

A Scientific Basis for *Vedāntic* View of Biodiversity **Bhakti Niskama Shanta, Ph.D.**

In a previous issue (January 2013) of *The Harmonizer* we responded to the criticism of one evodevo expert who surprisingly stated that “even Darwin recognized that geology provided the *least* amount of evidence for evolution”. Despite the well recorded fact of the continual grand propaganda of Darwinism based on fossil evidence for more than 150 years, in recent times a few biologists are surprisingly coming up with such statements, based on their confidence that evolution can be explained purely by the genealogical/genomic record provided by modern molecular biology. Still many respected journals (for example the *Nature* article by Retallack, 2013) continue to publish articles on fossil evidence to support Darwinian evolution. These incoherently diverse claims prove that Darwinists are struggling with unscientific ideological approaches to explain biodiversity.

Darwinian evolutionary theory is not only the basis of modern biology, but also acts as the guiding principle of science and intellectual reasoning for modern civilization. Hence, a scientific understanding of the breakdown of the Darwinian theory of objective evolution is very important for overcoming the traditional scientific temper of mechanistic intellectualism that characterizes this ideology. In my article “21st Century Biology Refutes Darwinian Abiology” (published in two parts in November and December 2012 issues of *The Harmonizer*) it was noted that several recent findings challenge the credibility that random mutations and natural selection can provide a valid basis for justifying the naturalistic evolution of species. The present article summarizes the problems associated with the fossil record and dating techniques, and its implication on the neo-Darwinian mechanistic misconception of biological life as mere molecular chemistry or abiology. An alternative approach based on the *Vedāntic* view for explaining biodiversity in the light of 21st century biology is also discussed in the end of the article.

Geological Chronology

To illustrate the timing and relationships between events that have taken place throughout the history of the globe, geologists, paleontologists, and other earth scientists use the geologic record represented by consecutive layers of rock strata to provide a scheme for chronological measurement. The geological column is also known as the stratigraphical column and is the most commonly used representation for estimating geological time (Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, and Tertiary). A doctrine termed uniformitarianism was first proposed by James Hutton in his ‘*Theory of the Earth*’ in 1795 and developed further by Charles Lyell in ‘*Principles of Geology*,’ first published in 1830. This doctrine explains that the causes that changed the Earth’s surface in past geologic times are identical to causes now producing changes on the Earth’s surface. Following this assumption, geologists believe that because sediments are presently observed as being laid down layer by layer, so they must have for all time been laid down gradually in a similar way. By estimating the rate of this sedimentary process they calculate that a certain thickness of sedimentary rock must symbolize, in certain circumstances, millions of years of time. This hypothetical representation of Earth’s surface as an ‘onion skin’ with successive layers representing the events throughout the history of the globe was, however, never substantiated with enough experimental or empirical evidence. Now, recent developments in the field are providing the greatest challenge to this widely used archaic methodology and its conclusions.

Evolution

The Origin of Species was published by Charles Darwin in 1859, in which he proposed the idea of natural selection to explain evolution. The widespread acceptance of this concept led to a radical change in the people's perception about life and world. Historically, numerous scientific objections and challenges were brought against this central conception, but with the dawn of the neo-Darwinian synthesis with Mendelian genetics, Darwin's idea eventually became the guiding principle of modern thinking, and for more than 150 years the only major focus of biologists has been to uphold the Darwinian vision intact. Evolution is a word not limited to biological evolution involving natural selection. Scientists claim that the fundamental matter of our universe and solar system has also evolved, according to the big bang theory, and that chemical elements eventually evolved from simpler matter. Then first-life evolved from those chemicals (abiogenesis), and complex organisms from simpler life forms (biological evolution). The broadest definition of evolution thus implies any purely mechanistic development by natural undirected processes to form the aggregates of matter that we observe in the universe today.

Historical Background in the Development of Darwinian Evolution Theory

The cerebral ambiance of Darwin's time played a vital role in the development of his theory. A number of natural historians were beginning to speculate that perhaps evolutionary changes are the cause of the patterns observed in nature. Meanwhile, geologists started elucidating their ideas about the age of the Earth's strata and suggested that a time sequence could be inferred, by assuming younger strata overlaid older strata. Using this as a basis geologists started calculating the age of Earth.

Continuous fossil findings revealed unknown living species (for example giant dinosaurs). Cuvier (1840) reported that a particular species can be detected in a certain stratum and that this coincidence of fossil-stratum is unique. Hence, he constructed a chronology of fossils based on the depth of strata. Similarities in different groups of organisms were recognized as proof of relatedness (evolutionary relationships) by naturalists. The predecessors in the line of Darwin, however, failed to come up with a satisfactory mechanism for explaining evolution. Among them Lamarck is well known. He most famously cited the giraffe as an example and proposed a mechanism based on the inheritance of acquired characteristics to explain adaptive changes (Koonin and Wolf, 2009). All these developments during that era proved to be catalysts in the formulation of the Darwinian evolution theory.

Darwinian Evolution Theory and Its Foundation

Based on fossil evidence Georges Cuvier denied the transition of one fossil form to another following a gradual alteration. Hence based on his knowledge about animal anatomy and physiology, he rejected objective evolution of one species from another (Waggoner, 1996). Due to these observations of Cuvier, gradual transmutation of species concept did not come into the limelight until Charles Darwin published *Origin of Species* (Larson, 2004). The major contribution of Darwin was that he could convince people in his time about biological evolution by proposing a mechanism based on natural selection (Koonin, 2009) and he supplied fossil records as major evidence (Web Reference, 1) for his theory. He further extended his thoughts in line with his theory to provide an explanation for the history of life on Earth and its biodiversity. He claimed that species change over geographical space and geological time. From the fossil records he explained that species that are living today are quite different than those that lived in past. Hence far enough back in time any pair of organisms share a common ancestor. He also

explained that evolutionary changes are gradual and slow. He claimed this could be supported by evidence in the fossil record. At that time naturalists believed that any observed sudden appearance of a new species in the fossil record was due to lack of sufficient fossil data, and that in future sufficient accumulation of fossil data would transform this sudden appearance of new species into a gradual one. Darwin had not ruled out the Lamarckian view of inheritance of acquired characteristics, but he was opposed to it since it contradicted his theory. This is because Lamarck believed organisms were active, adaptive systems driven by needs while, for Darwin, an organism is externally driven by contingent causes and natural selection. Latter Lamarckism was rejected by Weismann and Wallace (Kutschera, 2003). Today, Neo-Darwinism is a term introduced to describe the modern synthesis of Darwinian evolution thorough natural selection with Mendelian genetics. Lamarckian processes are also gaining some credence due to evidence that methylation and epigenetic changes influenced by the environment are also inherited. However, that did not change the fact that Darwin's evolution theory significantly relied on the basis of evidence derived from fossil records, although the emphasis has now shifted more to a genealogical, and further to genomic, proteomic, and phenomic comparative analysis.

Microevolution and Macroevolution

There are real and imaginary parts of the evolution theory. Variation known as microevolution (within a species) is the real part and big changes known as macroevolution (one species leading to another) is the imaginary part. The beaks of birds, colors of moths, leg sizes, and so on, are the characteristics which can be recognized as microevolution. There should not be any problem to accept microevolution because we do observe it in nature. However, the imagination of Darwinian evolution theory extends very far and claims that these small changes will gradually lead to a new species.

