis virus in Australia, the sickle-cell gene and other blood genes and malaria, to mention only a few spectacular cases."

THE EVOLUTIONARY POTENTIALS AND LIMITS OF NATURAL SELECTION

According to the first group of authors mentioned earlier, there are hardly any evolutionary limits for natural selection. The assertion that "through billions of years of blind mutations pressing against the shifting walls of their environment, microbes finally emerged as men" by H. J. Muller (who was awarded the Nobel prize for his work in mutation genetics) may illustrate this conviction in the near omnipotent potentials of mutation and natural selection. Avise states (1999, p. 83) that "natural selection comes close to omnipotence". The second group of authors, however, point to several investigations which are at odds with this view (see discussion in the next paragraphs).

The Law of Recurrent Variation and Selection Limits

Mutations are thought to be the ultimate basis for evolution by natural selection. So, let’s have a look at the question of whether mutations could have provided the raw materials for natural selection for the origin of all species and life forms of the earth. Having investigated the question for about 35 years now including the work with collections of mutants of two model plant species (the pea and the snapdragon - more than 1 million plants), I have come to a conclusion strongly differing from the modern synthesis concerning the potential of mutagenesis. The results I have summed up in "the law of recurrent variation" (Lönnig, 1993, 1995; Kunze et al., 1997). This law specifies that, for any case thoroughly examined (from pea to man), mutants occur in a large, but nevertheless limited spectrum of phenotypes which - in accordance with all the experiences of mutation research of the 20th century taken together - cannot transform the original species into an entirely new one. These results are in agreement with the statements of several renowned evolutionary geneticists, two of whom are quoted here. Hans Stubbe wrote after a lifetime spent in mutation research (1966, p. 154):

> The improved knowledge of mutants in *Antirrhinum* has provided some essential experience. During the years each new large mutation trial showed that the number of really new mutants recognized for the first time, was steadily diminishing, so that the majority of the genetic changes was already known.

And Gottschalk stated in 1994, p. 180, "The larger the mutant collections are, the more difficult it is to extend them by new mutation types. Mutants preferentially arise that already exist."

To understand these observations one must clearly distinguish between two levels: first, the level of the phenotypes, and second, the DNA level. On the latter, the potential of missense and nonsense mutations and other sequence deviations is nearly infinite. However, the spectrum of the resulting different phenotypes is not, because the space of functionally valid sequences within a given system of tightly matching regulatory and target genes and correspondingly co-ordinated functions involved in the formation of the finely balanced whole of an organism, cannot infinitely be stretched by chance mutations.

To take a crude illustration: Drop your computer from the desk or take a screwdriver and a hammer, open the casing, shut your eyes and then forcefully operate in the innards! Depending on the number of computers and how often and for how long one proceeds to act this way, one may collect a nearly endless number of *non-functional* changes. Yet - with much luck - one may also select a few operationally diminished, but nevertheless still working, systems. Thus, one may demolish a computer in a thousand and more different ways by some accidental procedures. However, the resulting still more or less *functional states* (the functional phenotypes), will be limited. The hope to secure a Pentium III from a 486er by this method would be very bold indeed. - Of course, the situation in biology is more complex than in engineering, because organisms are, for instance, reactive entities. Nevertheless, limits to selection have repeatedly been found in several areas of biological research.

The limits of selection due to the absence of hoped-for positive mutations were most severely felt in mutation breeding at the end of the 1970s and in the 1980s after some 40 years of worldwide mutation research with cultivated plants as maize, rice, barley, peas, and others. Mutation induction was originally thought to revolutionize plant breeding and substitute the costly and time-consuming "old" recombination method on a global scale. By mutation genetics, three time-lapse methods were available to the breeders: (a) raising the numbers of mutations so enormously in a few years, that nature would have needed millions of years to produce similar amounts of hereditary changes; (b) well-aimed and careful selection and conservation of promising genotypes, which often would have been lost in nature; and (c) well-aimed recombination of rare genotypes for which the chance to ever meet and mate in nature would again be very small.

After the neo-Darwinian school of biologists had taught plant breeders that mutation, recombination, and natural selection were responsible for the origination of all life forms and structures on earth, the possibility of the threefold time-lapse-method led to a previously unknown euphoria among geneticists in order to revolutionize plant breeding. Literally billions of mutations were induced by different mutagenic agents in many plant species. However, relatively few useful mutants were obtained, mostly loss-of-function-mutants loosing undesirable features like toxic constituents, shattering of fruits, spininess and so on. Due to the limits summarized by the law of recurrent variation (also pertinent to the processes in nature, i.e. for natural selection), these efforts ended in a worldwide collapse of mutation breeding some forty years later. It is self-evident that selection, whether artificial or natural, cannot select structures and capabilities which were hoped or believed to arise, but never did (Lönnig, 1993, 1998). Thus, qualitative limits in generating positive mutations point to the limits of natural selection.

Selection Limits in Population Genetics and their Relevance for Natural Selection

The situation in population genetics, where selection limits have been found and described in many papers, has been summarized by Hartl and Jones as follows (1998, p. 686):

> Population improvement by means of artificial selection cannot continue indefinitely. A population may respond to selection until its mean is many standard deviations different from the mean of the original

> population, but eventually the population reaches a selection limit at which successive generations show no further improvement.

Although often the qualitative differences between artificial and natural selection are stressed by many evolutionary biologists to avoid the inference to selection limits for the latter, there are no scientifically valid reasons to believe that natural selection is limitless. The plasticity of the genome is not infinite, irrespective of the kind of selection pressure exercised upon a population (Lönnig, 1993).

Natural Selection and the Origin of New Genes

The observations summarized in the law of recurrent variation directly lead to the question of the origins of new genes. The probability of obtaining an entirely new functional DNA sequence (necessary, for example, for the origin of the more than five thousand extant different gene families of today’s living organisms) due to gene duplications with subsequent nucleotide substitutions by point and other mutations has been calculated by several authors to be less than 1 in10^{50}, even granting billions of years for natural selection working on random mutations (ReMine, 1993; Kunze et al., 1997). The result is, simply put, that the probability is so low that no reasonable person would expect to obtain a target or goal in any other area of life by such small chances. Due to the factual absence of completely new functional DNA sequences in mutagenesis experiments, as well as the low likelihood referenced above, the origin of new genes and gene families cannot be explained by natural selection. Additionally, the necessity of genetic engineering for organism transformation simultaneously exemplifies the fact that induced mutations in the host organism cannot substitute for the task. This is not only true for slow breeding organisms, but also for the fastest; for instance, bacteria like *Escherichia coli,* where thousands of generations with trillions of individuals per generation can be cultivated in the relatively short time of a few years (3,500 generations in 1 year; 1 gram of *E. coli* cells contains about 10^{13} individuals).

Natural Selection and the Origin of "Irreducibly Complex Structures"

Behe defines irreducible complexity (1998, p. 178) as follows: "An irreducibly complex system is one that requires several closely matched parts in order to function and where removal of one of the components effectively causes the system to cease functioning." His mousetrap example illustrates the point: "The function of the mouse trap requires all the pieces: you cannot catch a few mice with just a platform, add a spring and catch a few more mice, add a holding bar and catch a few more. All the components have to be in place before any mice are caught." Concerning the significance of the principle of irreducible complexity for natural selection, Behe explains (p. 179):

> Closely matched, irreducibly complex systems are huge stumbling blocks for Darwinian evolution because they cannot be put together directly by improving a given function over many steps, as Darwinian gradualism would have it. The only possible recourse of a gradualist is to speculate that an irreducibly complex system might have come together through an indirect route - perhaps the mousetrap started out as a washing board, was changed into an orange crate, and somehow ended up as a mousetrap. One can never completely rule out such an indirect scenario, which is tantamount to trying to prove the negative. However, the more complex the system, the more difficult it becomes to envision

> such scenarios, and the more examples of irreducible complexity we meet, the less and less persuasive such indirect scenarios become.

In his 1996 book, *Darwin's Black Box,* Behe discusses several examples of biological irreducible complexity, among them the cilium, and the bacterial flagellum with filament, hook, and motor embedded in the membranes and cell wall, and the biochemistry of blood clotting in man. The open questions of the different positions of Dawkins and Hitching on the famous example of the origin of the eye are discussed at some length, especially the problems of natural selection for the biochemistry of vision in the introductory chapter. He sums up his analysis as follows (1996, pp. 38-39):

> Hitching's argument is vulnerable because he mistakes an integrated system of systems for a single system, and Dawkins rightly points out the separability of the components. Dawkins, however, merely adds complex systems to complex systems and calls that an explanation. This can be compared to answering the question "How is a stereo system made?" with the words "By plugging a set of speakers into an amplifier, and adding a CD player, radio receiver, and tape deck." Either Darwinian theory can account for the assembly of the speakers and amplifier, or it can't.

