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ECOLOGICAL ZONATION: THEORY, PROBLEMS AND PERSPECTIVES

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Harold Willard Clark was an Adventist pioneer in the study of the fossil record who was decades ahead of his time within the creationist community and, as we shall see, with respect to the geologic community as well. Clark lived from 1891-1986. He was a professor of biology and geology at Pacific Union College, Angwin, California. Author of *The New Diluvialism*, published in 1946, Clark began formulating his theory of Ecological Zonation (EZ) after a trip to the oil fields of Texas and Oklahoma where he observed fossil sequences in cores recovered from oil and gas wells. His intense study of the fossil record ensued.

The result of Clark's acceptance of order in the fossil record is well known within the Adventist community. A rift developed between him and George McCready Price who, for many years, did not accept order in the fossil record. Clark maintained that Price, in later publication, "...did not propose to do away with the orderly classification of the rocks that had been and was being developed..." (Clark, p 62).

In his development of EZ theory, Clark postulated a direct creation by an omniscient Creator and deposition of the fossil record primarily by the biblical Flood. Based on the fossil evidence he believed the following assumptions to be unavoidable:

- 1) Before the flood Earth's surface was diversified by mountains, plains, lakes, seas and streams.
- 2) These environmental niches contained many different communities of plants and animals.
- 3) These communities, in broader aspect, constituted the major life zones.



Harold W. Clark. Photo by Hershel Wheeler. Scan by Wilson's Photography bob@wilsonphotography.com.

- 4) Based on his understanding that the Creator pronounced the creation "very good," Clark assumed that the pre-Flood landscape and life zones would be closely correlated.
- 5) Lastly, he believed a more complete series of organisms existed pre-Flood than today (Clark, p 71).

Based on these assumptions the EZ Theory suggests that the order of fossils in sedimentary basins reflects landscapes sequentially eroded by rising Flood waters.

The most stunning aspect of Clark's position is his appeal to modern analogues in support of his theory. In Clark's discussion of various organisms he appealed to catastrophic, modern analogues, "Here again is a plain example of ecological zonation, if one interprets the past in terms of the present rather than in terms of an *a priori* theory" (Clark, p 73). The geologic community would not begin to accept catastrophic modern analogues for another 30 years! Today geologists, as actualists, use catastrophic modern analogues to interpret the past. Indeed, geologists have been compelled to redefine uniformitarianism ("the present is the key to the past") as actualism ("what you see is what you get").

There has been much discussion in the Adventist church about sequences of small land mammals and the inadequacy of the EZ theory to explain such order in the record. Clark used modern examples to explain these phenomena. He discusses the rabbits of the western United States as well as the weasel family, arguing,

Anyone finding these [referring to the living organisms] as fossils would be able to prepare as convincing evidence of their evolution as has been done for the Tertiary mammals. And yet there is absolutely no proof that one has evolved from another or all from common stock (Clark, p 78).

In his assessment of the sequences, Clark addressed the difficulty of sequence correlation, citing H.F. Osborn's *The Age of Mammals*,

Tertiary fossils are found largely in scattered basins, surrounded by mountains and volcanic peaks. The deposits are largely of volcanic ash, although the manner of deposition is not well understood (Clark, p 74).

At this point in the volume he seemed to be addressing the variation of species without evaluating the stratigraphic sequence. Later, however, he acknowledged the Gulf Coast Tertiary deposits which are laid down

“in long narrow lines along a shallow sea” (Clark, p 131). The point is that Clark was aware of that sequence and saw it as evidence of materials sequentially washed down from the highlands. In defense of his theory, Clark refers to the repeated references in the literature to incomplete ecological relationships in a variety of systems.

Indeed, post-flood Pleistocene deposits with extinct animals we know little about occur in deposits that have multiple interpretations (Suguio et al. 2003, Kaufman et al. 1998, Sanders & Merguerian 1991). With such a poor understanding of the more recent material, how can we expect to more fully understand the more complex deposition and destruction found in the lower units?