From animal and plant breeding experiments it is well known that there are strict limits to variation which are never crossed. A few Darwinists argue that we cannot see macroevolution now because it takes place very slowly (tens of thousands of generation). However, micro organisms are found to exhibit faster mutation rates (Bryan et al., 2012). Hence, it is possible to experimentally verify whether macroevolution takes place or not in such cases. As an example, bacterial colonies are found to grow (reproduce) in as quickly as 12 minutes or up to 24 hours and more in almost all types of environments. We can test the bacteria generation after generation but there is not a single case reported in the available scientific literature where they turn into something else. They always remain bacteria. Recently, Kuhn (2012) in his article 'Dissecting Darwinism' stated: "In all fairness, there is convincing evidence, that is widely acknowledged, that random mutation and natural adaptation (Darwinian evolution) does occur within species, leading to minor changes in areas such as beak size, skin pigmentation, or antibiotic resistance. Some of these changes involve a simple biologic survival advantage for a population, without a mutation in DNA. Others might be influenced by a single deletion or insertion within the DNA strand. However, the modern evolution data do not convincingly support a transition from a fish to an amphibian, which would require a massive amount of new enzymes, protein systems, organ systems, chromosomes, and formation of new strands of specifically coding DNA. Even with thousands of billions of generations, experience shows that new complex biological features that require multiple mutations to confer a benefit do not arise by natural selection and random mutation. New genes are difficult to evolve. The bacteria do not form into other species."

The morphologically based TOL (Tree Of Life) representation has dominated evolutionary biology from the time when Darwin first proposed it as a sufficient description of the total

history of life forms on Earth. Later, a three-domain tree of ribosomal RNA (rRNA) was introduced by constructing trees of other universal genes, such as ribosomal proteins and core RNA polymerase subunits (Woese, 1987). Thus, TOL was perceived as an authentic victory of tree thinking in biology. However, we now know that mechanisms like transduction, natural-transformation, horizontal (lateral) DNA transfer and conjugation can produce sudden changes in living organisms. Genome-wide analysis of gene phylogenies (phylogenomics), revealed an additional intricate image of evolution (Delsuc et al., 2005). The discovery of HGT (Horizontal Gene Transfer) has completely changed the whole picture.

There are cases reported in which phylogenetic trees of individual genes commonly have dissimilar topologies and this variety of tree topologies cannot be elucidated by artifacts of phylogenetic rebuilding (Koonin and Wolf 2008). These research studies recommend that TOL should be replaced by a 'net of life' or a 'forest of life' (Baptiste et al., 2009; Doolittle, 1999). With further advancements in research, evolutionary genomics successfully knocked down the simple idea of the TOL by bringing to light the dynamic, reticulated nature of evolution where HGT, genome fusion, and interaction among genomes of cellular life forms and diverse selfish genetic elements play a vital role. Hence, the phylogenetic TOL becomes the genetic 'forest of life' and this genetic 'forest of life' includes trees, bushes, thickets of lianas, and obviously, several dead trunks and branches (Koonin, 2009). Moreover, the manifestation of new species with novel features by hybridization takes place too fast for natural selection to operate innovatively. Despite the fact that hybridization and symbiogenesis have been recognized long back, still many neo-Darwinists dogmatically maintain confidence in gradualism in evolutionary change. In his noteworthy book, '*Evolution: A view from the 21st century*', Shapiro (2011) summarizes numerous instances where empirical evidence shows that gradualism in evolutionary change is refuted by 21st century biology.

Fossil Record

The fossil record is most uneven; it is nowhere near complete and can never be. Very rarely are organisms preserved as fossils in the best of circumstances. Organisms without hard parts (like worms) can only be represented very inadequately in fossil records. The number of species known through fossil records is insignificantly small as compared to total species. Raup (1981) stated in his paper in *Science*, "In the years after Darwin, his advocates hoped to find predictable progressions. In general, these have not been found—yet the optimism has died hard, and some pure fantasy has crept into textbooks." The fossil record suffers four major defects that are principally incompatible with gradualism: (a) stasis, (b) sudden appearance of forms, (c) sudden disappearance of forms, (d) relative absence of transitional forms.

(a) Stasis

Examining natural history, researchers reported that organisms never evolved into different novel anatomical structures; rather they continually unaltered, even over the period of hundreds of millions of years. This non-changing aspect of an organism is known as stasis in the fossil record. Stephen J. Gould (1977), Professor of Zoology and Geology, Harvard University, USA, stated that the history of most fossil species is particularly inconsistent with gradualism:

"Stasis. Most species exhibit no directional change during their tenure on earth. They appear in the fossil record looking much the same as when they disappear; morphological change is usually limited and directionless."

Lewin (1980) also quoted the statement of Gould: "For millions of years species remain unchanged in the fossil record". Gess et al. (2006) also reported in *Nature*, "lampreys as a whole

appear all the more remarkable: ancient specialists that have persisted as such and survived a subsequent 360 million years.” Many similar observations in the literature establish that species preservation is a natural characteristic of life. Life’s ability to preserve its own species over the period of hundreds of millions of years (‘Stasis’ in the fossil record) offers a significant challenge to Darwinian gradualism. Williamson (1981) stated,

“The principal problem is morphological stasis. A theory is only as good as its predictions, and conventional neo-Darwinism, which claims to be a comprehensive explanation of evolutionary process, has failed to predict the widespread long-term morphological stasis now recognized as one of the most striking aspects of the fossil record.”

(b) Sudden appearance of forms – ‘Darwin’s Dilemma’

Empirical evidence substantiates the fact that the new species did not evolve but suddenly appeared in geologic column. This is also famously known as ‘Darwin’s Dilemma.’ The Cambrian explosion refers to the abrupt manifestation of fossils of several of the most important animal phyla during a period of less than ten million years. Different species from numerous main divisions of the animal kingdom are found suddenly emerging in the lowest known fossiliferous rocks. Cooper and Fortey (1998) reported, “The beginning of the Cambrian period, some 545 million years ago, saw the sudden appearance in the fossil record of almost all the main types of animals (phyla) that still dominate the biota today. To be sure, there are fossils in older strata, but they are either very small (such as bacteria and algae), or their relationships to the living fauna are highly contentious, as is the case with the famous soft-bodied fossils from the late Precambrian Pound Quartzite, Ediacara, South Australia.” The Cambrian explosion offers a significant challenge to the conventional gradualistic mechanisms of Darwinian evolution. Darwin (1869) himself was perplexed that the fossil record disagreed with the claims of his evolution theory and believed that future fossil discoveries will help solve this major problem. However, Gould (1995) reported just the opposite: “The Cambrian explosion occurred in a geological moment, and we have reason to think that all major anatomical designs may have made their evolutionary appearance at that time. ...not only the phylum Chordata itself, but also all its major divisions, arose within the Cambrian Explosion. So much for chordate uniqueness... Contrary to Darwin’s expectation that new data would reveal gradualistic continuity with slow and steady expansion, all major discoveries of the past century have only heightened the massiveness and geological abruptness of this formative event...”. Carroll (2000) also explains the same, “The extreme speed of anatomical change and adaptive radiation during this brief time period requires explanations that go beyond those proposed for the evolution of species within the modern biota.”

(c) Sudden disappearance of forms

The fossil record reveals that in the history of life, several flourishing species were often suddenly wiped out. The K-T extinction (Cretaceous-Tertiary extinction) contributed to the disappearance of the dinosaurs. Several mass extinction episodes have been reported throughout the history of the Earth. For example (Web Reference, 2), Ordovician-Silurian mass extinction (third largest extinction in Earth’s history), Late Devonian mass extinction (Three quarters of all species on Earth died out), Permian mass extinction – The Great Dying (96% of species died out) and Triassic-Jurassic mass extinction (50% of species died). This is a big setback to conventional gradualistic mechanisms of Darwinian evolution and the same is reported by Fitch and Ayala (1995), “Many of the extinctions recorded in the fossil record are of species or large groups of species that were ecologically tolerant and occurred in great numbers in all parts of the world. If these extinctions were caused by slow declines over long periods of time, as Darwin thought, they might be explicable in terms of the cumulative effect of very slight deficiencies or

disadvantages. But it is becoming increasingly clear that successful species often die out quickly.” We have mentioned previously that life has a natural tendency to preserve its species and hence many species survive for several million years. This indicates that many species can adapt to the physical and biological stresses usual in its environment. The reason for such surprising extinctions is explained by Fitch and Ayala (1995): “This implies, in turn, that likely causes of extinction of successful species are to be found among stresses that are not experienced on time scales short enough for natural selection to act.”