For a detailed anatomical and developmental study of the genesis of the eye, specifying Darwin's and Dawkins' fallacies of natural selection and gradualistic evolution under full quotation of the relevant passages, see Lönnig, 1989. Also, several important points (as the improbability to derive a *reflecting* eye from a *refracting* one) have been discussed by Denton (1998).

Since the origin of irreducibly complex systems or subsystems necessitates the concerted origin of many new gene-functions, the odds against natural selection of undirected mutations as the final source of these genes and structures are rising correspondingly.

NATURAL SELECTION AS METAPHYSICS AND AS SCIENCE

Popper's Critique and Recantation

Another kind of objection that was launched on the concept of natural selection originated with scholars interested in the logical structure of scientific explanations. There is a long tradition among these scholars to view the concept of natural selection to be a tautology (MacBride, 1929; Waddington, 1960; Mahner and Bunge, 1997 - excellent reviews on the debate between some 50 scientists and philosophers have been given by Bird, 1989; ReMine, 1993; and Chauvin, 1997). Waddington commented that natural selection "states that the fittest individuals in a population (defined as those which leave the most offspring) will leave the most offspring" (Waddington, 1960, p. 385), and

> Natural selection is survival of the fittest, and the tautology hinges on the word *fittest*. When the fittest are identified by their survival then there is a tautology. We ask, who are the fittest? We are told, the survivors. We ask, who will survive? We are told, the fittest. Natural selection is then "the survival of the survivors." It is a tautology" (ReMine, 1993, p. 98).

This objection has been strongly attacked by neo-Darwinians and punctuationists alike, arguing that fitness can scientifically be defined and tested, and that the tautology argument has conclusively been disproved by many biologists and philosophers (Mayr 1991, 1997).

Perhaps the most renowned case of a criticism and later recantation concerning the metaphysics/tautology-problem of natural selection by a philosopher was Sir Karl Popper's comment that "Darwinism is not a testable scientific theory but a *metaphysical research program*", that is, natural selection was seen to be "almost tautologous" and at best only "a possible framework for testable scientific theories" (1974, p. 134; italics in original). In a time of rising creationism, these often quoted statements lead to an unusual amount of criticism and pressure of the evolutionary community for Popper to check, extend and reformulate his views on natural selection.

To back up his recantation four years later that "the theory of natural selection may be so formulated that it is far from tautological" (1978, p. 339), he mentioned as evidence the famous textbook example of 'industrial melanism' of the peppered moth *(Biston betularia)* asserting that here "we can observe natural selection happening under our very eyes, as it were". In this case the majority of the light colored form was believed to have been replaced by a dark type better adapted to sooty trees in the wake of the industrial revolution - an example of 'natural selection' probably well-known to every student who ever attended a course on evolutionary biology at school or university all over the world.

Popper's Case of the Peppered Moth: Still more Metaphysics than Science

Looking at the famous case of industrial melanism more than 20 years later, we have to point to the most surprising fact that the case has recently been found wanting (Sargent et al., 1998; Majerus, 1998; Coyne, 1998). Hence, we may conclude that Popper's partial retraction of his views was not necessary, at least not because of the example of the peppered moth.

After summarizing Kettlewell's presentation of the *Biston betularia* instance, Coyne (1998) states the main points of the critical recent observations as follows: (a) The peppered moth normally doesn't rest on tree trunks (where Kettlewell had directly placed them for documentation); (b) The moth usually choose their resting places during the night, not during the day (the latter being implied in the usual evolutionary textbook illustrations); (c) The return of the variegated form of the peppered moth occurred independently of the lichens "that supposedly played such an important role" (Coyne); and (d) Kettlewell's behavioral experiments have not been replicated in later investigations. Additionally, there are important points to be added from the original papers, as (e) differences of vision between man and birds and (f) the pollution-*in*dependent decrease of melanic morphs.

So Popper's case of the peppered moth as an observation against his own criticism of natural selection as a metaphysical research program consists, nonetheless, mostly of metaphysics. It may be asked: How is it possible that cases of insufficient or even false evidence for natural selection can be bolstered and presented in such a way that it appears to be so convincing and entirely compelling that even the best minds of the world can be grossly misled - even to the point of modifying a published evaluation on this topic?

For another renowned textbook-example of natural selection, which was pointed out recently to consist more of a metaphysical explanation than a scientifically valid case, see Gould for the origin of the neck of the giraffe (Gould, 1996). Moreover, as for the inherent limitations of one of the prime examples for natural selection, to wit the sickle cell allele and malaria resistance, see ReMine (1993). Moreover, one may ask whether Mayr‘s first four instances for natural selection mentioned above ("insecticide resistance of agricultural pests, antibiotic resistance of bacteria, industrial melanism, the attenuation of the myxomatosis virus in Australia") are really cases of natural selection or more "man-made" or "man-caused" selection.

NATURAL SELECTION AND THE LIMITED GEOGRAPHICAL DISTRIBUTION OF SPECIES

The main problem regarding natural selection and limited geographical distribution of species has aptly been summarized by the evolutionary biologist Futuyma (1998, p. 535):

> [R]ange limits pose an evolutionary problem that has not been solved. A species has adapted to the temperature, salt levels, or other conditions that prevail just short of the edge of its range. Why, then, can it not become adapted to the slightly more stressful conditions that prevail just beyond its present border, and extend its range slightly? And if it did so, why could it not then become adapted to still more demanding conditions, and so expand its geographic range (or its altitudinal or habit distribution) indefinitely over the course of time? These questions pose starkly the problem of what limits the extent of adaptive evolution, and we do not know the answers. We will discuss several hypotheses, citing little evidence because little exists (Hoffmann and Blows, 1994; Bradshaw, 1991).

Part of the answer is the inherent limit of variation specified by the law of recurrent variation, i.e. the intrinsic restriction of the action of chance mutations to generate functionally new genetic material, either for one new gene or many of them indispensable for the origin of irreducibly complex structures. The absence of such "positive mutations" results in limits for natural selection.

NATURAL SELECTION AND LIVING FOSSILS

Living fossils have been totally unexpected for a theory according to which everything is in a state of permanent flux and evolution (Lönnig, 1999b). In the wording of Eldredge (1989, p. 108), "Living fossils are something of an embarrassment to the expectation that evolutionary change is inevitable as time goes by." Darwin admitted, "When I see that species even in a state of nature do vary little and seeing how much they vary when domesticated, I look with astonishment at a species which has existed since one of the earlier Tertiary periods. ...This fixity of character is marvellous" (Darwin, 1852, quoted in Ospovat, 1995, p. 201). The general explanation by neo-Darwinians is that certain species are fixed because they are adapted to non-changing environments. This explanation is doubtful for the following reasons: (a) There are hardly any constant environments over longer geologic time periods; (b) Most living fossils are found in permanently changing environments with high competition factors (Storch & Welsch, 1989); and (c) According to the modern synthesis, even in constant environments the endless generation of new advantageous mutations plus selection pressures within the species should lead to the permanent substitution of primitive structures and species by more advanced ones. So, in spite of billions of mutations in the long history of living fossils and in defiance of natural selection during millions of years, species did not diverge (see definition of natural selection at the beginning of the article). Therefore, the rich array of living fossils constitutes another serious problem for the neo-Darwinian school.

NATURAL SELECTION AND EARTH HISTORY

One of the major setbacks for the idea of a pervasive and the history-of-life-dominating process of natural selection has been the rise of what neo-Darwinians derogatorily call "neocatastrophism" (Hsü, 1986; Alvarez, 1998; Prothero, 1998). Darwin "postulated a single process, the biotic struggle of natural selection, that was uniform over all the time on the earth, proceeded always at the same rate, on a planet that ceaselessly changed in detail but never abruptly changed state" (Hsü, p. 47). Today, Darwin’s view is generally rejected by all informed scientists. The current question is not whether catastrophes have repeatedly interrupted natural selection worldwide, but which kinds of catastrophes are the most important ones in earth history.

