

C-14 Dating and Christians in the Twentieth-Century United States

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20세기 미국에서의 탄소연대측정과 기독교

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요 약

탄소(C-14) 연대측정법은 창세기 초반의 해석과 관련된 과학적 자료를 제시하므로 창조론-진화론 논쟁의 핵심이 되고 있다. 본고에서는 1946년 C-14를 이용한 절대연대측정의 가능성이 리비(W. F. Libby)에 의해 처음으로 제시된 이래 탄소연대가 미국의 복음주의자들 사이에서 어떻게 받아들여졌는지를 추적한다. 1940년대 중반까지 미국의 안식교인들과 복음주의자들은 전반적으로 방사성 동위원소를 이용한 연대측정에 대해 비판적인 태도가 주류를 이루었다. 그러나 탄소연대측정법이 발명되고 기독교인들 중에 이 분야의 전문가들이 생겨나게 되자 1940년대 중반 이후 복음주의 과학자 진영은 둘로 나뉘게 되었다. 하나는 종전처럼 전지구적 노아홍수를 받아들이고 탄소연대를 부정하는 근본주의적인 복음주의자들과 다른 하나는 진화론의 균일설과 탄소연대 및 여타 방사성 동위원소 연대를 받아들이는 자유 복음주의자들이었다. 초기 탄소연대에 대한 논쟁은 American Scientific Affiliation (ASA)을 중심으로 일어났으며, 1950년대에 ASA가 자유복음주의자들의 손에 들어가자 이에 대한 반발로 1960년대 이후에는 Creation Research Society (CRS), Institute for Creation Research (ICR) 같은 근본주의적이며 보수적인 복음주의 과학자 단체들이 속속 생겨나기 시작하였으며 이들은 한국에서의 창조론 운동의 근거가 되기도 하였다. 복음주의 내의 이러한 대립적인 두 흐름은 현재까지 계속되고 있으며 C-14연대에 대한 논쟁은 물론, 기독교 내의 창조론-진화론 논쟁의 진원지가 되고 있다.

Key Words : radiocarbon dating, radioactive dating, creation science, flood geology, evangelicalism

In the recent history of interactions between science and Christianity, one of the most important events was the debate on the validity of radiocarbon (C-14) dating. The contradiction of C-14 dates to the literal interpretation of Genesis has split the evangelical Christians of the United States into two factions: one, the fundamentalist evangelicals, attempted to fit scientific findings into the literal interpretation of the Bible; and the other, liberal evangelicals, interpreted the Bible in light of modern science. In opposition to their fundamentalist predecessors who had subscribed to the gap theory¹⁾ and/or the day-age theory,²⁾ the fundamentalist evangelicals accepted a literal six-day creation and refuted the radioactive dates which had indicated the antiquity of the earth and life on earth. Although many nonreligious scholars criticized the technical details of the C-14 method,³⁾ it is interesting to note that some evangelical scholars themselves have seriously challenged the validity of C-14 dating.

This essay will trace both the fundamentalist and the liberal evangelicals' response to C-14 dating in the United States, focusing particularly on the response of the Seventh-day Adventist (SDA), the American Scientific Affiliation (ASA), the Creation Research Society (CRS) and the Institute for Creation Research (ICR)—groups demonstrating particularly sensitive response to C-14 dating. It will increase the understanding of the creationism movement in Korea since the early 1980s.

To begin with, we need to look at uses of the terms, "evangelicalism" and "fundamentalism". According to G.M. Marsden in *Encyclopedia of Religion*, evangelicalism generally refers to a Protestant movement with an emphasis on (1) the authority and reliability of the Bible, (2) eternal salvation by regeneration, and (3) a

1) For a historical review and spirited energetical defense of the gap theory, see Arthur Custance, *Without Form and Void* (99 Down Ave., No.609, Stoney Creek, Ontario: Dorway Press, 1970). The gap theory asserted that a geological age existed between the first two verses of *Genesis One*. Although this had been suggested by certain ancient writers, it was reintroduced in 1814 by the Scottish theologian Thomas Chalmers in order to deal with the geological-ages concept, a concept made especially popular by M.A. Pember's *Earth's Earliest Ages* (1885), as well as some Plymouth Brethren writers. Most geologists of note (with exception of Edward Hitchcock) have never accepted the gap theory, because it would require them to also accept a world-wide cataclysm terminating the geological ages.

2) The day-age theory tried to find a concordance between the creative acts of the six-days of creation and the succession of life-forms in the geological ages. It was advocated by the so-called "progressive creationists" as well as many Christian geologists. See Henry M. Morris, *A History of Modern Creationism* (San Diego, CA: Master Book Publishers, 1984) p. 41.