At present, we need to recognize that the scenario is even more complex than it was presented by Clark. There are difficulties in taxonomy of extinct plants because different parts of the same plant have been given

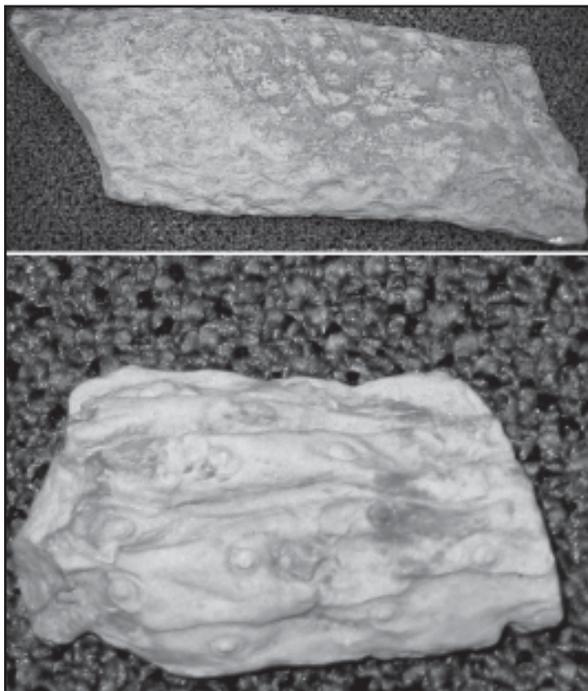
different names. For example, *Lepidodendron* is the name for the trunk of a tree fern; *Lepidophylloides* is the name for the leaves; *Lepidostrobus* is the name for the cones; but the term *Stigmaria* is the name for the roots of the same plant because when the names were applied the connection between the roots and the stem had not yet been discovered. In some cases, such as *Lepidodendron*, some very fortunate finds were made fairly early and the plant, for the most part, was better un-

derstood. This is not the case with all fossil plants which are often drawn without roots or canopy in the case of some of the fern trees.

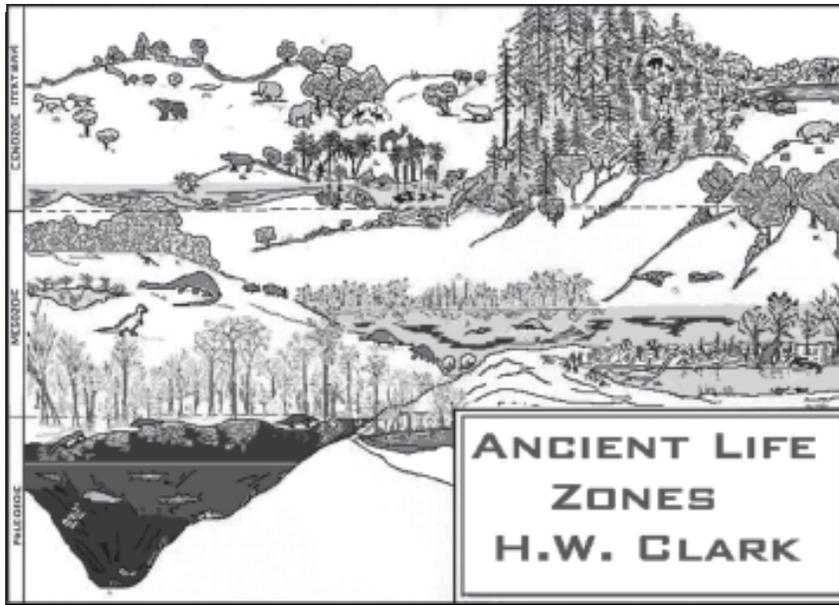
A similar situation exists with much of the extinct invertebrate fauna. Adults, juveniles, males, females, life-stage morphologies are all difficult to ascertain, and these problems complicate the taxonomy of fossil sequences. Gigantism and dwarfism also contribute to the complications within the fossil record. Adding to the complexity, are the plant extinctions that are not synchronous with the extinction events of the animal kingdom. Unaware of all the complexity to be found in the geologic record, Clark asks his readers,

When will geologists go all the way and accept the natural conclusion, that the whole geological series simply represents the ecological arrangement of a world which was complete as a unit, and not strung out throughout age after age of time? (Clark p.80).