THE QUEST FOR AN ALTERNATIVE

Although in this article alternatives for the origin of species cannot be discussed at length, a few points should be mentioned. As a first step into the direction of a realistic alternative to the doubtful hypothesis of the nearly omnipotent natural selection, let us shortly turn our attention to Behe’s arguments again. He writes, "Closely matched, irreducibly complex systems not only are tall problems for Darwinism but also are the hallmarks of intelligent design. What is design? In my definition, design is simply the purposeful arrangement of parts" (1998, p. 179). However, does this inference to intelligent design not lead us directly back into the realm of metaphysics in Popper’s sense? Not necessarily. A thoroughly epistemological study to clearly distinguish between the three basic parameters for any explanation in science and other areas of life in terms of either *law*, *chance*, or *design* (and in special cases to discover the proportions in a combination of two or even all three of them), has recently been performed and published by Dembski (1998a, 1998b). In his "explanatory filter" the object of explanation is an event called *E*. The first question is whether *E* is a highly probable event. If it is certain that *E* occurs under a set of standard conditions, *E* is probably due to deterministic or nondeterministic natural laws. If this first prerequisite is denied, it must be determined whether *E* is an event of intermediate probability, that is, an event, which one can commonly anticipate to happen by chance in normal situations of life. If an event has the probability of 1 in 10 million, it will happen a 100 times in 1 billion corresponding situations. Concerning intelligent design, Dembski further explains (1998b, pp. 101-102):

> But suppose that *E* is neither a high probability (HP) nor an intermediate (IP) event. By a process of elimination *E* will therefore make it all the way to the third and final decision node. In this case *E* is an event of small probability, or what I am calling an SP event. Our naive intuition is that SP events are so unlikely as not to occur by chance. To take an example, consider the possibility of a thermodynamic accident whereby a loaded gun (say a perfect replica of a .357 Magnum, complete with bullets) materializes in your hand, gets aimed at your favorite enemy, fires and kills him. Strictly speaking the laws of physics do not preclude such an event from happening by chance. Nevertheless, a court will surely convict you of willful homicide. Why does a court refuse to exonerate you by attributing such an event to chance? How would a jury respond to a defense that argues the gun simply materialized?
>
> > ...Yet we cannot deny that exceedingly improbable events (i.e., SP events) happen by chance all the time. To resolve the paradox we need to introduce an extraprobabilistic notion, a notion I referred to as specification. If a probabilistic set-up, like tossing a coin 1,000 times, entails that an SP event will occur, then necessarily some extremely improbable event will occur. If, however, independently of the event we are able to specify it, then we are justified in eliminating chance as the proper mode of explanation. It is the specified SP events (abbreviated sp/SP) that cannot properly be attributed to chance.

For the details and a mathematical treatment of these insights see Dembski, 1998a, 1998b; for further information on a testable (that is, ‘non-metaphysical’) theory of intelligent design, see also ReMine, 1993 and Lönnig, 1998. In contrast, the modern synthesis with its main pillars of natural selection and random mutations has scientifically failed to explain the origin and history of the living world.

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Now the Posts on the Basis of the Original Article:

2. Randomness in Natural Selection and Species as Islands in a "Vast Sea of Conceivable Arrangements"

Wolf-Ekkehard Lönnig March 30, 2016 3:14 AM

***Editor's note**: Dr. Lönnig is a retired geneticist at the Max Planck Institute for Plant Breeding Research in Germany.*

Stephen Meyer and Richard Dawkins have been engaged in a disagreement on randomness in natural selection. How shall we adjudicate it? First, I wrote in an encyclopedia article several years ago on "The Reproductive Powers of Living Beings and the Survival of the Fittest"[1]:

> Dobzhansky's 1937 work *Genetics and the Origin of Species* is generally viewed as the crystallization point for the origin and growth of the modern synthesis or neo-Darwinian theory of evolution (Lönnig, 1999a). There is hardly a better example to illustrate the key message (and, at the same time, the weaknesses) of the modern theory of natural selection than the following quotation from this pioneering work of Dobzhansky (p. 149):
>
>> With consummate mastery Darwin shows natural selection to be a direct consequence of the appallingly great reproductive powers of living beings. A single individual of the fungus *Lycoperdon bovista* produces 7 x 10^{11} spores; *Sisymbrium sophia* and *Nicotiana tabacum*, respectively, 730,000 and 360,000 seed; salmon, 28,000,000 eggs per season; and the American oyster up to 114,000,000 eggs in a single spawning. Even the slowest breeding forms produce more offspring than can survive if the population is to remain numerically stationary. Death and destruction of a majority of the individuals produced undoubtedly takes place. If, then, the population is composed of a mixture of hereditary types, some of which are more and others less well adapted to the environment, a greater proportion of the former than of the latter would be expected to survive. In modern language this means that, among the survivors, a greater frequency of carriers of certain genes or chromosome structures would be present than among the ancestors...

For agreement on and further documentation of the principle of natural selection, see the group of authors cited above, beginning with Bell (1997). However, in the 1950s, French biologists, such as Cuénot, Tétry, and Chauvin, who did not follow the modern synthesis, raised the following objection to this kind of reasoning (summed up according to Litynski, 1961, p. 63):

> Out of 120,000 fertilized eggs of the green frog only two individuals survive. Are we to conclude that these two frogs out of 120,000 were selected by nature because they were the fittest ones; or rather -- as Cuenot said -- that natural selection is nothing but blind mortality which selects nothing at all?

Similar questions may be raised for the 700 billion spores of *Lycoperdon*, the 114 million eggs multiplied with the number of spawning seasons of the American oyster, for the 28 million eggs of salmon and so on. King Solomon wrote around 1000 BC: "I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong,...but time and chance happeneth to all of them" (KJV 1611).

If only a few out of millions and even billions of individuals are to survive and reproduce, then there is some difficulty believing that it should really be the fittest who would do so. Strongly different abilities and varying environmental conditions can turn up during different phases of ontogenesis. Hiding places of predator and prey, the distances between them, local differences of biotopes and geographical circumstances, weather conditions and microclimates all belong to the repertoire of infinitely varying parameters. Coincidences, accidents, and chance occurrences are strongly significant in the lives of all individuals and species. Moreover, the effects of modifications, which are non-heritable by definition, may be much more powerful than the effects of mutations which have only "slight or even invisible effects on the phenotype" (Mayr 1970, p. 169, similarly 1976/1997; see also Dawkins, 1995, 1998), specifying that kind of mutational effects most strongly favored for natural selection and evolution by the neo-Darwinian school. Confronting the enormous numbers of descendants and the never-ending changes of various environmental parameters, it seems to be much more probable that instead of the very rare "fittest" of the mutants or recombinants, the average ones will survive and reproduce.

Second, combine these points with Dawkins's statement in his book *Climbing Mount Improbable* on species as islands "in a vast sea of conceivable arrangements" (1996, p. 88-89):

> Organisms are extremely complicated and sensitively adjusted pieces of machinery. If you take a complicated piece of machinery, even one which is not working all that well, and make a very large, random alteration to its insides, the chances that you will improve it is very low indeed.
>
> ...A small random change may improve it; or, if it makes matters worse, it will still not move too far from the correct arrangement. But a very large random change has the effect of sampling the gigantic set of all possible rearrangements. And the vast majority of all possible arrangements are wrong.
>
> ...Turning to living creatures, I wrote in *The Blind Watchmaker that however many ways there may be of being alive, it is certain that there are vastly more ways of being dead*...If you think of all possible ways of arranging the bits of an animal, almost all of them would turn out to be dead; more accurately they'd mostly never be born. Each species of animal and plant is an island of workability set in a vast sea of conceivable arrangements most of which would, if they ever came to existence, die" [italics by Dawkins].

Combining these two points -- (1) the questions on natural selection and (2) species as islands "in a vast sea of possible arrangements" -- one may indeed raise the question of whether the origin of all the forms of specified and irreducible complexity continually detected in species and higher systematic categories are really explained by mutation and selection alone.

As for further questions on natural selection (to what extent natural selection really exists in nature, population genetics, the neutral theory, selection limits, the law of recurrent variation, Popper's recantation and several further intriguing topics), please see the article referred to below.

References:

(1) Lönnig, W.-E. (2001): Natural Selection. Pp. 1008-1016 in W. Edward Craighead and Charles B. Nemeroff (eds.): *The Corsini Encyclopedia of Psychology and Behavioral Science*. Third Edition (2001), Volume 3, pp. 1008-1016. John Wiley & Sons, New York. See also here.

Image: Galápagos tortoise, by David Adam Kess [CC BY-SA 4.0], via Wikimedia Commons.

3. More on Randomness in Natural Selection and Evolution

Wolf-Ekkehard Lönnig April 7, 2016 3:35 AM

A common objection to neo-Darwinian evolution highlights the fact that the theory is based to a large extent on chance events, or chance in general. For decades now there has been an extraordinary volume of grim polemics against that objection. I wrote about this here last week in the context of a dispute between Richard Dawkins and Stephen Meyer. To my earlier comments, I would add the following.

Referring to Waddington and Mayr, Julian Huxley 1962 also strongly believed:

> The frequent assertion that biological evolution is based on chance is entirely untrue. "Chance" events furnish its raw material but the process itself is directional, self-steering, but automatically steering itself in a definite direction. This is because...natural selection is not a random but an "ordering" mechanism.