3) For example, see the references cited in Randy L. Wysong, *Creation-The Evolution Controversy* (Midland, MI: Inquiry Press, 1976) Ch. 10; Elizabeth K. Ralph, "Carbon-14 Dating" Henry M. Michael and Elizabeth K. Ralph ed., in *Dating Techniques for the Archaeologists* (Cambridge, MA: MIT Press, 1971). For more recent and comprehensive references, see M.J. Aitkens, *Science-Based Dating in Archaeology* (Longman House, 1990) and references in it.

Christian life marked by several biblical virtues. Fundamentalism, originated in America in 1920, is a part of evangelicalism, and emphasizes a Christian duty to combat uncompromisingly "modernist" theology and certain secularizing cultural trends. Organized militancy is one of the major features that distinguish fundamentalists from other evangelicals. Both evangelicalism and fundamentalism are complex coalitions, sometimes reflecting the convergence of a number of traditions but sometimes showing a sharp contrast in the interpretations of the Bible and modern science. The contrasting attitude toward C-14 dates is one of the classic examples showing the disagreement of fundamentalists with evangelicals.⁴⁾

Although the Adventists regard themselves as evangelicals, some hesitate to include them in evangelical Christianity because of its strong commitment to the writings of Ellen G. White. But during the twentieth century the Adventists played a very important role in influencing the evangelical Christian responses to the idea of a young earth in the formulation of the so-called "scientific creationism" in the United States. Therefore, in order to understand the relationship between Christianity and C-14 dating, we have to include the SDA in our discussion.

I. The Background of Radiocarbon Dating Method

An investigation of the earth's age and the dating of various geological events is essential in any study of the physical history of the earth. The discovery of the radioactivity of uranium in 1896 by Henri Becquerel, a French physicist, had far-reaching consequences, one of them being the development of radiometric dating several decades later. In 1907, based on the Rutherford-Soddy atomic transformation theory, B.B. Boltwood of Yale had done the first radioactive dating of ten minerals. But it was not until after 1920 that adequately refined methods of determining the uranium content and related chemicals of rocks were devised. After Boltwood, Robert J. Strutt, Arthur Holmes and J. Joly significantly contributed to the early development of radioactive dating method.⁵⁾

4) George M. Marsden, "Evangelical and Fundamental Christianity", in Mircea Eliade, ed., *The Encyclopedia of Religion*, 5 Vols. (New York : MacMillan Publishing Company, 1987), pp.190-197.

5) An excellent review of the origin and early development of radioactive dating technique was done in Lawrence Badash, "Rutherford, Boltwood, and the Age of the Earth : The Origin of Radioactive Dating Techniques", *Proceedings of the American Philosophical Society* 112(3) (June 1968), 157-169. For a brief history of radioactive dating, see Claude C. Albritton, Jr., "The Radiometric Dating", *The Abyss of Time* (Jeremy P. Tarcher, 1980), Ch.16; Gunter Faure, *Principles of Isotope Geology* (John Wiley and Sons, 1986), pp.2-5.

Radioactive dating method provided more quantitative data, higher controllability of dating process and possibility of world-wide sampling for measurements than any other method. Among several radioactive datings, C-14 method occupied a special position in archaeology, ancient history as well as geology, because it could give an absolute age of those carbonaceous archaeological findings that were not older than the half-life of C-14.⁶⁾ Glyn Daniel, a retired archaeologist at Cambridge, has insisted that the C-14 dating method represents the great revolution in the 20th-century studies of prehistory.⁷⁾

This development drew special attention from Christian scholars because of its effect on biblical interpretation. C-14 dating received special attention of those evangelical Christians who emphasized the authority and reliability of the Bible, because it could date the age of organic remains of ancient plants, animals and men in relation to the biblical chronology. Thus C-14 dating method is important in the study of the Old Testament since it professes to supply absolute dates for events within the past forty thousand years, which covers the apparent periods of the Old Testament history.⁸⁾ To fundamentalists who believe in the plenary inspiration of the Bible, confirming the reliability of the literal chronology of the Bible has two implications connected to the apologetics of the Christian faith: One is to confirm the divine authority of the Bible and the other is to debunk the theory of evolution and its anti-Christian overtones.⁹⁾

C-14 dating technique was invented by Willard F. Libby of the University of Chicago. In 1946 Libby first published the basic concepts of C-14 dating in the *Physical Review*.¹⁰⁾ In this paper Libby noted that if the half-life of C-14 was much greater than 1,000 years, then the processes of its production and decay are in equilibrium in living organisms. He predicted that there would be detectable differences in the C-14 radioactivity between biological and fossil carbon. In 1947 Libby and his student Ernest C. Anderson performed a critical experiment to verify their predictions for two samples: One sample, from a sewage disposal plant in Baltimore, contained biological methane (including biological carbon); the other sample, from a Sun Oil

6) For the history of C-14 dating, besides Libby's several original papers, see Royal E. Taylor, *Radiocarbon Dating: An Archaeological Perspective* (Orlando, FL: Academic Press, 1987), Ch.6: "Genesis and Prehistory: Conflicting Chronologies", *Spectrum* 7 (3/4) (1974), 32-35.