(d) Absence of transitional forms

The fossil record establishes that species never follow a step by step path of continuous alteration of their ancestors; rather they appear all of a sudden and fully shaped. Convincing transitional forms are never observed to substantiate gradualist mechanisms of Darwinian evolution. Gould (1977) confirms the same:

“In any local area, a species does not arise gradually by the steady transformation of its ancestors; it appears all at once and ‘fully formed.’”

Still, many hold a wrong notion that the fossil record uncovered transitional species to support gradualism in Darwinian evolution. In reality, the lack of transitional species data to explain the multitude of alterations associated with species transition is a well established fact in the literature. Carroll (2000) confirms that, “What is missing are the many intermediate forms hypothesized by Darwin, and the continual divergence of major lineages into the morphospace between distinct adaptive types.”. Very recently, Kuhn (2012) strongly affirms “The transitional species from primitive primates to man have been illustrated in textbooks for over 100 years. These drawings form the visual imagery that supports Darwinian evolution for high school students, university students, medical students, and the public. However, honest dissent exists in the accuracy of most of the transitional prehominooids, with many found to be frauds or animal species.” Hence a serious consideration is necessary to find out the actual reason for all these discrepancies.

The role of geological chronology

Objective evolution theory or Darwinism is basically founded on a uniformitarian theory that presumes random mutations and natural selection are adequate for elucidating the gradual macro-evolution of species during the course of billions of years of life history on Earth. Following Darwin’s ideas that evolutionary changes are gradual and slow, macro-evolution is often explained on the scale of geological time – measured in hundreds of millions of years (Web Reference, 3). However, as explained above, the evidence from the fossil record is substantially in disagreement with this gradualist, uniformitarian assumption of Darwinism. Moreover, Kuhn (2012) raises suspicion about the validity of the fossil data: “A reliance on gross morphologic appearances, as with fossils, drawings, and bone reconstructions, is severely inadequate compared to an understanding of the complexity of the DNA and coding that would have been required to mutate from a fish to an amphibian or from a primitive primate to a human.” In the midst of many such perplexities, what is lacking is a thorough investigation into the accuracy of the dating technologies that are often presumed. Geologic chronology or a coherent history of the Earth is heavily dependent on the accurate understanding of the ages of rock formations. Radiometric dating and Stratigraphy are the two pillars of geological chronology and they are often employed to date fossils without considering the accuracy of these techniques. Hence a thorough investigation into the accuracy of geological chronology is very much essential. Till date there are only a very few discussions in the literature on the authenticity of geological chronology. In the light of recent finds and reported empirical evidence, the present

article makes an attempt to summarize the current standing of the two pillars (Radiometric dating and Stratigraphy) of geological chronology.

Is Radiometric Dating Trustworthy?

A general notion among academic circles is that radiometric dating is extremely trustworthy. However, the reality is completely the reverse. Way back in 1950 itself it is famously stated that radiometric dates are like railway timetables and they are subject to change without notice (Whitten and Brooks, 1972). In the following subsections we will analyze the real picture of 'carbon dating,' 'radioisotope dating' and finally the robustness of 'radiometric dating,' the 'pacemaker of geologic time'.

Boundaries of carbon dating

Carbon-14 (C-14) dating is commonly employed to date the age of fossils. The major problem with C-14 dating in the context of evolution theory is that it cannot give an age of hundreds of millions of years to the fossils because its half-life period is merely $5,730 \pm 40$ years (Godwin, 1962). Anything beyond 50,000 years will lead to a situation where it is not possible to find a sample with high enough concentration of C-14 to perform the tests. If a fossil contains a measurable amount of C-14 then automatically it proves that the fossil is less than 50,000 years old. Therefore, such a technique cannot be employed for testing Darwinian evolution theory which requires hundreds of millions of years. Furthermore, it is observed that the intake of carbon dioxide containing C-14 differs for different plants (Brooks et al., 2002). This would require the impossible task of introducing a correction factor for each and every species in order to get an accurate age. It is also a well known fact that C-14 concentration in atmospheric CO₂ often varies (de Vries, 1958) due to solar activity (Stuiver, 1965), geomagnetic field strength (Bucha, 1970) and numerous other factors. Due to these variations, the C-14 clock runs at a varying pace throughout the history of Earth, thus an unimaginable calibration would be needed to establish a relation between C-14 time and the historical time. Hence the use of carbon dating in the geologic column of hundreds of millions of years is unrealistic.

Dearth in radioisotope dating

For dating the geologic column of hundreds of millions of years, some researchers suggest radioisotope dating as an alternative to carbon dating. The half lives of the radioisotopes are long enough to cover the entire Earth's history. It is important to note that unlike carbon dating, radioisotopes can only be used to date the sediments present in the rocks and not the fossils directly. Direct radiometric techniques can neither be used for dating the mineralized fossils nor the sedimentary rock that buried them. Fossils are buried in sediments and hence it is idealistically assumed that if somehow the age of sediments in rocks can be estimated then the same can be assigned to the fossils as well. Hence, many of these radioisotope dating methods necessarily need the presence of some igneous rock fragments within the sedimentary rock layer. If some igneous rock fragments are present within the sedimentary rock then only can these techniques be used to date those igneous rock fragments. Then follows the incredible assumption that the fossil is as old as the igneous rock fragment obtained from the sedimentary layer. However, a more reasonable thinking may conclude that fossils are indeed much younger than the sediment that buried them.

Moreover, the basic problem with radioisotope dating is that, we cannot know the radioactive concentrations (both parent and daughter isotopes) that existed in the rock in the beginning. Not only it is impossible to have the exact estimation of radioactive elements when the rock formed, but also there is no means to analyze the way those elements changed during its complete

geological history. In addition, it is assumed in these dating techniques that the system is closed so that none of the parent and daughter isotopes leak to the environment. Most of the uranium salts are soluble in water (Barbier-Baudry et al., 2000). Rocks are exposed to rain and moisture and therefore there is a maximum chance that they may get dissolved and lost in the environment. For example, US Geological Survey bulletin (Klepper and Wyant, 1957) reports that 90% of the radioactive elements in a few granites can be removed by leaching the rock with a weak acid. This report also states that 40% of the Uranium in newly emerging igneous rocks is easily leachable. In such cases we will get erroneous results when we use the sample for dating.

Failure of the pacemaker of geologic time

Interestingly, radioactivity is considered independent of temperature and pressure and hence radiometric dating technique cannot be used for calculating the time taken for the solidification of magma. Moreover, the constant decay rate assumption itself is facing many recent challenges (Jenkins, 2010). Researchers (Lynde and Spangler, 1974; Huh, 1999) have reported that even mild alterations in the environment may affect the stabilities of C-14, Co-60 and Cs-137. Experiments (Hahn et al., 1976) as far back as 1976 revealed changes in nuclear decay rates caused by physical or chemical changes in the surroundings. Reifenschweiler (1994) reported that changes in decay rates as high as 40% have been induced for certain nuclides. Radiohalos are found with different diameters for the same type of inclusion, and this has been taken by some investigators to imply that decay rates have varied with time (Allen, 1952, and Spector, 1972). Kerr (1999)'s article in *Science* also confirms that radiometric dating as the pacemaker of geologic time can no longer be called precisely 'clocklike'. Therefore, radiometric dating cannot be used reliably to give an age to the fossils and rocks. Stansfield (1977) fittingly stated in his book *The Science of Evolution*,

"It is obvious that radiometric techniques may not be the absolute dating methods that they are claimed to be... The uncertainties inherent in radiometric dating are disturbing to geologists and evolutionists"

The roles of stratigraphy and the geologic column in Darwinian evolution theory

In his book, *A History of Geology* (1990), Gabriel explained that the rate of deposition of sediments determines the geological ages and not biological evolution or orogeny. Therefore Stratigraphy remained the only basis of geological dating. In the 17th century Danish scientist Nicolas Steno (1669) formulated the basic principle of Stratigraphy based on three major assumptions: (1) Principle of superposition, (2) Principle of continuity, and (3) Principle of original horizontality. Steno, by assuming all rocks and minerals had once been fluid, theorized that rock strata were formed when sediments in a fluid such as water fell to the bottom. Obviously this method would lead to horizontal layers and is the reason why Steno's principle of original horizontality states that rock layers form in the horizontal position. Nicolas Steno also stated that if a solid body is enclosed on all sides by another solid body, of the two bodies that one first became hard which, in the mutual contact, expresses on its own surface the properties of the other surface.