Ridley 1985, p. 124, concurred:

> How can I hope to succeed with three authors (Denton, Hayward, and Pitman) who, like the Victorian astronomer Sir John Herschel, think that evolution by natural selection is the "law of higgledy-piggledy" -- a "random search mechanism" (Denton), of "pure chance" (Hayward and Pitman)?

And up to the present, authors including Lorenzen, Krauss (2016), and Dawkins (2016) have made similar statements (see here for Stephen Meyer's response to Dawkins).

Now, let's assume for a moment that the frequent assertion that biological evolution is based on chance is itself "entirely untrue." Assume instead that the process is, in fact, "directional" and "self-steering," truly an ordering mechanism.

In that case, what is the biological basis for the "survival of the fittest"? The survival is very clearly dependent on the functionality of the anatomical, physiological, genetic (and more) structures, synorganized and cooperating in the organism (including its behavior or conduct), about whose origin we just asked. How did these structures and functions evolve?

A hare runs faster, a lion jumps farther, a zebra senses a carnivore better, an eagle spots prey at a greater distance, a chimp responds more effectively than his or her conspecifics. Why? Because -- according to the neo-Darwinian doctrine -- the chance events of mutation and recombination have equipped them as needed, with all structures originating until then as well as the newly gained improvements. All this occurs in a continuous process of evolution. Thus, chance events determine everything in evolution: form and function of all structures dominating natural selection in the struggle for life and hence the entire phylogeny of plants and animals.

There is, of course, even according to neo-Darwinian theory, no selection without form and function of already existing and subsequently improved structures. Let me emphasize: all must be generated by random micro-mutations with "only slight or even invisible effects on the phenotype."

Hence, natural selection is in itself neither self-steering nor an ordering mechanism, etc. Instead it is the result of structures, features, forms, functions, and capabilities altogether produced by the chance events of accidental mutations alone, including the overproduction of descendants.

It is the habitual method of many supporters of the modern synthesis to disconnect or decouple natural selection from chance events, but this is totally unjustified. For me this disconnection or detachment appears to be part of a wily and widespread propaganda effort, seeking to manipulate public and scientific opinion to make neo-Darwinian evolution more acceptable and digestible. For evolution by an almost infinite series of fortunate strokes of small serendipities seems to be, *prima facie*, implausible to most thoughtful people.

And yet, consistent with evolution, the entire world of organisms has to be, in fact, traced back to pure chance events and random occurrences. Nobel laureate Jacques Monod seemed to belong to a minority of evolutionists who fully comprehend the consequences of the synthetic or neo-Darwinian theory. He wrote concerning mutations:

> We call these events accidental; we say that they are random occurrences. And since they constitute the *only* possible source of modifications in the genetic text, itself the *sole* repository of the organism's hereditary structures, it necessarily follows that chance *alone* is at the source of every innovation, of all creation in the biosphere. Pure chance, absolutely free but blind, at the very root of the stupendous edifice of evolution: this central concept of modern biology is no longer one among other possible or even conceivable hypotheses. It is today the sole conceivable hypothesis, the only one that squares with observed and tested fact. [Italics by Monod.]

Yet, Monod's assertions on the origin of the biosphere are essentially all wrong. See here, please, for the facts and inferences in my encyclopedia article about natural selection.

References:

Huxley, J. (1962) [Book Review]: The Nature of Life, by Prof. C. H. Waddington. Pp. 131 (London: George Allen and Unwin, Ltd., 1961. *Nature* **194**: 43-44. The full quotations reads:

Waddington proceeds to point out that the frequent assertion that biological evolution is based on chance is entirely untrue. "Chance" events furnish its raw material, but the process itself is directional-selfsteering, but automatically steering itself in a definite direction. This is because, in Ernst Mayr's phrase, natural selection is not a random but an 'ordering' mechanism. It is quasi-finalistic, or, to use Pittendrigh's useful term, "teleonomic" -- it orders chance events into directional channels.

Ridley, M. (1985) [Review of 3 books]: More Darwinian Detracters. *Nature* **318**: 124-125.

Monod, J. (1971): *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*. Pp. 112-113. Random House, Inc., New York. First Vintage Book Edition, October 1972. Also see here.

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Updated by W.-E. L, April 14, 2016.

4. Short Comment by David Klinghoffer and 5. Link to Podcast on Randomness in Natural Selection

David Klinghoffer May 1, 2016 2:37 AM

The question of whether evolution is "random" is a perennial. Darwinists respond to the challenge, often delivered casually, by exasperatedly pointing out that the natural-selection component of evolution is hardly a matter of chance. Actually, though, as geneticist Wolf-Ekkehard Lönnig explains in an *ID the Future* podcast interview with Discovery Institute's Paul Nelson, this is not quite true:

Download the podcast by clicking here:

Everyone understands, or should understand, that the evolutionary component of random genetic variation is just that -- random. But, Dr. Lönnig clarifies, citing the American oyster and other examples, "selection" also incorporates a high degree of old-fashioned luck. The folk objection to Darwinian theory is, then, not as naïve at it might at first seem.

Photo: Bed of American oysters, Cockspur Island, Georgia, by JohnCub [GFDL or CC-BY-SA-3.0], via Wikimedia Commons.

6. Joseph Felsenstein's Comment at Panda's Thumb:

A devastating critique of population genetics? The Discovery Institute thinks so

By Joe Felsenstein on May 4, 2016 10:11 PM | 216 Comments

A retired European geneticist, Wolf-Ekkehard Lönnig, has made a point that he feels is devastating to population genetic arguments about the effectiveness of natural selection. In a post at the Discovery Institute's blog *Evolution News and Views*. He pointed to an argument he made in 2001 in an encyclopedia article. The essence of his criticism is that many organisms produce very large numbers of gametes, or of newborn offspring. Most of those must die. Then

> If only a few out of millions and even billions of individuals are to survive and reproduce, then there is some difficulty believing that it should really be the fittest who would do so.

In addition, he was interviewed two days ago by Paul Nelson, in a podcast posted very recently by the Center for Science and Culture of the Discovery Institute, on their blog Evolution News and Views. You will find it here. He makes the same point (while Nelson misunderstands him and keeps raising an unrelated point about protein spaces).

It is a stunning thought that evolutionary biologists have ignored this issue. Have they? Have population geneticists ever thought about this? Well, actually they have, starting nearly 90 years ago. And the calculations that they made do not offer support to Dr. Lönnig. Let me explain …

The standard model

In population genetics, the standard model of genetic drift in finite populations is the Wright-Fisher model, introduced in 1930 and in 1932 by those two founders of that discipline. The other great founder, JBS Haldane, used a nearly equivalent model in 1927, though discussed less explicitly.

In a Wright-Fisher model there are N parents, each of whom produces a very large but equal number of gametes. So large, that it is assumed that there are an infinite number of them, each parent contributing equally. These gametes then combine at random to form all possible genotypes, each in exactly its expected frequency.

If natural selection occurs, it then shifts the genotype frequencies in precisely the expected way. Finally, density-dependent mortality occurs, leaving only N survivors, so that the population size is maintained. It impacts all genotypes equally, so that the N surviving adults are in effect a random sample from the genotypes that survived natural selection. This sampling of adult survivors causes the genetic drift.

A numerical example

For example, if we have a population of a haploid species with N = 10,000 individuals with two alleles *A* and *a* at equal frequencies, each of them will produce a vast number of gametes, equal numbers from the two genotypes. Among the gametes they will be in a 1:1 ratio. Now if the *a* genotype has viability 1% lower, after that mortality their numbers will stand in the ratio of 1 : 0.99. So after this mortality the frequency of the *A* genotype is 1/(1+0.99) = 0.50251256.

These young individuals then die randomly in freak weather, are eaten randomly by predators, are run over by trucks, and so on. All the haphazard random mortality that Lönnig is worried about. Finally a random 10,000 of them are chosen to win the lottery and survive.

As Lönnig says, there are all sorts of outcomes possible. Will the natural selection be effective? Lönnig obviously thinks not. But we can do the calculations. Will the frequency of the *A* genotype increase? Each of the 10,000 survivors is a randomly drawn offspring, and 0.50251256 of those are *A*. So it's just like tossing a coin 10,000 times, when the probability of Heads is 0.50251256.

The outcome

A simple binomial distribution shows that among the adult survivors the probability that the *A* genotype is more frequent than *a* is 0.681725. In all the random dying and random survival, the frequency of *A* rises more often than it falls.