7) Glyn Daniel, "Editorial", *Antiquity* 33 (1959), 79-80; *The Origins and Growth of Archaeology* (New York: Crowell, 1967), p.266.

8) John C. Whitcomb and Henry M. Morris, *The Genesis Flood* (Phillipsburg, NJ: Presbyterian and Reformed Publishing Co., 1961), p.370.

9) Henry M. Morris, *That You Might Believe* (Chicago, IL: Good Books Inc., 1946), pp.80-82.

10) Willard F. Libby, "Atmospheric Helium Three and Radio Carbon from Cosmic Radiation", *Physical Review* 69 (1946), 671-672.

Company refinery, contained petroleum methane (including fossil carbon).¹¹⁾ This experiment affirmed that there were two different levels of radioactivity between the samples and led Libby to announce that C-14 might be used to determine the ages of various carbonaceous materials in the range of 1,000-40,000 years.¹²⁾

According to Libby, C-14 is formed in the upper atmosphere when high energy cosmic rays react with nitrogen in the atmosphere. This C-14 combines with oxygen to form radioactive carbon dioxide, which is then incorporated by plants and animals through the carbon exchange cycle. At the instance of death, C-14 is no longer assimilated into living tissues, and the fraction of the C-14 present at death continues to decay into nonradioactive materials in exponential rate. Since the present level of C-14 in a living organism is known and the half-life for C-14 is known to be about 5568 years,¹³⁾ the age (T) of an organic sample can be determined by measuring the intensity (I) of C-14 radioactivity in the death organism :

$$I = 15.3 \exp(-0.693T/5568)^{14)}$$

This method provided an absolute age of antique artifacts and opened new horizons in such fields as geology and archaeology. In 1960 Libby received the Nobel Prize in chemistry for his work on radiocarbon dating method.

II. Evangelical Christians and Radioactive Dating Before 1950

Since the principles of C-14 dating are similar to other radioactive dating techniques, the Christian response to other radioactive methods preceding C-14 method should be studied first in order to understand response to C-14 dating. Before the advent of the C-14 dating method in late 1940s, several Christian scholars had already been critical of accepting radioactivity as the real index of the age of the earth.

One of the earliest critiques came from Byron C. Nelson, a fundamentalist Lutheran pastor with an extensive geological field experience. He was a graduate of the University of Wisconsin (1917) and had studied genetics at Rutgers University. In *The Deluge Story in Stone* published in 1931, Nelson said that nobody knew that all the lead in any piece of rock was originally uranium and the rate of change from uranium into

11) Ernest C. Anderson, Willard F. Libby, S. Weinhouse, A.F. Reid, A.D. Kirshenbaum and A. V. Grosse, "Natural Radiocarbon from Cosmic Radiation", *Physical Review* 72(1947), 931-936.

12) The development of C-14 dating techniques since 1930 was reviewed in Royal E. Taylor, "Radiocarbon Dating in Historical Perspective", *Radiocarbon Dating*, Ch. 6.

13) Half-life of radiocarbon was an estimate. 5568 years has been commonly preferred as an averaged value, while more precise values might be 5730 or 5760 years.

14) The process of C-14 dating has been described in W.F. Libby, *Radiocarbon Dating* (Chicago : University of Chicago Press, 1965) Chs. 1-4.

lead has always been the same.¹⁵ This criticism was also raised in 1938 by Theodore L. Handrich who was trained for the teaching profession at Concordia Teachers College. He repudiated the argument that when lead was present with other radioactive materials, it was formed through decay of the radioactive materials and the decay rate was always the same.¹⁶ He suggested an alternative theory that "in the case of the radioactive materials God either created or brought about later by direct intervention assemblages of materials."¹⁷ Both Nelson and Handrich were conservative Lutherans who followed the teachings of Martin Luther, who firmly believed that the biblical creation was perfected in six ordinary days.¹⁸

Besides these uncertainties in decay rate and initial condition, Dudley J. Whitney, a member of charismatic Community Church with a B.S. in agricultural chemistry from University of California (Berkeley), pointed out the uncertain features of the chronology of the plutonic actions, the tangled relationship between radioactive dating and the established geologic time table and the contradiction of radioactive dates with results from other dating methods.¹⁹ He argued for a literal interpretation of Genesis and believed that science affirmed the young earth.²⁰