Another complicating factor is the evidence for transport. Scripture states that the flood waters covered the whole earth; however, it might not mean that the entire earth was covered simultaneously. If it were, then the concept that “...only the lowest flood-deposited rock unit could contain fossils that lived where they died; all others must have been transported in (with, typically, progressively higher “life zones” requiring progressively greater transport)” (Brand and Goodwin, p 10) would be difficult to reconcile with the rock record. Perhaps transport should include animals moving under their own power as well as by water or rafting into the area. For example, a marine environment that had been rapidly buried by sediments might for a few days, weeks or even months become in effect “prime real estate” for organisms dislodged by flood related activi-



Top: Lepidodendron (scale tree) is the name given to the stems of Carboniferous fossils having this plant structure. Below: Stigmaria is the name for the roots of the same plant.



ties from their original habitats. The same would be true for land dwelling organisms that might migrate from their flooded homelands into regions that have been tectonically uplifted and recently exposed after having been submerged.

In a letter to *Science*, Dr. David M. Raup at the Field Museum of Natural History in Chicago stated:

One of the ironies of the evolution-creation debate is that the creationists have accepted the mistaken notion that the fossil record shows a detailed and orderly progression and they have gone to great lengths to accommodate this 'fact' in their flood geology (Raup, 1981).

Note that this is not an Adventist response but is rather from one of America's better known paleontologists. He is not referring specifically to the order in the record but rather to the sequence of fossil links that evolutionary biologists hope to find. In the view of some, things have improved somewhat for evolutionists since this statement was made. Nevertheless, his point is well taken, i.e., in the fossil sequences most scientists see a hierarchy of primitive to modern characters in the organisms, but this

hierarchy may not represent reality at the time of deposition. In Clark's view, the sequences in the fossil record may not represent long age sequences but rather sequential burial of organisms during the Genesis Flood that we have not, as yet, adequately explained. Clark's position and the fossil record may not be as diametrically opposed as some have suggested.

Recognizing the differences in the pre-Flood ecologies relative to modern ecologies, the theory works well in general, with marine organisms suddenly appearing and dominating the lower part of the record, followed by a wide variety of terrestrial organisms that suddenly appear together higher in the record and may represent lowland life forms. It is important to remember that the fossil sequences actually do not record the sudden appearance of life forms but rather, the sequence represents a record of death. Most researchers believe the first occurrence of a fossil in the rock record marks the beginning of that organism's existence in the long chronology proposed for this Earth's history. Many creationists believe that the first appearance of a species represents that point in time during the Genesis

flood that a particular group of organisms began to be buried. Thus, interpretations of this record of death are drawn from the same data base but differ radically based on world-view. Complicating factors for Flood geology in the sequence include escape motility of organisms, transport and sorting, bloat and float properties, etc. Perhaps this is the primary reason the ecological zones are not complete in the fossil record.

The lack of mixing of fossils and the specific sequences of the various kinds of organisms preserved in the fossil record seem problematic for creationists and although the theory of ecological zonation was proposed in response to this issue, these issues remain problematic. Recognition that pre-Flood ecologies were very different from the ecologies we have today and acceptance of the fact that our visions of global Flood activity may not reflect the reality, should encourage researchers to study the theory of ecological zonation more carefully as well as to encourage exploration of alternative theories.

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EDITOR'S ANGLE



For many years there has been a lot of criticism of Harold W. Clark's Ecological Zonation model within the Seventh-day Adventist Church. After reading what he has written, I'm no longer certain that the model has been fully understood or tested.

One difficulty with the model is the sense that it is more of an elevational zonation than an ecological one when the model is related to rising flood waters. Perhaps that is an unfair comparison and consequently an unfair evaluation of his ideas. If we were to think of it more in terms of successive burial of biomes and include the variability and variety of biomes at similar elevations we might come closer to the model Clark endeavored to describe.