Steno's explanation popularized the idea that fossils and crystals must have solidified before the host rock that contains them was formed. In geology a stratum is known as a layer of rock with consistent uniqueness that distinguishes it from the adjacent layers. Following Steno's idea scientists believe that these parallel layers rest one upon another in the rocks due to natural forces. In cliffs, road cuts, quarries, and river banks strata can be characteristically observed as bands of dissimilar colors or differently structured substance. In general geologists analyze the rock strata by categorizing the layers with respect to the material content within them. Each layer

represents a particular type of deposition of beach sand, sand dune, river silt, coal swamp, lava bed, etc. A typical stratigraphic column shows a series of sedimentary rocks, with the oldest rocks on the bottom and the youngest on top. Thus stratum is an essential fundamental element to study geologic time scale. Geologists, paleontologists and other earth scientists use the stratigraphic principle to describe the timing and relationships between events that have occurred during the history of the Earth. Evolutionists recognize the age of the fossil according to the geologic time scale based on the vertical location of the strata in which the fossil was discovered. Hence fossils obtained from the bottom of the geologic column are recognized by evolutionists as the most ancient fossils.

Practical defects in Nicolas Steno's principles of stratigraphy

Steno's three basic assumptions on which stratigraphy stands were never substantiated by either experimentation or empirical evidence. We will discuss below the fallacies of Steno's assumptions based on the available empirical evidence in the literature. French sedimentologist Guy Berthault could recognize these defects in Steno's assumptions and carried out the most fundamental experiments on sedimentation at Colorado State University with Pierre Julien (Professor of hydraulics and sedimentology) to evaluate the validity of Steno's assumptions (Berthault, 1986; Berthault, 1988; Julien and Berthault, 1993; Julien et al., 1993; Berthault, 2002). The technical problems with each of these three assumptions by Steno (1667) are discussed below.

Defects in Steno's First Assumption – Principle of superposition [(i) *At the time when one of the high strata formed, the stratum underneath it had already acquired a solid consistency, and* (ii) *At the time when any stratum formed, the superincumbent material was entirely fluid, and, due to this fact at the time when the lowest stratum formed, none of the superior strata existed* (Steno, 1667, p. 30, CII. 3.d).]:

A stratum is considered as thick if its thickness is about 50 - 100 cm. Following the first part of Steno's first assumption we would expect solid strata after a few meters in the seabed. However, the evidence recorded from the submarine drillings of deep seabed reveal that the first semi-consolidated sediments are found between 400 - 800 m. Isolated, hardened chert beds are found below 135 m of unconsolidated sediments (Logvinenko, 1980). These sedimentological evidences challenge Steno's successive hardening assumption which extends significantly the total time of deposition.

The second part of the Steno's first assumption is not found to be in line with experimental data obtained by Guy Berthault in Colorado State University. Steno mentioned that "Strata owe their existence to sediments in a fluid" (Steno, 1667, p. 30, CII.3c). However, Steno's stratigraphic model completely overlooked the fluid current and its chronological effects, which is the major variable factor in oceanic fluid. We cannot find an ocean without current and it is well known from a long time that oceanic currents erode, transport and deposit sediments (Strakhov, 1957). Charles Lyell, following Steno's principles, developed his theory of uniformitarianism. Lyell observed that the layers deposited in fresh water in Auvergne were less than 1 mm thick and he further considered that each one of them had been laid down annually.

Following this assumption we would expect that a 230 m thick deposit would have taken hundreds of thousands of years to form. But, long back Dunbar and Rodgers (1957, p. 198, 33) cautioned, "Without critical analysis and supporting evidence, however, it is unsafe to assume that the laminae in a shale represent annual deposition rather than deposition by a single storm or stormy spell. Several laminae may even have formed during a single flood". Blatt et al. (1980, p. 134) also gave similar suggestions. In fact, Bouma (1962) reported that turbidites can dump thick

multilayered sediments in a few minutes, and also the layers in the middle of such catastrophic flows did not solidify before other layers formed on top of them. Baas et al. (2000) also reported that laminar beds can be deposited in a span of a few minutes in turbidites. Similar observations are also reported in the pattern of volcanic ash deposits (Schmincke et al., 1973; Fisher and Schmincke, 1984). Guy Berthault's (2002, p. 442-443) sedimentation experiments also confirm that Steno incorrectly assumed that underlying layers must acquire a 'solid consistence' before overlying layers can be deposited. Guy Berthault conducted sedimentation experiments with a constant supply of heterogeneous materials in water with and without current (Web Reference, 4). In still water a deposition is obtained giving the false impression of succeeding beds or laminae. In reality these laminae appeared due to a spontaneous periodic and a continuous grading process taking place immediately following the deposition of a mixture of particles. The thickness of laminae is found to be independent of sedimentation rate and increases only when there is an extreme difference in particle sizes in the mixture. It was observed that the time required for development of these layers was much less than that indicated by the modern geological timescale.

More interestingly, when the experiments were carried out by Guy Berthault in a hydraulic channel with a horizontal current under constant discharge condition, it was observed that laminated layers developed laterally in the direction of the current. The critical sedimentation rate for each particle size can be obtained from the works of Hjulstrom (1935). It was observed in the experiments that by varying the current velocity a superposed stratification can be obtained based on the segregation of particles by size. It must be noted that the experimentally observed superposed stratification is completely independent of time of deposition of heterogeneous particles and thus disproves Steno's principle of superposition as an indication of relative time.

The videos (Web Reference, 5) in flume experiments clearly show that in the presence of a variable current, stratified superposed beds progress simultaneously in the direction of current. If we take a horizontal cross section of the deposition we can clearly visualize the stratification, and each of those beds from top to bottom were deposited at the same time. Following the trend it is obvious that the deposition in the downstream of fluid flow is always younger than the deposition in the upstream. These fundamental experiments in sedimentation prove that the chronology of deposition is dependent on the direction of growth of superposed beds (direction of fluid current) and is independent of thickness of deposition.

Defects in Steno's Second Assumption – Principle of continuity [*Strata owe their existence to sediments in a fluid. At the time when any stratum formed, either it was circumscribed on its sides by another solid body, or else it ran around the globe of the earth (Steno, 1667, p. 30, CII.3c.)*]:

This is certainly an unrealistic assumption because we cannot find any single evidence where a sedimentary layer is extended globally (all around the Earth). Long back in the 19th century itself geologists concluded that facies alteration is a direct refutation of Steno's principle of continuity. In the 19th century rigorous field studies and facies changes refuted flood geology and geologists agreed that Steno's assumption regarding the principle of continuity is inaccurate. Hence, geologists (Young, 1982, p. 44, 51-54; Mintz, 1977, p. 6-7, 18-19) accept that, "At the time when any stratum formed, either it was circumscribed on its sides by another solid body, or else it ran round the globe of the Earth." There are also cases in which even though continuity was established, they suffer from a time-equivalence crisis. For example, Dunbar and Rodgers (1957, p. 272), considering the case of lithostratigraphic units like the Tapeats sandstone, explained, "This unit can be traced almost continuously from one end of the Grand Canyon to the other; for long distances it upholds a wide bench, the Tonto Platform, which testifies to its perfect

continuity. Yet because of facies shifts the unit is of different ages at the two ends of the canyon, so that physical continuity has failed completely to establish correlation.” Hence, Dunbar and Rodgers (1957) conclude that, “It must never be forgotten, however, that even if continuity is thus suggested or proved, time-equivalence, though perhaps probable, is not assured.” Byers (1982, p. 219) also states,

“For over a century we have known about facies change. Facies change is a violation of the purest form of lateral continuity, which says that strata extend without change to the basin margin.”