In 1946, Henry M. Morris, a young civil engineer and later the most prolific writer of strict creationism, criticized radioactive dating methods because of its evolutionary implications: "the [radioactive] methods used by geologists to determine the age of the earth are so extremely questionable as to discourage definitely much faith in any of their estimates The only method that has been satisfactory to the evolutionists is the radio-active method"²¹ Although Morris grew up in the fundamental Southern Baptist Church which firmly believed in literal interpretation of the Bible, he did not himself believe in a six-day creation until mid-1940s. But it was a paper by Clifford L. Burdick, an Adventist and a disciple of G.M. Price and Pricean flood geologist, that convinced Morris that he "no longer had to dabble with the gap theory or some other means of allowing a great age for the earth." His first book, *That You*

15) Byron C. Nelson, *The Deluge Story in Stone* (Minneapolis, MN: Bethany Fellowship, 1968) (1st printing 1931). pp.151-152. For Nelson's brief biography, see the back cover of his book *After Its Kind*.

16) Theodore L. Handrich, *Every-Day Science for the Christian* (St. Louis, MO: Concordia, 1938). pp.65-69. He also discussed the young earth in detail in a later book: *The Creation: Facts, Theories and Faith* (Chicago: Moody Press, 1953). Ch.6.

17) Handrich. *Every-Day Science for the Christian*, p.255.

18) Morris, *A History of Modern Creationism*, p.84.

19) Dudley J. Whitney, "The Age of the Earth", *The Bulletin of Deluge Geology and Related Science* 1(5) (December 1941), 129.

20) For his position in regard to this matter, see D.J. Whitney, *Genesis versus Evolution: The Problem of Creation and Atheistic Science* (New York: Exposition Press, 1961).

21) Morris, *That You Might Believe*, pp.80-82.

Might Believe, which "allowed the possibility of antiquity of the earth," was at the presses by then, so he could not change it. But none of his later writings included the "un-Biblical possibility."²²⁾

In the SDA, George McCready Price, the inventor of modern flood geology, viciously attacked the radioactive dating. He unequivocally rejected radioactive methods, saying that it is "full of fallacies, of slipshod methods, and of sheer charlatantry."²³⁾ Price confessed in his brief autobiography that from childhood he had always believed in the Noah's Flood as an "actual historical event in the early history of the world," and that he was already familiar with that "very interesting and remarkable book, *Patriarchs and Prophets* (by Ellen G. White, 1890)." He had convinced himself that Ellen G. White's book taught that the Great Flood was the cause of the major geological changes.²⁴⁾ Interestingly, however, Price at times accepted the great age of the earth's core and the universe, while still believing in a literal six-day creation and the fossil formation after the fall and curse.

Other Adventist scholars were also critical of radioactive dating methods. Burdick pointed out that contamination of dating samples was possible and said that "no such uncontaminated radioactive ore has ever been found." Therefore no radioactive calculation can be accurate. Almost as serious an obstacle to the radioactive time-system is the marked chemical instability of all radioactive ores."²⁵⁾ Lloyd E. Downs, an Adventist biology professor at La Sierra College, also claimed that the uranium-lead dating method was based on an "unproved" and "unprovable" assumption.²⁶⁾ Quoting Jeffreys,²⁷⁾ he argued that "if the rocks on their formation already contained lead, then the time would be shortened. there are certain discrepancies and difficulties encountered in the application of the [radioactive] method" Burdick and Downs were also among the orthodox Adventists who held on to the idea of a young earth, because "their main teacher/founder, Ellen G. White, taught literal creationism." As J. Laurence Kulp, a Wheaton College graduate and an evangelical geochemist, pointed out, "The primary proponents of flood geology have been of 7th Day Adventist persuasion and have assumed from their theological tenets that a

22) Morris, *A History of Modern Creationism*, p. 83.

23) George M. Price, *Genesis Vindicate* (Takoma Park, Washington, D.C. : Review and Herald Publishing Association, 1942), p. 312.

24) G. M. Price, "Some Early Experiences with Evolutionary Geology", *The Bulletin of Deluge Geology and Related Science* 1(4) (November 1941), 80.

25) Clifford L. Burdick, "The Radioactive Time Theory and Recent Trends in Methods of Reckoning Geologic Time", *The Forum* 1(1946/47), 57-58.

26) Lloyd E. Downs, *Evolution or Creation* (Published by the author, 1945) pp. 59-60.

27) Harold Jeffreys, "The Origin of the Solar System", *International Constitution of the Earth* (New York : McGraw-Hill Book Company, 1939), pp. 14-15.