Now that is one generation. Further rounds of reproduction and survival, with the same fitnesses, will ultimately lead to the frequency of *A* either rising to 100% or falling to zero. What is the probability that, starting with equal frequencies, we end up with *A* winning out? For that we move from Fisher and Wright's models to calculations by PAP Moran (1958) and Motoo Kimura (1962). Let's leave out the details, and open the envelope. And the probability is … 0.999999… and so on *until there are 43 of those 9s*.

An explanation

We can conclude that Dr. Lönnig is not familiar with theoretical population genetics. He is a retired plant breeder at the Max Planck Institute for Plant Breeding Research, who specialized in mutation effects in such plants as the "husk tomato" *Physalis pubescens*. I can understand why he might not have studied population genetics thoroughly.

But why then is he holding forth on the topic? This is easily explained. He is also a creationist, associated with the German creationist organization Wort und Wissen. He formerly posted creationist material on his homepage at his Max Planck Institute. In a controversial move, the Institute forbade him to do this.

If Dr. Lönnig wants to understand these matters more, I recommend to him that he visit a gambling casino – in spite of the wild uncertainty of individual gambles, he might be surprised at how often he would lose his pocket money playing games that are mostly random, but slightly biased in favor of the house.

7. In Terror of Chipmunks: A Response to Joseph Felsenstein

Wolf-Ekkehard Lönnig July 25, 2016 3:27 PM

I'm now back in my hometown of Cologne after a trip to Mexico, where I had been studying several native plants and animals. On returning, I had the opportunity to consider a recent post by University of Washington geneticist Joe Felsenstein[1] at *Panda's Thumb*: "A devastating critique of population genetics? The Discovery Institute thinks so." Felsenstein responds there to my post at *Evolution News*, "Randomness in Natural Selection and Species as Islands in a 'Vast Sea of Conceivable Arrangements.'" Seldom have I seen a piece of scientifically inspired writing like Felsenstein's that is so far off the mark. In fact, he quotes just one sentence of my post here, itself taken from my encyclopedia article on natural selection. He disregards my second post on the same topic entirely.

In the encyclopedia article mentioned by Felsenstein (but to which he provides no link), I unmistakably emphasized I am among those who accept "natural selection as a real process in nature." In reply, Felsenstein kicks in an open door, as the saying goes, and pretentiously preaches to the converted.

I added in a later paragraph of that encyclopedia article:

> Furthermore, survival of the fittest evidently takes place, for example, in cases of alleles and plasmids with strongly selective advantages, as in the cases of multiple resistance in bacteria and resistance to DDT in many insect species. After pointing out that Darwin knew hardly any cases of natural selection, Mayr asserts (1998, p. 191): "Now, there are hundreds, if not thousands, of well-established proofs, including such well-known instances as insecticide resistance of agricultural pests, antibiotic resistance

> of bacteria, industrial melanism, the attenuation of the myxomatosis virus in Australia, the sickle-cell gene and other blood genes and malaria, to mention only a few spectacular cases."

Joseph Felsenstein (J.F.) also refers to a podcast conversation with Paul Nelson and myself. In contrast to the view of total non-randomness as the essence of natural selection, held by Dawkins and many others in line with Darwin himself, I explained in the podcast that a comment by Litynski ("...that natural selection is nothing but blind mortality which selects nothing at all"[2]) "is the other extreme in the opinion on natural selection." This implies, of course, that the truth is to be found somewhere between these extreme views. I also emphasized that "we have just touched some of these things and there is much more to be said," referring listeners to the encyclopedia article.

In two posts on *randomness in natural selection*, my starting point was the perpetually asserted "antithesis" between mutation as a random process and natural selection as a totally nonrandom process -- the "directional ordering mechanism" -- in the neo-Darwinian theory of evolution. That's why I stressed Julian Huxley's verdict referring to and supporting Waddington and Mayr:

> The frequent assertion that biological evolution is based on chance is entirely untrue. "Chance" events furnish its raw material but the process itself is directional, self-steering, but automatically steering itself in a definite direction. This is because...natural selection is not a random but an "ordering" mechanism.

The absolute distinction here is between random/chance events in mutation *versus* unrestricted non-randomness in natural selection putatively governing all biological processes in the wild. The latter view was implied once more by Richard Dawkins in a comment on Stephen Meyer's debate with Lawrence Krauss: "...natural selection is a NONRANDOM process" (capital letters by Dawkins).

Moreover, since some authors even assert that "natural selection comes close to *omnipotence*" (Avise 1999), and Exley (2009) is convinced that "both the beauty and the brilliance of natural selection are reflected in its *omnipotence* to explain the myriad observations of life" (emphasis added in both cases), I supposed that it would not be wrong to put this infallible, unerring Goddess into a new perspective. I thus indicated that there is a strong element of randomness involved in the very process of natural selection (in Darwin's and most of his followers' encompassing sense) itself.

This fact is clearly evident from the following calculations by several population geneticists themselves and other authors referred to in my encyclopedia article, as I also mentioned in the podcast with Dr. Nelson:

> Fisher, perhaps the most important forerunner of the neo-Darwinian theory, has calculated (1930) that new alleles with even 1% selective advantage (i.e., more than is usually expected by neo-Darwinian theorists), will routinely be lost in natural populations. According to these calculations the likelihood of loosing a new allele with 1% advantage or no advantage is more than 90% in the next 31 generations (Fisher, 1930/1958; Dobzhansky, 1951; Schmidt, 1985; see also ReMine, 1993; Futuyma, 1998; Maynard Smith, 1998). Considering genetic drift, i.e. random fluctuations of gene frequencies in populations, Griffith and colleagues state in agreement with these authors (1999, p. 564):
>
>> Even a new mutation that is slightly favorable will usually be lost in the first few generations after it appears in the population, a victim of genetic drift. If a new mutation has a selective advantage of S in the heterozygote in which it appears, then the chance is only $2S$ that the mutation will ever succeed in taking over the population. So a mutation that is 1 percent better in fitness than the standard allele in the population will be lost 98 percent of the time by genetic drift.

Compare also J.F. (2015) as quoted later. So, far from offering a "devastating critique of population genetics," I cited this branch of theoretical biology *in support* of a critique of the limits of natural selection. Now, how does Felsenstein deal with these explications?

Consider, please, the following points:

(1) Instead of focusing on my arguments for diploid populations, in his reply Felsenstein starts tutoring an obtuse W.-E. L. with a haploid population where the new mutation *has already been established* even to the point that exactly *half of all* the individuals are displaying it[3]. He states:

For example, if we have a population of a haploid species with N = 10,000 individuals with two alleles *A* and *a* at equal frequencies, each of them will produce a vast number of gametes, equal numbers from the two genotypes.

So, why does he start with a population with two alleles *A* and *a* at equal frequencies? We find the answer in J.F. 2015, p. 307: "[M]ost of the loss of advantageous alleles takes place while these alleles are still present in only a few copies" (see context below). And for the rest he thus skips the immense waiting time problem (see also below).

(2) And why did he choose a *haploid* species? Maybe Felsenstein starts with a *haploid* species because diploid ones are more complex to model in theoretical population genetics (see J.F. 2015, pp. 18, 49, 103, 108, 143).

(3) Equal numbers of gametes? Not necessarily so. Mutants often produce less. And by adding further presuppositions, you will find, of course, the outcome J.F. describes in his post.

(4) However, does the standard model to which he refers in his post, really consider "All the haphazard random mortality that Lönnig is worried about"? What about such terrible things like tsunamis, hurricanes, earthquakes, floods, heavy thunderstorms, famines and pestilences/epidemics? What about migrations? Assume that the two genotypes display different ecological preferences so that they separate from each other: *A* prefers to live in coastal areas and *a* in mountaineous regions. Then, after many generations, unexpectedly a tsunami occurs and unfortunately kills almost all *A* individuals. In the interim the *a* genotype adapted also to the coastal niche and settles as well there.

(5) And after all, always 10,000 individuals? Real population numbers can vary strongly sometimes even from one generation to the next.

(6) What about available area/space and the effects of population densities? "It is unlikely that relative fitnesses of genotypes will remain constant through time, since the environmental conditions, population density, and densities of other species will fluctuate, and these will in many cases affect the strength of natural selection" (J.F. 2015, p. 106).

(7) So, has the *a* genotype really forever a viability 1 percent lower over enormous numbers of generations even under extremely different environmental conditions? How, then, could the population of N=10,000 individuals ever come to have two alleles *A* and *a* at equal frequencies? A biologist well versed in population genetics stated his personal opinion on this question in a preliminary note to his mail (11 July 2016) as follows: "Using a 50 percent initial allele frequency is cheating -- it is optimal for evolution for several reasons -- but has almost no relevance to reality..."