It is our hope that the paper presented here will inspire Seventh-day Adventist scientists and educators to take a closer look at the Ecological Zonation model from a little different perspective. It might be helpful if biologists and paleontologists collaborated with geologists on this project so that a broader understanding of the complexities of our earth are addressed by workers in their respective fields.

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SCIENCE NOTES

GEOLOGY



Belcher C, Collinson M, Sweet A, Hildebrand A, Scott A. 2003. *Fireball passes and nothing burns—The role of thermal radiation in the Cretaceous-Tertiary event: Evidence from the charcoal record of North America*. *Geology* 31:1061-1064.

Research was conducted from Colorado, USA, into Saskatchewan, Canada, to document the amount of charcoal in the K-T boundary claystones and lowest Tertiary deposits that could be indicative of wildfires thought to have been ignited by the Chicxulub impact event. Previous workers had cited the discovery of soot in these beds; however this research cites numerous sources for soot that are independent of burning vegetation. From the six localities studied there was no charcoal or insignificant charcoal traces detected in the uppermost Cretaceous claystone and lowest Tertiary layers. In addition, researchers found significant quantities of noncharred organics in the same deposits. They concluded that the impact event did not have enough thermal power to ignite global wildfires.

Discussion questions: There are a variety of models proposed to explain the K-T extinctions. The infrared radiation model is the most recent. The questions that the scientific community are trying to answer relate to those organisms that survived the impact event as well as those that went extinct. Why did dinosaurs go extinct while the crocodiles, turtles, frogs and flowering plants (angiosperms) survived? What global event could explain the demise of the terrestrial dinosaurs and the marine ammonoids and leave virtually unharmed many of the other animal groups?

Dempster T, Hay D, Bluck B. 2004. *Zircon growth in slate*. *Geology* 32:221-224.

Zircon crystals have been considered by the geochronologists as the most reliable closed-system source for obtaining a variety of isotopic dates. In addition, use of zircons for acquiring isotope dating and geochemical data has been based on the non-reactive nature of the mineral. Zircons are largely resistant to chemical and erosive processes and have been assumed to be detrital, i.e., recycled from an igneous source. Any alteration of zircon crystals indicates potential for contamination

and mobilization of the radioactive materials.

This scanning electron microscope (SEM)-based research project documented overgrowths on zircon crystals and newly crystallized zircon in greenschist facies slate (low temperature [$<350^{\circ}\text{C}$] metamorphic rocks). The researchers advised caution when using U-Pb analyses of sedimentary and low grade metamorphosed sedimentary rocks "be-

cause zircon is mobile during low temperature processes.” They also noted evidence for redistributed rare earth elements (REEs) during slate formation.

Discussion questions: What are the implications of mobile isotopes in zircon? How might the mobility of zircon affect isotopic dates?

MOLECULAR BIOLOGY



Huynen L, Millar CD, Scofield RP, Lambert DM. 2003. Nuclear DNA sequences detect species limits in ancient moa. Nature 425:175-178.

Moas were large ostrich-like birds that lived in New Zealand, becoming extinct several hundred years ago. The number of species that actually lived in New Zealand has been a question of interest. The first describers of moa skeletons named at least 64 species in about 20 genera. Over the past 25 years, the number of species has been reduced to 11, on the basis that moas were sexually dimorphic and highly variable in size. Nuclear DNA recovered from moa bones indicates that the three “species” in the genus *Dinornis* actually represent only two groups, one from the North Island and one from the South. This further reduces the number of moa species by one species, and suggests the possibility that further reduction might be justified.

Discussion questions: Moas were apparently more highly variable morphologically than modern bird species. To what extent might this tendency apply to the rest of the fossil record? Why would the use of only skeletal material be problematic when interpreting morphological patterns of fossils for taxonomic purposes? What other data in the fossil record could be used?

Wolf YI, Rogozin IG, Grishin NV, Koonin EV. 2003. Genome trees and the tree of life. Trends in Genetics 18:472-479.