6,000-10,000 year span is required for all life."²⁸⁾

Although most Adventists did not welcome radioactive dating, some showed a cautious but favorable attitude toward it. In 1937 a number of Adventist science teachers held a meeting and decided to accept the concept of the earth's antiquity.²⁹⁾ But this was not widely known. Probably, Molleurus Couperus, a medical doctor and the Executive Secretary of the Society for the Study of Natural Science, a successor of the so-called Creation-Deluge Society, was the first Adventist scholar openly to publish his support of radioactive dating. Although radioactive dating did not provide an absolutely reliable age of the earth, he did believe that the evidence accumulated so far suggested that "the earth [was] quite old, probably older than two billion years."³⁰⁾ Some ASA members cautiously suggested that the underlying assumptions of radioactive dating were valid. Edwin K. Gedney, an ASA member and geology professor at Gordon College, admitted that radioactive dating results were "the right order of magnitude although still not absolutely accurate, and are capable of giving an acceptable series of determinations of the age of the various geological formation."³¹⁾

But it was a 1948 symposium that triggered a hot debate among ASA members on the validity of the assumptions behind radioactive dating. Walter E. Lammerts, a Ph. D. in genetics from University of California (Berkeley) and later a key figure in the formation of the CRS criticized radioactive dating, arguing that "the time of disintegration of each [radioactive] constituent atom is unpredictable." Opposing Lammerts, however, Roland N. Icke and F. Alton Everest maintained constancy of radioactive disintegration with time in this symposium.³²⁾ Kulp, a young geochronologist and editor of the proceedings, played the most prominent role to quell those voices that opposed radioactive dating and encouraged acceptance of the radioactive dates in the ASA. Kulp refuted Lammerts' argument that radioactive analyses were inconsistent, remarking that "Age determination has passed through this stage of 'growing pains' and more recent results are much more consistent."³³⁾ Kulp could not

28) J. Laurence Kulp, "Deluge Geology", *Journal of American Scientific Affiliation* 2(1) (January 1950), 2.

29) Morris, *A History of Modern Creationism*, p.124.

30) Molleurus Couperus, "Some Remarks Regarding the Radioactive Time Estimation of the Age of the Earth", *The Forum* 2(1947/48), 118-119.

31) Edwin K. Gedney, "Geology and the Bible", in *Modern Science and Christian Faith: A Symposium on the Relationship of the Bible to Modern Science* (Wheaton, IL: Van Kampen Press, 1948, 1950), p. 27. Similar opinion was presented by William A. Smalley and Marie Fetzer, "A Christian View of Anthropology", *ibid*, pp.172-174.

32) W.E. Lammerts, "Critique of Radioactivity Estimates of Age of the Earth", in J.L. Kulp, ed., *A Symposium on the Age of the Earth* (1948), Ch.6; Roland N. Icke, "Helium and Lead Methods of Dating", *ibid*, Ch.3; F. Alton Everest, "Pleochroic Halos", *ibid*, Ch.4.

33) W.E. Lammerts, *A Symposium on the Age of the Earth*, Ch.6; J.L. Kulp, "Present Status of Age

see any reason to refute the radioactive dates as long as the gap and/or day-age theory were available for the interpretation of Genesis.

Peter W. Stoner, a mathematics professor at Pasadena City College and one of the founders of the ASA, also recognized radioactive dating as a consistent and reliable technique, "giving us the ages of many geological formations in the earth's historical sequence."³⁴⁾ Believing that modern scientific discoveries confirmed the Bible, he demonstrated how evidence of an old earth corresponded to the day-age theory.³⁵⁾

The controversial atmosphere of the ASA at that time was vividly described in a discussion session of Edwin Y. Monsma's paper published in the *Journal of American Scientific Affiliation (JASA)* in 1949.³⁶⁾ Monsma, a biology professor at Calvin College, hesitated to accept the antiquity of the earth. In this discussion, however, Kulp gave a long impressive talk in an effort to prove the validity of the radioactive datings. He believed that the earth was close to two billion years old. And Joseph S. Maxwell, a physician, questioned the validity of assumptions associated with the disintegration of uranium. But Kulp insisted confidently that he would demonstrate the age of the earth with "as much validity as we can demonstrate many of the laws such as conservation of momentum that we meet with as physicists." To Paul Bender who suggested the possibility of fossilization by a catastrophic event like Noah's Flood, Kulp replied citing real examples showing ongoing fossil formation. Kulp's authority as an expert of geochronologist finally led Allen A. MacRae, a biblical archaeologist of Faith Theological Seminary, to suggest :

Now, Dr. Kulp is the man, and I think a very bright man, and he has been working in that field for a comparatively short period of time as yet, and naturally we are all tremendously interested in what he has found, but I think we will have to reserve judgement on what appears even quite obvious until he has worked on it and until many more have worked on it. There are certain points that appear to be practical and answerable at present. I don't think that any one of us should take his word for it. We need to go further in that ourselves, and he also needs to work on it. I think if we find that the evidence is just about absolutely definite on these points, I think there is a way of interpreting the Scriptural evidence in such a way that these matters can be worked out.³⁷⁾

Determination in Geology", *ibid*, Ch.8.