Defects in Steno’s Third Assumption – Principle of original horizontality [At the time when any stratum formed, its lower surface, as also the surfaces of its sides, corresponded with the surfaces of the subjacent body and lateral bodies, but its upper surface was (then) parallel to the horizon, as far as it was possible (Steno, 1667, p. 30. C.II. 3.4.)]:

This assumption is also far from confirmed by empirical observations. The horizontality assumption demands a uniform sedimentation rate globally. In reality, sedimentation involves extremely complex phenomena and rate of sedimentation depends on several local physical and biological factors (Schneidermann et al., 1976). The rate of sedimentation cannot be identical in different oceans all around the Earth. Geologists unanimously admit that Steno’s assumption about global scale horizontal layers is generally untrue (Press and Siever, 2001, p. 392, 396). A basic geology textbook by Press and Siever (2001) explains that seismic cross-sections of continental slopes and other areas of the ocean floor confirm that sediment layers are often not deposited in a strict horizontal direction. Furthermore, submarine coring and seismic analysis reveals that strata in oceanic sediments are not always horizontal (Web Reference, 6). G.K. Gilbert explained long back in 1885 (Boggs, 1995, p. 362) that sands are time and again not deposited horizontally. Berthault (2002, p. 445) also reported:

“the experiments reported in my second paper to the Academy of Sciences, as well as experiments conducted by P. Julien and presented as the video, Fundamental Experiments on Stratification, at several sedimentological conferences, clearly shows that up to the limit of the angle of repose (30 degrees to 40 degrees for the sands), the lamination of sediments is parallel to the slope... The principle of horizontality does not apply in this case.”

Is the ‘Chronology of the Geologic Column’ Drowning in the Mud?

The simplistic model based on Steno’s erroneous assumptions ignores the effects of fluid and sediment parameters. Recently, a series of experimental observations in sedimentation reveals the vital role of those ignored parameters on the pattern of stratification. Guy Berthault’s inspirational work (Berthault, 1986; Berthault, 1988; Julien and Berthault, 1993; Julien et al., 1993; Berthault, 2002) on the most fundamental experiments on sedimentation created a revolution in experimental sedimentology and thus instigated a more rigorous experimentally based approach in this field. For example, the world’s leading scientific journal *Nature* also published (Makse et al., 1997; Fineberg, 1997) similar experimental work that Berthault initiated. Makse et al. (1997) also reported that in the absence of external perturbations, mixtures of grains of different dimensions spontaneously segregate. In such condition when a mixture of grains is normally dropped onto a heap, they observed that usually larger grains are settled near the base and the smaller ones at the top. On the other hand, when a granular mixture is dropped between two vertical plates, a spontaneous stratification of alternating layers of small and large grains is observed in those cases where large grains have a larger angle of response than the smaller ones (Makse et al., 1997, p. 379). Fineberg (1997, p. 323) also reported similar observations and these experiments have most important applications in the field of stratification

analysis of avalanches. The geological chronology based on Steno's simplistic theoretical model did not incorporate the influence of fluid and sediment parameters that are reported by these experiments. Hence, these prestigious publications and their conclusions further invalidate the widely used naive geological chronology.

Much beyond that, shale sedimentology is undergoing abundantly rapid paradigm shifts and a series of novel sedimentology experiments and observations on this are reported by Juergen Schieber from Indiana University, Bloomington and his colleagues (Schieber et al., 2007; Schieber and Southard, 2009; Schieber and Yawar, 2009; Schieber et al., 2010; Schieber, 2011). It is very important to note that the majority of the sediments in the world are mudstones (Schieber et al., 2007), which include shale and clays. Around a century ago Henry Clifton Sorby (1908), the 'Father of Petrography' made a suitable comment in the present context and it is still valid:

“Possibly many may think that the deposition and consolidation of fine-grained mud must be a very simple matter, and the results of little interest. However, when carefully studied experimentally it is soon found to be so complex a question, and the results dependent on so many variable conditions, that one might feel inclined to abandon the inquiry, were it not that so much of the history of our rocks appears to be written in this language.”

Despite much advancement in the field, sedimentologists still believe that muddy sediments are highly complex systems and a staggering 32 variables and parameters are required to be considered for a reasonable physicochemical interpretation (Berlamont et al., 1993). Being ignorant about this complexity and also significantly influenced by Steno's simplistic ideas, in the past geologists presumed that mudstones formed only in tranquil, unruffled seas. Disproving this now outmoded model and practically confirming this complexity in his experiments, Schieber (2011) concludes,

“Essentially, the experiments presented here demonstrate that many long-held assumptions about mud deposition and erosion do not agree with physical realities. Examination of the rock record increasingly shows that, once studied in some detail, shales and mudstones contain such a bewildering variety of textures and structures that one may indeed wonder whether the inherent questions about depositional conditions have any hope to ever be answered in full. By necessity, experimental approaches to the sedimentology of shales will therefore have to be as varied as these rocks themselves.”

Juergen Schieber and his colleagues are now experimentally establishing that mudstones can form in abruptly flowing or turbulent water. They are using a novel imaging technique to study turbulent muddy water. Schieber and Southard (2009) reported in *Geology* that mudstone particles can produce ripples, identical to those found in sand. Thus shales or mudstones are vulnerable to climatic conditions and hence are very much defectively understood compared to other types of sedimentary rocks. Schieber et al. (2007) reported a unique experimental study in *Science*, and abstract of this article states,

“Mudstones make up the majority of the geological record. However, it is difficult to reconstruct the complex processes of mud deposition in the laboratory, such as the clumping of particles into floccules. Using flume experiments, we have investigated the bedload transport and deposition of clay floccules and find that this occurs at flow velocities that transport and deposit sand. Deposition-prone floccules form over a wide range of experimental conditions, which suggests an underlying universal process. Floccule ripples develop into low-angle foresets and mud beds that appear laminated after postdepositional compaction, but the layers retain signs of floccule ripple bedding that would be detectable in the rock record. Because mudstones were long

thought to record low-energy conditions of offshore and deeper water environments, our results call for reevaluation of published interpretations of ancient mudstone successions and derived paleoceanographic conditions.”

Schieber et al. (2007) also state, “Our observations do not support the notion that muds can only be deposited in quiet environments with only intermittent weak currents... Instead, bedload transport of flocculated mud and deposition occurs at current velocities that would also transport and deposit sand”. Schieber et al. (2007) finally conclude,

“This, in turn, will most likely necessitate the reevaluation of the sedimentary history of large portions of the geologic record.”

These novel experimentations and observations are clearly making ‘Chronology of the Geologic Column’ to drown in the mud. Macquaker and Bohacs (2007) fittingly remarked in *Science* concerning this article (Schieber et al., 2007) in the same issue:

“The results call for critical reappraisal of all mudstones previously interpreted as having been continuously deposited under still waters. Such rocks are widely used to infer past climates, ocean conditions, and orbital variations.”

Hence, the stratigraphic model is found to be based on completely falsified assumptions. At the current time sedimentologists are realizing the key role of paleohydraulic factors in stratigraphy. Paleohydraulic analyses are not limited to the laboratory. In 2007 a team of Russian sedimentologists directed by Alexander Lalomov (Russian Academy of Sciences, Institute of Ore Deposits) has applied paleohydraulic analyses in conformity with Newtonian mechanics to geological formations in Russia. They concluded that the current velocities derived from sedimentary particle analysis would have resulted in the deposition of the entire sedimentary sequence in a very short period of time, rather than the millions of years implied by a stratigraphic analysis using the geological timescale (Lalomov, 2007). However, based on these experimental evidences we cannot conclude that all laminae form rapidly. For example, Lambert and Hsu (1979, p. 460) explained that annual varves are undoubtedly present in Swiss lakes, like Lake Zurich. Other varved deposits are also reported in the literature (Ripepe et al., 1991; Smith, 1997, p. 161). The famous Green River varves are known to be build up in a span of four million years and these varves demonstrate cyclic thickness variation with known periods for sunspot, Earth’s precession and Earth’s orbital eccentricity periods (Ripepe et al., 1991; Smith, 1997). All these observations indicate that laminae can appear from a complex mixture of processes of which some are slow and some are fast.