Phylogenetic (evolutionary) trees are typically based on sequence comparisons of nucleotides or amino acids. Ribosomal RNA (rRNA) has probably been the most popular molecule for estimating phylogenetic trees, in part because it is relatively easy to sequence. However, trees based on different genes or proteins often produce conflicting trees. The advent of comparative genomics has added a new layer of complexity to the effort to produce phylogenetic trees, and has raised new questions about the reliability of phylogenies based on rRNA. Comparative genomics has indicated extensive lateral gene transfer and selective gene loss, particularly among prokaryotes. An extensive study of 28 protein families concluded that there was no reliable phylogenetic signal present after probable horizontal transfers were removed from the data set. Comparative genomics seems to produce con-

sistent results when comparing closely related species, and consistently separates the major kingdoms of organisms, but seems difficult to interpret when comparing species with intermediate differences. The simple notion of a single Tree of Life that accurately portrays the evolutionary relationships of all species is probably “gone forever.”

Discussion questions: Construction of a single tree of life is the holy grail of evolutionary biology. Many types of data have been applied in efforts to construct such a tree, along with increasingly sophisticated methodology. Amino acid sequences, chromosomal banding patterns, DNA sequences, and now complete genome sequences have all been utilized, but the results remain contradictory and frustrating. Why are consistent results obtained with closely related species, but not at higher taxonomic categories? Could this reflect reality – there is not a single tree, but a forest of trees representing multiple independent lineages, each of which has diversified within limits? If so, what are the implications with regard to Creation?

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Geoscience Reports is a newsletter published by the Geoscience Research Institute to present current happenings at the Institute as well as general-interest articles that deal with creation/evolution issues for elementary/secondary-school and college science classes. The views expressed are those of the authors and not necessarily those of the Institute.

Staff of the Institute: L James Gibson, Director (PhD, biology); Ben L Clausen (PhD, nuclear physics); Raúl Esperante (PhD, vertebrate paleontology), Elaine Kennedy (PhD, geology); Katherine Ching, Editor (MA, history); Timothy G. Standish (PhD, molecular genetics); and Janet Williams, Administrative Secretary.

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GEOSCIENCE RESEARCH INSTITUTE NEWS



Ben Clausen

Dr. Benjamin Clausen gave a series of lectures in April to university students and church members near Riccione, Italy. He spent a little time at Mt. Vesuvius which is a high alkaline volcano and a classic locality for leucite which is found as large crystals in the lavas and associated with augite. Both leucite and augite form in lavas that do not contain quartz. Leucite forms at high temperatures in recently deposited lavas.

In May Dr. Clausen spoke to Division and Union personnel in Nairobi, Kenya. He also visited small high alkaline volcanos within 100 km of Nairobi. In his tour he included Mt. Longonot near Lake Naivasha, as well as Mounts Suswa and Menengai in the Rift Valley. These are high alkaline volcanos with phonolite and trachyte rocks. Phonolites (the name comes from the Greek word “phone” meaning “sound”) allegedly have a characteristic ring to them when hit with a hammer. Trachyte rocks have a rough texture due to the variation in crystal size.

Dr. Antonio Cremades is the Director for the GRI branch office in

South America. His primary field of study for the past six years has been the human hand. He is interested in the human fossils and associated archeology. In addition, Dr. Cremades teaches part-time at the Adventist University in Argentina. He has participated in numerous conferences in Chile, Uruguay, Brazil, Argentina, Spain and the United States.

For the past five years Dr. Raúl Esperante has studied the paleontology and geology at research sites in Perú, Spain, the United States and México. His primary area of research



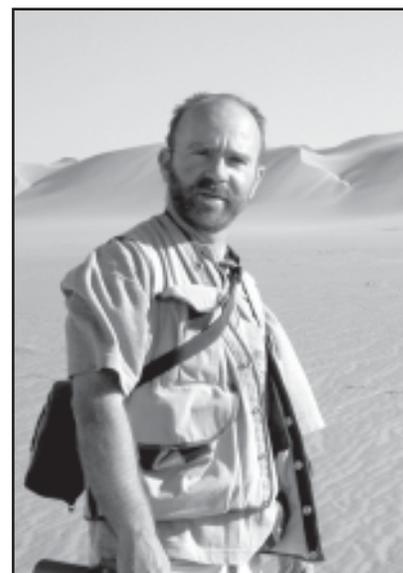
Antonio Cremades

has focused on the rapid burial of fossil whales in diatomaceous deposits (sediments composed primarily of marine diatoms, one-celled organisms made of silica). His goal is to develop a model that explains the characteristics of this peculiar deposit of fossils.