34) Peter W. Stoner, "General Discussion on Latest Results in Geological Dating", *ibid*, Ch.7.

35) P.W. Stoner, *From Science to Souls* (Chicago : Moody Press, 1944). This book was published in a later edition (1952) under the title *Science Speaks: Scientific Proof of the Accuracy of Prophecy and the Bible*, in which he advocated the day-age theory. The fourth revised edition of 1976 listed Robert C. Newman, a Ph.D. in astrophysics from Cornell University and M.Div. of Faith Theological Seminary, as a coauthor.

36) E. Y. Monsma, "Some Presuppositions in Evolutionary Thinking", *JASA* 1(3) (June 1949), 15-30.

37) Discussion of the paper of E. Y. Monsma, *JASA* 1(3), 20-29.

III. Christian Responses to C-14 Dating

In his book *The New Geology* of 1923 and other publications, Price framed the so-called “flood geology” which greatly influenced fundamentalist evangelicals as well as the Adventist scholars. Since the late 1930s, Price’s disciples in both evangelical and Adventist circles actively sought to establish organizations committed to strict creationism. While they faithfully followed Price’s flood geology, some of them, however, modified his arguments concerning the age of the earth and life on earth.

H.M. Morris and J.C. Whitcomb, supporters of Pricean flood geology, published *The Genesis Flood* in 1961, which was most influential in reviving flood geology and the idea of a young earth and life in evangelical Christianity. The great flood and the age of the earth and life was coupled with C-14 dates and produced hot debates between fundamentalists and liberal evangelicals. Here, I will trace first the response of the SDA to C-14 dating, and evangelical Christian circles.

1. Seventh-day Adventists

Seventh-day Adventists’ opinions on C-14 dating and the age of the earth had been diversified with time. Most of the orthodox SDAs accepted the Pricean flood geology and criticized C-14 dating. One of the first Adventist critics on C-14 dates was Robert W. Woods, a college physics teacher, who criticized not the technical process of C-14 activity measurement but assumptions by which the dating results were interpreted.³⁸⁾ He conceded that C-14 dating was accurate up to 4,500 years, but dating beyond this extension into the past was extrapolation beyond the accuracy controls of the method. Thus he said that the method was good as far back as shortly after the Flood which seems to be the practical limit of historical dating.

To Woods, although the assumptions of C-14 dating were accepted, C-14 method was capable of measuring some 20,000 years into the past. However, this was the case only if certain conditions were met. First, the rate of the formation and decay of C-14 has always been the same. Woods admitted that no method had been found to accelerate or retard the radioactive decay of an atom : It seemed unaffected by temperature, pressure, chemical reaction, or any natural influence. The constancy of decay was probably accurate. However, the assumption that the rate of formation of C-14 has been the same for long ages past, was to Woods not certain. Such an assumption presumes that : (1) The rate of cosmic-ray activity has always been the same as present; (2) The magnetic field of the earth has always been the same as it is now; (3) The nature of the upper atmosphere has always been the same as now.

38) Robert W. Woods, “How Old Is The Earth?”, *Signs of the Times* (April 7, 1953), 8-9, 15.

Woods believed that a large part of cosmic-ray activity was interstellar and extragalactic in origin. While the origin of the cosmic-ray did not preclude the possibility of variation in the cosmic-ray activity, he thought, regularities we observed in cosmic phenomena were so arresting that one would hesitate to assume any condition other than equilibrium and continuity. However, the magnetic field of the earth, he pointed out, was subject to diurnal and long term variations. To Woods, the possibility remained that the magnetic field of the earth had not always had its present value. When we examined the third assumption we must pause to see the principal argument of flood geologists.³⁹

Flood geologists tend to believe that, at creation, there were waters above the expanse as well as beneath. The water vapor above the expanse would have acted as a shield, absorbing much of the cosmic radiation and reducing its intensity. This shielding effect could have materially reduced the rate of C-14 formation. Furthermore, a large fraction of the C-14 formed could have remained as carbon dioxide in the water vapor. With the advent of the flood, this dissolved C-14 in the vapor would have precipitated onto the earth's surface, with the winds and ocean currents stirring and thereby distributing the C-14 uniformly over the earth. These possibilities as well as the uncertainties of the method made C-14 dating unacceptable to the believer in the flood.