Geology is also witnessing ‘Shifting Paradigms in Shale Sedimentology’ as reported by Juergen Schieber (2011), who wrote, “Shales and mudstones are by far the most common sedimentary rocks, accumulate in a wide range of environments, and contain the bulk of recorded Earth history. This history is written in a well-defined special language that is still poorly understood... Shale research is a frontier area of sedimentary geology and will require several decades of sustained effort by multiple investigators to come to maturity.” Hence, in the given circumstances a blind application of Steno’s simplistic theory to all the rocks may overestimate the age of those rocks that did not appear by varved deposits. It is also observed from the evidence that radiometric dating techniques are not at all reliable. The age of the rocks and fossil ages based on such anomalous theories are no longer trustworthy. The plain fact is that geology does not have any credible dating technique at the present time. Modern geological evidence clearly reveals the crumbling pillars of geological chronology (radiometric dating and stratigraphy) and thus rather than supporting, completely undermines the “Chronology of Geologic Column,” which has several important fundamental applications in geology and many

other fields. Keeping that in view, attention is needed for doing profound research in sedimentary geology, which is currently very essential for developing a reliable method of prediction in geological chronology.

***Vedāntic* view of Biodiversity in the Light of 21st Century Biology**

The intemperate view in science, that we can, and in the future will provide a necessary, complete explanation of the universe (including life) has actually lead to the degradation of modern civilization. In general, anthropocentric scientism indefatigably overlooks the boundaries of science in its dogmatic claims. However, as we are regularly presenting in *The Harmonizer*, there is convincing scientific evidence for honest scientists to emphatically challenge the attitude of ‘dogmatic scientism’ that has hijacked the true method of science. Scientists who try to understand nature utilizing a purely reductionistic approach employ ontological, methodological and epistemic reduction (Nagel, 1998). By assuming ontological reduction, scientists are able to think of an organism as being nothing more than a combination of molecules and their interactions. Based on this presumption biologists employ methodological reduction by only studying the separate contents of an organism independent of their integral context. However, continually mounting evidence only refutes the idea of an epistemic reduction of an organism by appeal to the unification of ontological and methodological reduction. In fact, frontier biology confirms that all living organisms are sentient and hence cannot be reduced to mere physics and chemistry.

Living organisms are cognitively adaptive systems, a characteristic which is absent in inanimate or dead objects. Even the smallest living cells obtain information of their external environment and accordingly monitor their internal processes (Shapiro, 2011). For more than 150 years, following a reductionistic approach, Darwinism has considered only an insentient view of the living organism or abiology. On the other hand, 21st century biology rejecting the abiology of Darwinism, now accepts all living organisms including the smallest cells as sentient beings (Shapiro, 2011).

In the November 2012 issue article, “21st Century Biology Refutes Darwinian Abiology” the failure of the Darwinian theory to explain how novel regulatory elements arise was explained as being one of the major blows that late 20th century molecular biology presented to Darwinism. Each species of life has its own unique gene regulatory network, such that from its initial stage to maturity the particular species develops in accord with processes unique to that species only. Evo-devo experts primarily try to understand the appearance of developmental networks and the emergence of novel protein domains at decisive steps of embryological development in an organism. In applying this process to evolution Shapiro (2011) explains the difficulty,

“To have new subprotein domains arise in the course of evolution, a process is needed for generating novel exons that can encode extended polypeptide structures to be incorporated into proteins in combination with other exons. Exon generation cannot occur efficiently by the gradual accumulation of single amino acid changes in existing protein chains because the probability of losing the original functionality is too high and of gaining a new functionality too low. A more rapid, facultative process is needed—and has in fact been discovered.”

The new facultative process Shapiro calls “natural genetic engineering,” but this clearly exposes the naïveté of Darwinian abiology based on the assumption of gradualism. Gene regulatory networks are not a result of gradual evolutionary progress. Even unicellular simple creatures like bacteria have their own unique and extremely sophisticated regulatory networks. Smith and Hoover (2009) stated, “Synthesis of the bacterial flagellum is a complex process involving dozens of structural and regulatory genes. Assembly of the flagellum is a highly-ordered process,

and in most flagellated bacteria the structural genes are expressed in a transcriptional hierarchy that results in the products of these genes being made as they are needed for assembly. Temporal regulation of the flagellar genes is achieved through sophisticated regulatory networks that utilize checkpoints in the flagellar assembly pathway to coordinate expression of flagellar genes.” Hence, the belief that all life forms arrived from a common ancestor following a trajectory of mere objective evolution is rather unreasonable and more the result of a dogmatic imposition of an ideology.

In the context of multicellular organisms, Shapiro (2011) states, “Without an elaborate sensory apparatus to pick up signals about chemicals in the environment (nutrients, poisons, signals emitted by other cells) or to keep track of intracellular events (DNA replication, organelle growth, oxidative damage), a cell’s opportunity to proliferate or contribute to whole-organism development would be severely restricted. Life requires cognition at all levels”. The last sentence, “Life requires cognition at all levels” is the same paradigm that *Vedānta* has advocated since antiquity. In *Vedānta* it is described that the *ātma* (soul) is responsible for animating the bodies of all living organisms, from the simplest single cell to complex multicellular organisms. The immortality of *ātma* is explained in *Bhagavad-gītā* verse 2.20 and the same is also described in *Kaṭha Upaniṣad* verse 1.2.18, *na jāyate mriyate vā vipaścin nāyaṁ kutaścin na babhūva kaścit ajo nityaḥ śāśvato 'yaṁ purāṇo na hanyate hanyamāne śarīre* – “For the soul there is neither birth nor death at any time. He has not come into being, does not come into being, and will not come into being. He is unborn, eternal, ever-existing and primeval. He is not slain when the body is slain.”, where the word *vipaś-cit* means learned or with knowledge. According to *Vedāntic* understanding *ātma* is eternal and fully cognizant.

Vedānta explains that consciousness is one of the symptoms by which the existence of the *ātma* can be inferred. Although scientists cannot sensually perceive the *ātma*, still they can infer its existence just from the presence of consciousness in all biological systems. As the presence of the sun can be inferred from the sunlight, similarly existence of the *ātma* can also be understood from the presence of the different varieties of consciousness in various living organisms. Furthermore, *Bhagavad-gītā* verse 18.61 states, *īśvaraḥ sarva-bhūtānāṁ hṛd-deśe 'rjuna tiṣṭhati bhrāmayan sarva-bhūtāni yantrārūḍhāni māyayā* – “all living forms (*sarva-bhūtānāṁ*) are machines (*yantrā*) made of material energy (*māya*) of a Unitary Supreme Cognizant Being, Kṛṣṇa (*īśvara*), and Kṛṣṇa’s *Paramātmā* (super-soul) feature is guiding the conditioned *ātma* situated within that machine”. Hence, *Paramātmā* (infinite consciousness) is also known as the ground or sustainer of the *ātma* (finite consciousness). This explanation of *Bhagavad-gītā* is self evident from the scientific evidence described above. Living entities, from bacteria to humans, do not have full knowledge or control over the complex biological process that are sentiently going on within their bodies and yet those processes go on very perfectly. This perfect maintaining principle is *Paramātmā*. However, *Vedānta* explains laws of *Karma* (actions and reactions of good and bad activities performed by the living being) as the cause of any abnormal condition (diseases, errors in biological process, cancer, etc) that affects the body of an organism.