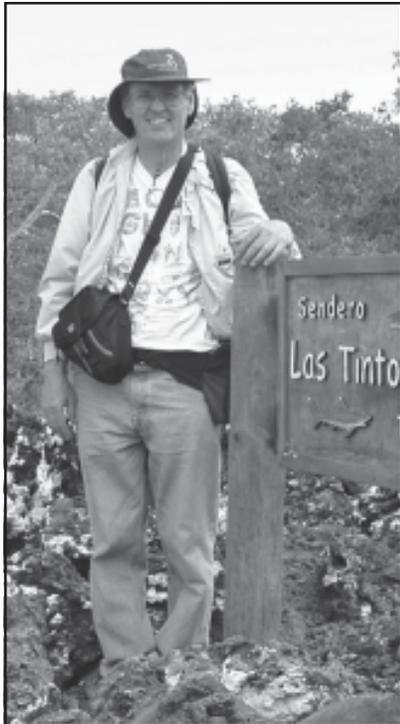
Dr. Esperante has presented papers on this topic in Germany, Australia, Spain, the United States, New Zealand and Perú. He is also editor of *Ciencia de los Orígenes*. Issue number 67 was the first issue published under his able leadership this past May.

Dr. Jim Gibson is the Director of GRI and recently visited the Galapagos Islands with Dr. Tim Standish and Dr. Humberto Rasi. Located approximately 1000 km west of Ecuador, these Islands are well known for their unique flora and fauna. While there he observed the marine iguanas, the large tortoises and the finches made famous by Darwin. Dr. Gibson’s position at the Institute requires him to travel to numerous conventions, congresses, symposiums, and conferences to present papers on biogeography, speciation, philosophy of science, as well as papers on science and faith.

Dr. Elaine Kennedy has been busy preparing *Geoscience Reports* for publication as well as writing several new papers and preparing PowerPoint presentations for the recently held North American Division Teachers’ Field Conference. Earlier this year she uploaded a seven-part PowerPoint presentation on the GRI website for Teachers (<http://www.grisda.org/teachers>). The material is titled “Taming the T-rex and other dinosaurs.” Part I begins



Raúl Esperante



Jim Gibson

with “The Questions,” followed by Part II: The Data; III: The Death; IV: The Biblical Questions; V: The Eggs and Nests; VI: The Links and VII: The Feathered Dinosaurs. It is hoped that this material will be of benefit to teachers and faith affirming for teachers and students regarding the creative power of God. Dr. Kennedy has also presented papers in the



Elaine Kennedy

Pacific Northwest, at Southern Adventist College, and in Germany. In Holland she attended a presentation on a Global Information System (GIS) mapping project and discussed the potential for a future collaborative effort there.

Dr. Jacques Sauvagnat is the director of GRI’s European branch office. He studies microfossils known as ostracodes — important markers in biostratigraphy and depositional environment. His work is focused on the ostracod biostratigraphy in the lower Cretaceous deposits of Switzerland and SE France. Specifically, ostracods occur in such a precise sequence in the lower Cretaceous that



Jacques Sauvagnat

explaining the sequence is problematic and raises many questions with respect to the Genesis flood. Dr. Sauvagnat has traveled extensively in Europe this year, attending conferences and teaching classes in Germany, France, Romania and Switzerland to students, professors and Adventist pastors. He has lectured at universities and schools in Australia and the United States.