It seems that the standard model functions only under idealistic, virtually paradisiacal conditions. Well, I know, of course, that for decades population geneticists have tried to develop models for many different biological conditions, premises and assumptions. J. F. himself has written an extensive overview on them (J.F. 2015). However, by his standard model and subsequent explanations the non-informed public may be deceived into a naive confidence, baseless trust and unreasonable faith in the putative omnipotence of natural selection in the wild.

(8) Among the many examples in my encyclopedia article I also drew attention to the following momentous discovery regarding earth history:

> One of the major setbacks for the idea of a pervasive and the history-of-life-dominating process of natural selection has been the rise of what neo-Darwinians derogatorily call "neocatastrophism" (Hsü, 1986; Alvarez, 1998; Prothero, 1998). Darwin "postulated a single process, the biotic struggle of natural selection, that was uniform over all the time on the earth, proceeded always at the same rate, on a planet that ceaselessly changed in detail but never abruptly changed state" (Hsü, p. 47). Today, Darwin's view is generally rejected by all informed scientists. The current question is not whether catastrophes have repeatedly interrupted natural selection worldwide, but which kinds of catastrophes are the most important ones in earth history.

One may think, for instance, of the Permian extinction (up to 96 percent of all marine species and about 70 percent of terrestrial vertebrate species annihilated). If J.F. is fully convinced that he has considered all the haphazard random mortality that I am so worried about then you have to conclude that in theoretical population genetics omnipotent natural selection still functions extraordinarily well *even in cases of the complete absence of any populations*. *Vive la sélection naturelle*!

(9) It is also important to note that *Felsenstein is not a naturalist*, that is, "a person who is expert ...in botany or zoology, especially in the field," "a person who studies plants and animals as they live in nature," or, similarly, "a scientist who studies living organisms." Many naturalists, like Carl Correns, William Bateson, Oscar Hertwig, John Christopher Willis, Lucien Cuénot[4] (and many others up to now) have vigorously confirmed their strong reservations regarding the omnipotence of natural selection. Their inferences were specifically *due to their direct studies of species in the wild*.

Evolutionary biologist Cuénot formulated the basic objection quoted in my post and article. Willis started as a convinced Darwinist, until he found the exact opposite in natural species "of tropical flora and the remarkable plant family Podostemaceae" (Cronquist) in Ceylon/Sri Lanka. Or in the words of Willis himself: "...selection could not be responsible for evolution." Bateson and Cuénot discussed several examples of distinctly relaxed natural selection in the wild (natural selection simply not found to be functioning or explaining anything in these cases). As for Bateson's arguments and those of many other biologists on the limits of natural selection, see the detailed discussion in my book on the evolution of carnivorous plants.

(10) Felsenstein explains humorously in an interview with Dr. Mary Kuhner for the Distinguished Faculty Interview Series at the University of Washington:

> ...by the time I got to high school, I was convinced I was going to go to into wildlife conservation, which is completely ridiculous because I am the world's most timid field person. I'm always, when I'm camping out, I'm always terrified, that I'm going to be eaten by chipmunks. And such a person should not go out into wildlife conservation.

He is in terror of chipmunks? There is no doubt some backstory to that, and of course I understand he is trying to be funny. However, had Felsenstein been out in the woods during, say, the last two or three months, carefully studying plants, he would have noticed thousands of tree seedlings (probably billions in the Northern Hemisphere alone) of many different genera and families just germinating. Of those thousands, only a very small percentage -- perhaps less than 0.01 percent on average -- will ever reproduce or even become full-grown trees. In exploring nature, Felsenstein would have seen the evidence for Cuénot's basic argument that, similarly, 99.99 percent and more of this juvenile generation will become extinct. The mutation rate per gene per generation of the surviving rest (i.e. of the less than 0.01 percent) is generally calculated to be between 10^{-5} and 10^{-7} (about 5×10^{-9} per nucleotide per generation in the 10^{-5} cases). More than 99 percent of these mutations with any effects on the phenotype are negative, i.e. deleterious or at least slightly deleterious, essentially constituting losses of function. And now, of all these mutants, again an extreme minority of perhaps less than 0.001 percent (1 in 100,000; cf. here and here) displaying a new allele due to a new beneficial mutation in the sense of Sanford et al. (2015) with 1 percent selective advantage the overwhelming majority of 98 percent will ultimately also be lost/become extinct simply due to stochastic events and/or population density.

For the latter point see also the calculations of J.F. (below) in agreement with virtually all other population geneticists. Thus, the question may be allowed: Is natural selection really "directional, self-steering, but automatically steering itself in a definite direction" or undoubtedly "close to omnipotence" or displays even the "omnipotence to explain the myriad observations of life"?

A biologist well versed in population genetics stated his personal opinion on this question as follows: "Using a 50 percent initial allele frequency is cheating -- it is optimal for evolution for several reasons -- but has almost no relevance to reality..."

Mostly Acer platanoides tree seedlings in a wood observed for several years and photographed (unretouched), April 29, 2016 by W.-E. L. The undergrowth can, of course, vary widely in different populations and environments as well as in different seasons.

Interestingly, since Felsenstein himself has stated (2015, p. 133) that "Genetic drift, which changes gene frequencies at random, may cause a favored allele to be lost," he *in principle* has already long understood and even taught Cuénot's argument.

Or consider Felsenstein's treatment of *random genetic drift* in his book *Theoretical Evolutionary Genetics* (2015), contrasting random genetic drift with natural selection defining random genetic drift as a "new force" (p. 339), or "another force," setting, together with the mating system and the mechanisms of recombination, "the context within which natural selection takes place" (p. 133). He also affirms in the context of mutations that (p. 139) "it is genetic drift, not mutation, that is the random force." He explains that (p. 271) "Genetic drift is the one force which can act as the "thermal noise" in the evolutionary machine. The relative strength of this "noise" compared to the nonrandom forces will determine to what extent the random effects of genetic drift will override other evolutionary forces."

Also, please see and check J.F. 2015, pp. 306-307, and compare the following quotation with that of the other population geneticists quoted from the encyclopedia article above:

> When s is small, clearly $2s$ is close enough to the probability of survival to serve as a working rule of thumb. It is worth considering how small a probability of survival this is. When $s = 0.01$, only one new mutant in 50 will succeed in spreading, despite the fact that all are advantageous. Even with s as large as 0.1, large enough to guarantee fairly rapid change in gene frequencies in the deterministic case, only one new mutant in six will establish itself. Obviously, genetic drift is a powerful force when only a few copies of an allele are in existence. Only rarely will an allele, even if advantageous, escape from the risk of loss due to the randomness of births and deaths, and of Mendelian segregation." [...] "So most of the loss of advantageous alleles takes place while these alleles are still present in only a few copies.... This in turn must be during the first few generations. An allele present in only one or a few copies is constantly at risk of being lost and could not last long in that state. If it survives many generations it must therefore be fortunate enough to have drifted to a larger number of copies."

Thus, Felsenstein is obviously in agreement, at least to a certain extent, with Cuénot and other biologists in doubting the omnipotence of natural selection.

Let me emphasize again: In contrast to what Felsenstein calls a "devastating critique of population genetics," this branch of theoretical biology, imperfect as it is (more on that in a further post), really *supports* a well-founded and compelling critique of the limits of natural selection by many famous biologists.

Hence, altogether, can there be any doubt that the process of natural selection includes, in fact, "an inescapable element of randomness" (Nelson)? Or, in other words, that randomness/chance events necessarily play a substantial and really far-reaching part for the survival of the fittest in the wild?

And yet, in my encyclopedia article I have also considered the surviving individuals of, for instance, the tree example above ("nevertheless, it appears that if such a mutation [one percent better in fitness] occurred at a constant rate in a large population, it would have a fair chance to become established after an average occurrence of about 50 times").

Following Felsenstein's post, a reader, "Ravi," offered the following comment:

> It is a real flaw in Darwinist thinking -- some organisms just don't reproduce in sufficient numbers for a slightly beneficial change to be "selected." The unrealistic cost of replacement, of course, is the dilemma faced by Haldane.

This is Haldane's dilemma in the clear words of Theodosius Dobzhansky referring to Crow and Kimura (1977, pp. 163-164):

> Crow and Kimura (1970) give the following example of gene substitution: "if the typical allele has a initial frequency of 10^{-4}, a population of one million individuals will have to have nine million genetic

> deaths each generation of it is to substitute an average of one allele per generation." [...] Granted that most species produce numbers of progeny far in excess of those needed to have the population survive, it is difficult to understand how evolution can happen at such an enormous cost in genetic deaths. Haldane saw clearly that he was confronted by a dilemma.