It should be noted that, the machine description of different bodily forms in the above verse for different species should not be misunderstood with the machines that a human could manufacture artificially. Unlike artificial machines, the bodies of all living organisms (from bacteria to humans) are inimitably complex. A frog’s zygote will never develop into a puppy. Life intrinsically preserves its species type. Darwinian objective evolution theory using the laws of physics and chemistry cannot explain why species like, bacteria, fish, frogs, banyan trees, lions and so on appeared. On the other hand, the conception of *Vedānta* holds that different forms (species) are original archetypes that accommodate different varieties of consciousness through which the transmigration of the soul (*ātma*) takes places on the basis of the evolution of

consciousness. For example, *Viṣṇu Purāṇa* states, “*jala-jā nava-lakṣāṇi sthāvarā lakṣa-vimśati kṛmayo rudra-saṅkhyakāḥ pakṣiṇām daśa-lakṣaṇam triṁśal-lakṣāṇi paśavaḥ catur-lakṣāṇi mānuṣāḥ* – There are 900,000 species living in the water. There are also 2,000,000 nonmoving living entities (*sthāvara*), such as trees and plants. There are also 1,100,000 species of insects and reptiles, and there are 1,000,000 species of birds. As far as quadrupeds are concerned, there are 3,000,000 varieties, and there are 400,000 human species.” According to *Vedānta*, species identification and classification are based on a cognitive paradigm, where the body is a biological expression of the consciousness of the soul (*ātma*). Therefore, the different species described in above verse are representations of different varieties of consciousness. The transmigration of the soul (*ātma*) is described in *Bhagavad-gītā* 8.6: *yaṁ yaṁ vāpi smaran bhāvaṁ tyajanty ante kalevaram taṁ tam evaiti kaunteya sadā tad bhāva-bhāvitaḥ* – “The soul (*ātma*) obtains a body in next life based on the consciousness in which it left the previous body.” Animals and lower species of life do not have enough intelligence to understand these descriptions of ancient wisdom. However, a sober human being may easily understand his/her entanglement in the dangerous cycle of endless transmigration and thus inquire about their true identity as the immortal soul under an expert spiritual guide. *Vedānta* advocates this scientifically verifiable subjective evolution of consciousness, while the unscientific Darwinian objective evolution of bodies is only a misconceived perverted reflection of this subjective evolution of consciousness. A lot of energy and time are already wasted for more than 150 years following the dogmatic imposition of Darwinian abiology and now the scientific evidence is forcing honest scientists to understand genuine biology based on cognition as revealed in depth within ancient *Vedāntic* literature.

References

- Allen, R.M., 1952. The evaluation of radioactive evidence on the age of the Earth. *Journal of the American Scientific Affiliation* 4, p. 18. Allen noted that, “The extent of the haloes around the inclusions varies over a wide range, even with the same nuclear material in the same matrix.”
- Baptiste, E., et al., 2009. Prokaryotic evolution and the tree of life are two different things. *Biol Direct* 4, 34.
- Barbier-Baudry, D., Bouazzacm A., Desmursd, J.R., and Dormond, A., 2000. Uranium^{IV} and uranyle salts, efficient and reusable catalysts for acylation of aromatic compounds. *Journal of Molecular Catalysis A: Chemical* 164(1-2), 195-204.
- Baas, J.H., van Dam, R.L., and Storms, J.E.A., 2000. Duration of deposition from decelerating high-density turbidity currents. *Sed. Geol.* 136, 71-88.
- Berlamont, J., Ockenden, M., and Toorman, E., 1993. The characterisation of cohesive sediment properties. *J. Winterwerp Coast. Eng.* 21, p. 105.
- Berthault, G., 1986. Sédimentologie: Expériences sur la lamination des sédiments par granoclassement périodique postérieur au dépôt. Contribution à l'explication de la lamination dans nombre de sédiments et de roches sédimentaires. *Comptes Rendus de l'Académie de Sciences* 303, 1569-1574.
- Berthault, G., 1988. Sédimentation d'un mélange hétérogranulaire. Expériences de lamination en eau calme et en eau courante. *Comptes Rendus de l'Académie de Sciences* 306, 717-724.
- Berthault, G., 2002. Analysis of the main principles of stratigraphy on the basis of experimental data. *Lithology and Mineral Resources* 37(5), 442-446.
- Blatt, H., Middleton, G., and Murray, R., 1980. *Origin of sedimentary rocks*. 2nd edition, Prentice-Hall, Inc. Englewood Cliffs, NJ 07632.
- Boggs, S., 1995. *Principles of sedimentology and stratigraphy*. 2nd ed., Prentice Hall, Upper Saddle River, NJ.
- Bouma, A.H., 1962. *Sedimentology of some flysch deposits: A graphic approach to facies interpretation*, Elsevier, Amsterdam.
- Brooks, J.R., et al., 2002. Heavy and light beer: A carbon isotope approach to detect C4 carbon in beers of different origins, styles, and prices. *J. Agric. Food Chem.* 50, 6413-6418.

- Bryan, J., Chewapreecha, C., and Bentley, S.D., 2012. Developing insights into the mechanisms of evolution of bacterial pathogens from whole-genome sequences. *Future Microbiol.* 7, 1283-1296.
- Bucha, V., 1970. Influence of the Earth's magnetic field on radiocarbon dating. In: Olsson I.U. (ed.), *Radiocarbon variations and absolute chronology*, Nobel Symposium (Almqvist and Wiksell, Stockholm) 12, 501-512.
- Byers, C.W., 1982. Stratigraphy – The fall of continuity. *J. Geol. Ed.* 30, 215-221.
- Carroll, R.L., 2000. Towards a new evolutionary synthesis. *Trends in ecology and evolution* 15(1), 27-32.
- Cooper, A., and Fortey, R., 1998. Evolutionary explosions and the phylogenetic fuse. *Trends in Ecology and Evolution* 13(4), 151-156.
- Cuvier, G.B., 1840. Cuvier's animal kingdom, arranged according to its organization : forming the basis for a natural history of animals, and an introduction to comparative anatomy / Mammalia, birds and reptiles, by Edward Blyth. The fishes and Radiata, by Robert Mudie. The molluscos animals, by George Johnston, M.D. The articulated animals, by J. O. Westwood, F.L.S. Illustrated by Three hundred engravings on wood. London: W.S. Orr and co.
- Darwin, C., 1869. *On the origin of species*. Fifth edition, Chapter IX, On the imperfection of the geological record, 378-381.
- de Vries, H., 1958. Variation in concentration of radiocarbon with time and location on Earth. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen B*(61), 1-9.
- Delsuc, F., Brinkmann, H., and Philippe, H., 2005. Phylogenomics and the reconstruction of the tree of life. *Nat Rev Genet* 6, 361-375.
- Doolittle, W.F., 1999. Phylogenetic classification and the universal tree. *Science* 284, 2124-2129.
- Dunbar, C.O., and Rodgers, J., 1957. *Principles of stratigraphy*. John Wiley & Sons, Inc., New York.
- Fineberg, J., 1997. From cinderella's dilemma to rock slides. *Nature* 386, 323-324.
- Fisher, R.V. and Schmincke, H.U., 1984. *Pyroclastic rocks*. Springer-Verlag, Berlin.
- Fitch, W.M., and Ayala, F.J., 1995. *Tempo and mode in evolution: Genetics and paleontology 50 years after Simpson*. New York: National Academies Press.
- Gess, R.W., Coates, M.I., and Rubidge, B.S., 2006. A lamprey from the Devonian period of South Africa. *Nature* 443, 981-984.
- Godwin, H., 1962. Half life of Radiocarbon. *Nature* 195, p. 984.
- Gohau, G., 1990. *A history of geology*. New Brunswick: Rutgers University Press.
- Gould, S.J., 1977. Evolution's erratic pace. *Natural History* 86(5), p. 14.
- Gould, S.J., 1995. Of it, not above it. *Nature* 377, p. 682.
- Hahn, H.P., Born, H.J., and Kim, J.I., 1976. Survey on the rate perturbation of nuclear decay. *Radiochemica Acta* 23, 23-27.
- Hjulstrom, F., 1935. Studies of the morphological activity of rivers as illustrated by river Fyris. *Bulletin of the Geological Institute Uppsala* 25, 89-122.
- Huh, C.A., 1999. Dependence of the decay rate of ⁷Be on chemical forms. *Earth and Planetary Science Letters* 171, 325-328.
- Jenkins, J.H., et al., 2010. Analysis of environmental influences in nuclear half-life measurements exhibiting time-dependent decay rates. *Nuclear Instruments and Methods in Physics Research A* 620, 332-342.
- Julien, P.Y., and Berthault, G., 1993. *Fundamental experiments on stratification*. Video, Sarong Ltd., Monaco.
- Julien, P.Y., Lan, Y., and Berthault, G., 1993. Experiments on stratification of heterogeneous sand mixtures. *Bulletin Géologique de France* 164(5), 649-660.
- Kerr, R.A., 1999. Tweaking the clock of radioactive decay. *Science* 282, p. 882.
- Klepper, K.R., and Wyant, D.G., 1957. Notes on the geology of Uranium. *US Geological survey bulletin No. 1046-F*, p. 93.