Tim Standish

Dr. Timothy Standish has continued to work on his research in molecular genetics and participated in a conference at the Seventh-day Adventist university in Perú. He has written a variety of articles for several publications, including *Adventist Review*, *Harvard Crimson* and *Theologika*. In addition he has attended conferences at the University of Washington and the University of Idaho. Dr. Standish spent some time collaborating with television productions on 3ABN and LLBN.

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Men of Science...Cont. from Page 8

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MEN OF SCIENCE & FAITH IN GOD



ALLAN REX SANDAGE (1926 —)

Benjamin Clausen, Geoscience Research Institute

Allan Rex Sandage (1926-) had a childhood fascination with stars and how the world works (Durbin p 73). He was a religious child, going to the Methodist church by himself while his parents slept late (Sandage, p 52; Overbye, p 11).

Sandage received an A.B. in physics from University of Illinois in 1948, a Ph.D. in physics in 1953 at California Institute of Technology working under Walter Baade, and did a postdoc at Princeton University under Martin Schwarzschild (Golden, p 58).

In 1952 Sandage started working on the research staff at the Mt. Wilson and Palomar Observatories as an assistant to the famous Edwin Hubble. Hubble died a year later, leaving to Sandage the mapping of the continued expansion of the universe. In 1997 Sandage retired to Research Staff Astronomer Emeritus at what by then was called The Observatories (Pasadena, California) maintained by the Carnegie Institution of Washington and still lives with his wife Mary Lois in Pasadena (Durbin, p 76).

Sandage's continuation of Hubble's work established the discipline of observational cosmology and laid the groundwork for the central questions of cosmology — the age, size, shape, and perhaps fate of the universe. This involved a pursuit of the true value for the Hubble constant, H_0 , [or rate of expansion of the universe] and the deceleration parameter [or how the rate is decreasing] (Durbin, p 71,76; Golden, p 56).

In addition to determining the Hubble constant, Sandage's research has included pulsating variable stars,

stellar evolution, the first optical identification of quasars, and galaxy classification, formation, and evolution. He has more than 400 research papers and 5 books to his credit (*Today in Science* website). He became a senior member of the American Astronomical Society and the National Academy of Sciences (Croswell, p 22). In 1991 he received the Crafoord Prize, the Royal Swedish Academy's equivalent of the Nobel for astronomy (Durbin, p 71).

As a scientist, Sandage maintains a materialist-reductionist point of view, but recognizes that it can't explain everything (Durbin p 75,81). He recognized that science can address only a very limited range of problems and cannot answer a great number of questions (Sandage, p 55,61).

Sandage became a "born-again" Christian and joined a faith community. His inclination was to view the Bible as inerrant (Durbin, p 80; Sandage, p 54). "[T]hat doesn't mean that I'm enamored with fundamentalist theology," says Sandage, and their ridicule of evolution "angered me greatly" (Sandage, p 54). "Genesis says nothing about a literal six-day creation in terms of days as we know them *now*." In fact, "the Bible cautions us against taking itself literally" [2 Peter 3:8; Psalm 90:4] (Sandage, p 59). He rejects such literalism and confronts Christians for whom inerrancy means a young-Earth creationism and tries to convince strict creationists that their science is dead wrong (Durbin, p 80).

On the other hand, Sandage believes that "[w]ithin the realm of science one cannot say any more

detail about that creation than the First Book of Genesis" (Overbye, p 186). The first chapter of Genesis cuts through the murk of ancient mythology. The creation event is outside science and only through the supernatural can it be understood (Sandage, p 58,59). This unique, one-shot universe had to be created. The expansion of the universe is a scientific prediction of the creation event (Durbin, p 74,75).

Sandage believes that science and religion should each take the other seriously (*Sandhawk* website); however, science and theology are completely separate, nearly orthogonal. It is important to have the proper boundaries between science and religion (Sandage, p 55,60,62). Science answers what, when, and how; religion answers why (*Sandhawk* website).

In his office Sandage has a large candy jar labeled "megapotent Bible vitamins" containing 365 texts in plastic capsules (Overbye p.395); e.g.: "Oh Lord, our Lord, how majestic is Thy Name, in all the earth who hast displayed Thy splendor above the heavens" (Psalm 8:1).

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