The simplest way to escape the dilemma would be "to postulate that only a few genes are substituted in racial, specific, and transspecific evolution by natural section," all the others being neutral, thus constituting "the strongest argument in favor of the panneutralist position"(Dobzhansky). Such a solution, however, has not been substantiated so far. Many regulatory and target genes seem to be involved in most cases. For an intriguing recent paper on the waiting time problem associated with Haldane's dilemma, see Sanford et al. (2015). But how can we explain the origin of a species definitely *not* producing numbers of progeny far in excess of those needed to have the population survive, such as *Eleutherodactylus limbatus* ("Female frogs have a single ovary and lay one egg at a time") and others?

Lucien Cuénot sums up his position on natural selection as follows (1951, pp. 401-402):

> Il y a égalité de chances pour les 800.000 oeufs pondus anuellement par une Carpe et abandonnés au hazard, et de 200 oeufs de l'Épinoche abrités dans un nid surveille par le mâle, entre les 120.000 oeufs (1) de nos Grenouilles et Crapauds, et les 9 oeufs portés sur le dos de la femelle du Leptodactyle *Ceratohyla* (Équateur) (fig. 155), ou l'oeuf unique de *Sminthillus* [*Eleutherodactylus limbatus*] dont le développement ne comporte pas la phase de têtard libre. La mortalité intraspécifique n'a donc, à part les quelques morts du début, aucun caractère sélectif ; lorsqu'il n'échappe que 2 individus sur 120.000, comme chez la Grenouille verte, comment admettre que ces deux sont élus en raison de petits avantages anatomique ou physiologiques[5]? C'est tout a fait invraisemblable, puisque ce sont les jeunes qui sont sacrifiés alors qu'ils n'ont pas leur perfection definitive. Enfin les observations positives montrent que la selection suppose n'a nullement la rigeur et l'infaillibilité que requiert la conception darwinienne ; il ne pas rare du tout de trouver à l'état sauvages des animaux handicapés par des malformations ou de mutilations, et qui cependent se maintiennnent comme les intacts.

For the latter, Cuénot mentions the following cases among others:

> ...il n'est par rare du tout de trouver à l'état sauvage des animaux handicapés par malformations ou de mutilations, et qui cependant se maintiennent comme les intacts. Kellicot ayant examine 450 exemplaires de *Bufo lentiginosus*, trouve que 8% d'entre eux sont anormaux, blesses ou amputés (Science, 1908, 855). J'ai peché plusieurs fois le Bassins d'Arachon des Poissons (*Atherina presbyter*, *Mugis labrosus*) à colonne vertébrale ondulée (fig. 156), moins bons nageurs que leurs congénères normaux (Sigalas compte 14 Athérines à rachis déformé sur 122 exemplaires); il est habituel de rencontrer des Orthoptères sauteurs qui ont perdu une patte sauteuse depui longtemps, des Lapin, Chamois, etc. qui ont réparé tant bien que mal des fractures ou amputations graves...

Relaxed natural selection may also be involved to a large extent in processes of degeneration in the wild (see the details here). In contrast, considering the possibility that advantageous mutants even under strong selection can exactly have this superior quality of being advantageous, beneficial, and helpful *due to losses of function*, as Michael Behe has so well pointed out and argued for in "Experimental evolution, loss-of-function mutations, and 'the first rule of adaptive evolution'" (Behe 2010, see also Lönnig 1971, 1993, 2015), Darwin's ensuing assertion on natural selection of 1859 is simply wrong:

> It may be said that natural selection is daily and hourly scrutinising, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good...

I will address some other inaccuracies in Felsenstein's post in another entry.

Notes:

(1) Joseph Felsenstein is Professor of Genome Sciences and of Biology and Adjunct Professor of Computer Science and Statistics at the University of Washington.

(2) Cuénot was more cautious, declaring: "*Enfin les observations positives montrent que* ***la selection suppose n'a nullement la rigeur et l'infaillibilité que requiert la conception darwinienne"*** (see full quotation above).

(3) Of the commenters on Felsenstein's post, "Ravi" seems to have been the first who noted a discrepancy here.

(4) All great names in the history of biology. For more on Cuénot, see the *Wikipedia* article.

(5) Note, please, that by this statement Cuénot is not denying natural selection totally or suggesting that if it does not exist at all. He nevertheless strongly limits "*l'infaillibilité que requiert la conception darwinienne.*"

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Photo at top: Eastern chipmunk, by Gilles Gonthier [CC BY 2.0], via Wikimedia Commons.

8. Scientific Inaccuracies, False Accusations: Concluding My Response to Joseph Felsenstein

Wolf-Ekkehard Lönnig July 26, 2016 4:29 AM

Writing here yesterday I addressed some scientific inaccuracies in a post by University of Washington geneticist Joe Felsenstein at *Panda's Thumb* ("In Terror of Chipmunks: A Response to Joseph Felsenstein"). There are additional problems beyond those I have already noted. Before going on, however, I feel it is important to correct some accusations made against me.

Felsenstein asserts:

> We can conclude that Dr. Lönnig is not familiar with theoretical population genetics. He is a retired plant breeder at the Max Planck Institute for Plant Breeding Research, who specialized in mutation effects in such plants as the "husk tomato" *Physalis pubescens*.

Just as an illustration: Imagine someone speaking of Charles Darwin as a pigeon breeder who strayed into the topic of the origin of species and evolution. Could anyone accept such a comment as an adequate assessment of Darwin's work?

Allow me, then, to introduce myself to Dr. Felsenstein. I am a transposon and mutation geneticist working with *Pisum* (for my PhD, see "Heterosis in *Pisum sativum*" (December 1979), for which I had checked also Falconer and Felsenstein), and then especially with

Antirrhinum and *Misopates* and eventually also with *Physalis* (altogether in field trials alone with more than 2.1 million plants, not including thousands of greenhouse and climate chamber plants). You can find a list of my publications here. I also study plants and animals in the wild wherever I go. (Most recently, that was to Isla Contoy and elsewhere in Mexico.) I've published books on carnivorous plants, giraffes, and the origin of dogs. Almost all my biological studies, going back fifty years now -- from mutagenesis and natural selection to embryogenesis and the geographical distribution of plants and animals -- are made in view of and in connection with the topic of the origin of species and higher systematic categories.

J. F. continues:

> I can understand why he might not have studied population genetics thoroughly.

I have carefully studied Haldane's dilemma, and some other aspects of population genetics. But, of course, I'm not a theoretical population geneticist but a mutation geneticist and naturalist studying the ongoing *real processes in nature*. On a small excursion last month, having examined several species of water plants (especially of the family of *Scrophulariaceae*), I was reminded again that in biology, nothing -- *really nothing* -- can wholly substitute for real contact with nature as part of our universe. And as Haldane mused, “the universe is not only queerer than we suppose, but also queerer than we can suppose." With due respect for Felsenstein's work, can theoretical population genetics really ever fully model the biological processes in the wild, of the "endless forms most beautiful," as Darwin said? To perhaps exaggerate the principle: No dry swimming exercise (helpful as it may be in certain cases) will ever substitute for the real thing, namely training in the pool, ocean, or river. Or, in the words of evolutionary biologist Lynn Margulis, member of the U.S. National Academy of Sciences, stating (1997, p. 279):

> [T]he Academy guards, using neo-Darwinism as an inquisitory tool, superimpose a gigantic superstructure of mechanism and hierarchy that protects the throbbing biosphere from being directly sensed by these new scientists -- people most in need of sensing it. The dispensers of the funds for scientific research and education and other opportunity makers, herd the best minds and bodies into sterile laboratories and white-walled university cloisters to be catechized with dogmatic nonsense to such an extent that many doctoral graduates in the biological sciences cannot distinguish a nucleic acid solution from a cell suspension, a sedimentary from an igneous rock, a kelp from a cyanobacterium, or rye from ergot.

See also Margulis as quoted in the supplement below. But, of course, comprehensive research needs all three best in cooperation, the lab, the "cloister," and, last but not least, the field -- this essential, decisive, and most important but nowadays often forgotten direct contact with nature herself.

J. F. goes on:

> But why then is he holding forth on the topic? This is easily explained. He is also a creationist, associated with the German creationist organization Wort und Wissen.

False, and embarrassingly so [for him]. I have never been associated with the German creationist organization *Wort und Wissen* for the simple reason that I do not subscribe to their agenda (the entire universe created some 6000 years ago and other regards). Nor have I ever been a member of ISCID or of Discovery Institute, as commenters on Felsenstein's post suggested. (If you doubt it, see my curriculum vitae.)

J. F. proceeds:

> He formerly posted creationist material on his homepage at his Max Planck Institute. In a controversial move, the Institute forbade him to do this.