- Koonin, E.V., 2009. Darwinian evolution in the light of genomics. *Nucleic Acids Res* 37, 1011-1034.
- Koonin, E.V., Wolf, Y.I., 2008. Genomics of bacteria and archaea: the emerging dynamic view of the prokaryotic world. *Nucleic Acids Res* 36, 6688-6719.
- Koonin, E.V., and Wolf, Y.I., 2009. Is evolution Darwinian or/and Lamarckian? *Biology Direct* 4, p. 42.
- Kuhn, J.A., 2012. Dissecting Darwinism. *Proc Bayl Univ Med Cent* 25(1), 41-47.
- Kutschera, U., 2003. A comparative analysis of the Darwin-Wallace papers and the development of the concept of natural selection. *Theory in Biosciences* 122, 343-359.
- Lalomov, A.V., 2007. Reconstruction of paleohydrodynamic conditions during the formation of Upper Jurassic conglomerates of the Crimean Peninsula. *Lithology and Mineral Resources* 42(3), 298-311.
- Lambert, A., and Hsu, K., 1979. Non-annual cycles of varve-like sedimentation in walensee, Switzerland. *Sedimentology* 26, 453-461.
- Larson, E.J. 2004. *Evolution: The remarkable history of a scientific theory*. New York: Modern Library. ISBN 0-679-64288-9.
- Lewin, Roger., 1980. Evolutionary theory under fire: An historic conference in Chicago challenges the four-decade long dominance of the Modern Synthesis. *Science* 210, p. 883.
- Logvinenko, N.V., 1980. *Morskaya geologiya (Marine Geology)*. Nedra, Leningrad, Russia.
- Lynde, A.J., and Spangler, G.W., 1974. Radiometric dating: is the 'decay constant' constant? *Pensee*, p. 31.
- Macquaker, J.H., Bohacs, K.M., 2007. Geology: On the accumulation of mud. *Science* 318(5857) 1734–1735.
- Makse, H.A., Havlin, S., King, P.R., and Stanley, H.E., 1997. Spontaneous stratification in granular mixtures. *Nature* 386, 379-382.
- Mintz, L., 1977. *Historical geology: The science of a dynamic Earth*. 2nd ed., Charles E. Merrill Pub. Co., Columbus, OH.
- Nagel, T., 1998. Reductionism and antireductionism. G.R. Bock and J.A. Goode (eds.), *The limits of reductionism in biology*, Chichester: John Wiley & Sons, pp. 3-10.
- Press, F., and Siever, R. 2001. *Understanding Earth*. 3rd ed., W.H. Freeman and Co., New York.
- Raup, D.M., 1981. Evolution and the fossil record. *Science* 213, p. 289.
- Reifenschweiler, O., 1994. Reduced radioactivity of tritium in small titanium particles. *Physics Letters A* 184, 149-153.
- Retallack, G.J. (2013). Ediacaran life on land. *Nature* 493, 89-92.
- Ripepe, M., Roberts, L.T., and Fischer, A.G., 1991. ENSO and sunspot cycles in varved eocene oil shales from image analysis. *Journal of Sedimentary Petrology* 61(7), 1155-1163.
- Schieber, J., 2011. Shifting paradigms in shale sedimentology – The implications of recent flume studies for interpreting shale fabrics and depositional environments. *Recovery – CSPG CSEG CWLS Convention*, 1-4.
- Schieber, J., and Southard, J.B., 2009. Bedload transport of mud by floccule ripples – Direct observation of ripple migration processes and their implications. *Geology* 37, 483-486.
- Schieber, J., Southard, J.B., and Schimmelmanna, A., 2010. Lenticular shale fabrics resulting from intermittent erosion of muddy sediments - Comparing observations from flume experiments to the rock record. *Journal of Sedimentary Research* 80, 119-128.
- Schieber, J., Southard, J.B., and Thaisen, K.G., 2007. Accretion of mudstone beds from migrating floccule ripples. *Science* 318, 1760-1763.
- Schieber, J., and Yawar, Z., 2009. A new twist on mud deposition - Mud ripples in experiment and rock record. *The sedimentary record* 7/2, p. 4-8.
- Schmincke, H.U., Fisher, R.V., and Waters, A.C., 1973. Antidune and chute and pool structures in the base surge deposits of the laacher see area, Germany. *Sedimentology* 20, 553-574.
- Shapiro, J.A., 2011. *Evolution: A view from the 21st century*. Upper Saddle River, NJ: FT Press Science.

- Smith, A.G., 1997. Estimates of the Earth's spin (geographic) axis relative to Gondwana from glacial sediments and paleomagnetism. *Earth-Science Reviews* 42, 161-179.
- Smith, T.G., and Hoover, T.R., 2009. Deciphering bacterial flagellar gene regulatory networks in the genomic era. *Adv Appl Microbiol.* 67, 257-295.
- Sorby, H.C., 1908. On the application of quantitative methods to the study of the structure and history of rocks. *Q. Geol. Soc. London* 64, p. 171.
- Spector, R., 1972. Pleochroic halos and the constancy of nature: a reexamination. *Physical Review A* 5, p. 1323.
- Stansfield, W.D., 1977. *The science of evolution*. Macmillan: New York, p. 84.
- Steno, N., 1669. *Prodromus. Ex typographia sub signo Stella*, Florence, Italy.
- Steno, N., 1667. *Canis Calchariae. Ex typographia sub signo Stella*, Florence, Italy.
- Strakhov, N.M., 1957. Theoretical lithology and its problems. *Izv. Akad. Nauk SSSR, Ser. Geol.* 11, 15-31.
- Stuiver, M., 1965. Carbon-14 content of 18th- and 19th-century wood variations correlated with sunspot activity. *Science* 149, 533-34.
- Waggoner, B., 1996. *Georges Cuvier (1769–1832)*. University of California, Berkeley. Retrieved July 19, 2011.
- Whitten, D.G.A., and Brooks, J.R.V., 1972. *The penguin dictionary of geology*. Penguin Books, Middlesex (England), p. 378.
- Williamson, P.G., 1981. Morphological stasis and developmental constraint: real problems for neo-Darwinism. *Nature* 294, p. 214.
- Woese, C.R., 1987. Bacterial evolution. *Microbiol Rev* 51, 221-271.
- Young, D.A., 1982. *Christianity and the age of the Earth*. Zondervan, Grand Rapids, MI.

Web References:

1. Evolution and the fossil record – Archaeopteryx, the missing link. BBC.
www.bbc.co.uk/learningzone/clips/evolution-and-the-fossil-record-archaeopteryx-the-missing-link/5523.html Accessed 19th January 2013
2. Big five mass extinction events, Prehistoric life. BBC.
www.bbc.co.uk/nature/extinction_events Accessed January 22, 2013
3. Field Museum (2010, November 5). New statistical model moves human evolution back three million years. *ScienceDaily*.
www.sciencedaily.com/releases/2010/11/101105124241.htm Accessed January 19, 2013
4. Berthault, G. Experiments. *Sedimentology*.
<http://efficalis.com/sedimentology/home/experiments> Accessed January 19, 2013
5. Berthault, G. Videos. *Sedimentology*.
<http://efficalis.com/sedimentology/videos> Accessed January 19, 2013
6. Berthault, G. Videos. *Sedimentology*.
<http://efficalis.com/sedimentology/home/problems> Accessed January 19, 2013