Another figure was Lester E. Harris, an Adventist biologist. Not a major figure in the creationism, he did demonstrate the possibility of contamination in C-14 dating samples.⁴⁰ In addition to the criticisms raised by Woods, he argued, with the level of C-14 and the constant influx of cosmic radiation in the atmosphere, that it would be virtually impossible to know whether the C-14 sample was free of foreign carbon-containing material.

One of the most interesting and controversial defenses of a young earth was raised by Robert V. Gentry, an Adventist geophysics professor at Columbia Union College, who published several scientific articles in authoritative journals on pleochroic halo and its implications.⁴¹ Pleochroic halos were produced in minerals such as mica by the

39) The preliminary idea of the flood geology was proposed by G.M. Price in his pamphlet, *Illogical Geology* (1906). But it was only intended to be circulated privately for examination and criticism of his idea. Encouraged by numerous replies, Price wrote a more comprehensive book, *The Fundamentals of Geology* (Mountain View, CA : Pacific Press Publishing Association, 1913). But it was not until 1923 that he published the most comprehensive book on flood geology : *The New Geology* (Mountain View, CA : Pacific Press, 1923).

40) Lester Harris, *In the Beginning* (Nashville, TN : Southern Publishing Association, 1964), pp. 6-7.

41) Robert V. Gentry, "The Antiquity of Life and Carbon-14", *The Youth Instructor* 114 (October 22, 1968), 9-11, 20; "Extinct Radioactivity and the Discovery of the New Pleochroic Halo", *Nature*

bombardment of alpha particles from radioactive nuclei enclosed in the mineral. Gentry argued that these halos indicated that some of the Precambrian rocks were created suddenly and recently. He related the radiohalo evidence to prove the youth of the earth, Noah's flood, and the uncertainty of C-14 dating.⁴²⁾ His pleochroic halo argument was widely cited by flood geologists in the evangelical circles. Ironically, many Adventist scholars gave little credence to Gentry's findings, some even opposing them.⁴³⁾

In the late 1960s, the orthodox Adventists relaxed their attitude toward the C-14 method. Even Price, a major critic of C-14 dating, admitted the validity of C-14 dates for the post-diluvian period,⁴⁴⁾ assuming that the C-14 method might be reasonably accurate up to the flood. Yet he continued to believe that the environment of the pre-flood era was totally different from the present one and argued that the present conditions of cosmic radiation from outer space did not prevail before the flood. Although he sometimes accepted the antiquity of the earth by subscribing to the gap theory,⁴⁵⁾ on the whole, he never went against his teacher White for his long life.

Although the majority of orthodox Adventists even in the 1980s still accepted the critique of Woods on C-14 dating,⁴⁶⁾ there appeared some scholars who were much bolder than their predecessors in accepting the C-14 method. The apparent consistency of results achieved by many different, often independent, dating methods was recognized as a serious problem by Adventist scholars. It was noticeable that most of them were trained as professional geologists or geochemists.

From the late 1950s onward, some scholars in the Geoscience Research Institute (GRI), an affiliate of Andrews University and Loma Linda University, objected to a rigid young earth interpretation and accepted the C-14 dating. The GRI was founded in 1958 to meet the realistic needs of the SDA church: to defend their doctrines in regard to natural science and to meet the demands of Adventist science teachers for qualified earth scientists in the church. Within a year, the church selected Frank Lewis Marsh, a student of Price and a Ph.D. in biology from University of Nebraska,

213(1967), 83-85; "Radiohalos in a Radiochronological and Cosmological Perspective" *Science* 184 (1974), 62-66.

42) Gentry, "The Antiquity of Life and Carbon-14"; Harold W. Clark, *The Battle over Genesis* (Washington, D.C.: Review and Herald Publishing Association, 1977), pp.130-140.

43) Robert H. Brown, "A Critique. Criticism of Points Raised in ... Five Minutes with the Bible and Science", Supplement of the *Bible-Science Newsletter* (October 1975) (Mimeographed). It was cited by M. Couperus, "Tension between Religion and Science", *Spectrum* 10(4) (1980), 82.

44) G.M. Price, *The Time of the End* (Nashville, TN: Southern Publishing Associations, 1967), p.114.

45) G.M. Price, "In The Beginning", *The Forum* 1(1946), 9-10.