These posts consisted essentially of the discussion of biological facts not convincingly explained by Darwinism, not of "creationist material." Partial closure was solely due to pressure by neo-Darwinian activists *from outside* the Institute over the course of three years, first on a national scale and later internationally (see the details in my book about "*Die Affäre Max Planck," die es nie gegeben hat*). In this, there was no discussion of the contents of my homepage, which consisted in part of peer-reviewed and/or peer-edited papers.

J. F. continues:

> If Dr. Lönnig wants to understand these matters more, I recommend to him that he visit a gambling casino -- in spite of the wild uncertainty of individual gambles, he might be surprised at how often he would lose his pocket money playing games that are mostly random, but slightly biased in favor of the house.

The proprietors of gambling casinos, slot machines, and lotteries have very intelligently calculated (that is, designed) this overall necessarily negative outcome for the players. (That's exactly why I'm a long-standing critic of such games of chance.) To adopt Felsenstein's metaphor, macroevolution would have long ago lost its money, as it were, if the process did not consist of much more than (and had to rely exclusively on) something like a gambling casino.

Returning to the question of population genetics, there have been some criticisms worth quoting, as for example, that by Samir Okasha (2006, *substantive revision* 2012):

> It is clear that population genetics models rely on assumptions known to be false, and are subject to the realism / tractability trade-off. The simplest population-genetic models assume random mating, non-overlapping generations, infinite population size, perfect Mendelian segregation, frequency-independent genotype fitnesses, and the absence of stochastic effects; it is very unlikely (and in the case of the infinite population assumption, impossible) that any of these assumptions hold true of any actual biological population. More realistic models, that relax one of more of the above assumptions, have been constructed, but they are invariably much harder to analyze. It is an interesting historical question whether these 'standard' population-genetic assumptions were originally made because they simplified the mathematics, or because they were believed to be a reasonable approximation to reality, or both. This question is taken up by Morrison (2004) in relation to Fisher's early population-genetic work.

Just before, Okasha writes:

> In a recent book, Sean Carroll, a leading evo-devo researcher, argues that population genetics no longer deserves pride-of-place on the evolutionary biology curriculum. He writes: "millions of biology students have been taught the view (from population genetics) that 'evolution is change in gene frequencies' ... This view forces the explanation toward mathematics and abstract descriptions of genes, and away from butterflies and zebras, or Australopithecines and Neanderthals" (2005 p. 294). A similar argument has been made by Massimo Pigliucci (2008). Carroll argues that instead of defining evolution as "change in gene frequencies," we should define it as "change in development," in recognition of the fact that most morphological evolution is brought about through mutations that affect organismic development. Carroll may be right that evo-devo makes for a more accessible introduction to evolutionary biology than population genetics, and that an exclusive focus on gene frequency dynamics is not the best way to understand all evolutionary phenomena; but population genetics arguably remains indispensable to a full understanding of the evolutionary process.

Now, to what extent has theoretical population genetics been successful in understanding the evolutionary process?

Compare, in his book on *Theoretical Evolutionary Genetics*, Professor Felsenstein's assertion that "population geneticists model all kinds of cases" with his ensuing statement on a comprehensive theory of evolution (2015, p. 49, emphasis added):

> A comprehensive theory of evolution, *one which does not yet exist*, would integrate ecological processes (which determine the range of environments and the fitnesses of phenotypes), developmental processes (which determine the effect of genotype on phenotype), and population genetics (which tells us the changes in genetic composition of a population when the fitnesses of the genotypes are known). Lacking the other elements of this future theory, we concentrate here on the population genetics.

Regarding the present state of the art of population genetics for molecular sequences, Felsenstein states (p. 473):

> Sampling methods (both IS and MCMC) are currently the state of the art in statistical inference from population samples of molecular sequences. The hope is that a "black box" can be constructed which will accommodate many of the possible complications of evolutionary models (multiple loci, diploid genotypes, recombination, population size changes, migration, even simple kinds of natural selection). The user will specify what evolutionary scenarios to allow and what kinds of data have been supplied. The user will need to understand the evolutionary models employed, but may be relatively insulated from having to master the details of the sampling. The program will then run the sampler and provide a likelihood surface, or a Bayesian posterior distribution, for the genetic or population parameters. *We are not there yet*, though many of the pieces have been tested. The great unknown is how much sampling will be necessary in complicated models.

If I had to write my encyclopedia article anew, I would probably also add some critical paragraphs on the presuppositions and limits of population genetics.

Now let's assume, for the sake of argument, that natural selection really comes "close to *omnipotence*," and that "both the beauty and the brilliance of natural selection are reflected in its *omnipotence* to explain the myriad observations of life," or that "natural selection is daily and hourly scrutinising, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good." (All of this is, of course, nonsense as we've seen in my recent articles at *Evolution News*; see here and here.) In the absence of intelligent design and by selected mutations alone, would that solve the problem of the origin of the necessarily enormously complex information that is an integral part of all life forms?

Concerning mutations, Felsenstein points out correctly (2015, p. 133):

> In a sense, it is a destructive force, making random changes in the genetic material. In any highly adapted organism such changes are overwhelmingly likely to be detrimental. The usual analogies we make in such cases involve making random adjustments in a finely constructed watch, or making random alterations of a carefully-written poem. While one will occasionally improve the timing of the watch or the effectiveness of the poem by random changes, with much greater probability one will make things worse.

Most probably I am not the only one who doubts that "random adjustments in a finely constructed watch...will occasionally improve the timing of the watch." Nevertheless, Felsenstein later asserts that "mutation holds a special place among these [migration and genetic drift], for without it the whole process of evolution would grind to a halt" (p. 134).

Although Felsenstein's models and calculations may to a certain degree be relevant for variation in natural populations, he never considers whether mutations really ever provide the raw materials for the creation of entirely new functional DNA sequences. Such sequences are required for constituting new genes and new gene reaction chains involved in the formation of novel synorganized anatomical structures and/or physiological functions for both the animal and plant kingdoms. That is, they are vital for the origin of all life forms on earth.

He simply *assumes* that this will be the case, and he builds his evolutionary worldview on exactly this delusion. For more information on mutations, see here for "Mutations: The Law of Recurrent Variation" (short version) or here for the long version. For additional papers I've written, see here. See also the calculations of Douglas Axe refereed to by Meyer, as well Axe's new book, *Undeniable*. Or in the words of Michael J. Behe:

> A fundamental facet of rationality is our ability to discern the existence of other minds. In our world we perceive other minds through their physical effects. A theory which arbitrarily rules out mind as an explanation for certain physical effects has abandoned a facet of reason. Abandoning a facet of reason leads ultimately to irrationality. Life reeks of Design.

That is well said. For my part, Joe Felsenstein's criticisms aside, for many scientific reasons discussed elsewhere (see Lönnig from 1971 to the present), I am entirely convinced that life displays ingenious design -- unparalleled, exceptional, unsurpassed, consummate, unique, and undeniable design.

Postscript:

See additionally Margulis on the state of biology especially in the USA (1997, p. 265) -- which appears to be very similar to the present state of affairs (emphasis added):

> More and more, like the monasteries of the Middle Ages, today's universities and professional societies guard their knowledge. Collusively, the university biology curriculum, the textbook publishers, the National Science Foundation review committees, the Graduate Record examiners, and the various microbiological, evolutionary, and zoological societies *map out domains of the known and knowable; they distinguish required from forbidden knowledge*, subtly punishing the trespassers with rejection and oblivion; they award the *faithful liturgists* by granting degrees and dispersing funds and fellowships. Universities and academies, well within the boundaries of given disciplines (biology in my case), determine who is permitted to know and just what it is that he or she may know. Biology, botany, zoology, biochemistry, and microbiology departments within U.S. universities determine access to knowledge about life, dispensing it at high prices in peculiar parcels called credit hours.

(Margulis, L. and D. Sagan (1997): *Slanted Truths: Essays on Gaia, Symbiosis, and Evolution*. Springer-Verlag, Berlin. (See also here.))

And perhaps a question to Joe Felsenstein: How do you explain, for example, the origin of the *Utricularia* trap mechanism by mutations and natural selection? See here, here, and here.

Photo: Starling murmuration near Tønder, Denmark, by Tommy Hansen [Public domain], via Wikimedia Commons.

Comment by Granville Sewell, Professor of Mathematics at the University of Texas, El Paso (mail: 26 July 2016): “Your two responses to Felsenstein are excellent. For 150 years Darwinists have used 3 primary tactics to silence dissenters: question their credentials, question their motives and appeal to authority. This strategy is certainly clear in Felsenstein's attack on you, it has been an extremely successful strategy in most cases, but I'm glad it isn't effective on you.”

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