46) E.g., Ross O. Barnes, "Time and Earth's History", *Spectrum* 3(1) (1971), 43.

and P. Edgar Hare, a chemist, and in 1961 added Richard M. Ritland, a comparative anatomist. In spite of their age differences the three men worked together in a reasonable harmony. But the harmony was broken next year because, while Marsh believed in the young earth and the global flood, Hare and Ritland insisted the old earth and the local effect of the Noah's flood. Marsh could not understand why both men supported radioactive dating methods that placed "Creation Week hundreds of millions of years ago" in direct contradiction to the Bible and White.⁴⁷⁾

In 1962, in an unpublished paper, "Problems and Methods in Earth History," Ritland pointed out that multiple catastrophes, not just Noah's flood, had structured the surface of the earth.⁴⁸⁾ Hare's argument came from his research on amino-acid datings in marine shells, which were based on changes in proteins. Hare claimed that life had been on earth for much longer than a few thousands years. Hare originally developed the amino-acid dating method to undermine the credibility of C-14 dating, but to his surprise the results he achieved were consistent with C-14 dates.⁴⁹⁾ He confessed frankly to church leaders :

I am beginning to wonder if our whole approach to this problem is in error. We have been taught for years that almost everything in the geologic record is the result of the flood. I've seen enough in the field to realize that quite substantial portions of the geologic record are not the direct result of the flood. We also have been led to believe by men like Marsh and Burdick that the evidence for the extreme age of the earth is extremely tenuous and really not worthy of any credence at all. I have tried to make a rather careful study of this evidence over the past several years, and I feel the evidence is not ambiguous but that it is just as clear as is the evidence that the earth is round.⁵⁰⁾

But the struggle of Hare and Ritland for "liberalizing" the GRI came to an end when they left the institute.

The GRI's view on C-14 dating after 1970s was represented by its new director, physicist Robert H. Brown. He ardently believed that life on earth was not older than 10,000 years and "originated within six consecutive rotations of the planet," and that the earth "experienced a universal destruction as portrayed in Genesis 6-8." But because C-14 dates on the age of life on earth contradicted the "testimony given by Moses and Ellen G. White," he refuted C-14 dates as incorrect. Interestingly, though,

47) Ronald L. Numbers, *The Creationists: The Evolution of Scientific Creationism* (New York : Alfred A. Knopf, 1992), Ch. 14.

48) R.M. Ritland, "Problems and Methods in Earth History", unpublished manuscript cited in Numbers, *The Creationists*, Ch. 14.

49) P.E. Hare, "Amino Acid Dating—A History and Evaluation", *Masca Newsletter* (University of Pennsylvania) 10(1) (1974), 4-7.

50) Numbers, *The Creationists*, Ch. 14.

he accepted other radioactive dates showing the antiquity of the earth.⁵¹⁾ Later Brown's attitude toward C-14 dating became flexible. From late 1970s, he proposed a new interpretation of C-14 dates rather than a total rejection of them. According to his recent papers, C-14 dates could agree with historical dates if some of the environmental factors of the antediluvian world were taken into account: the variation of cosmic ray intensity, geomagnetic field strength, water vapor concentration and C-14 dilution by the biosphere carbon. He admitted that if the premise and method of C-14 dating were sound, C-14 dates were acceptable up to about 2,000 B.C. At the same time he postulated that more carbon dioxide was present in the atmosphere prior to the flood, and that the prediluvian biosphere contained eight times as much non-radioactive carbon and 1/100 to 1/1,000 of the present value of C-14.⁵²⁾ Later, Brown's view of the age of the earth changed. He openly accepted the old earth but young life. And he concentrated on a compromise between biblical chronology and C-14 dating, trying to extend the biblical time-scale and correct C-14 dating.⁵³⁾

There were similar attempts in the early 1960s by Henry F. Pearl. He tried to reduce both the age of the Bristlecone pine and C-14 dates to adjust the biblical chronology. Although Pearl and Brown gave comprehensive arguments, neither gave enough scientific evidence to support their arguments, nor did they explain the dates obtained by other dating methods.⁵⁴⁾ Brown's compromising approach to radioactive dating has appeared in several issues of *Origins*, a GRI journal founded by Brown and edited by Roth.⁵⁵⁾ By accepting the antiquity of the earth, Brown clarified what White had kept silent, as Price did. He was still within orthodox SDA's line.⁵⁶⁾

51) For a brief summary of Brown's view by the late 1960s, see his two chapters, "Radioactive Time Clocks" and "Radiocarbon Dating", Harold G. Coffin, *Creation—Accident or Design?* (Washington, D.C.: Review and Herald Publishing Association, 1969), pp.273-316. Also see Numbers, *The Creationists*, Ch. 14. By the mid-1970s, Brown was still quite critical of C-14 dates: See R.H. Brown, "C-14 Age Profiles for Ancient Sediments and Peat Bogs", *Origins* 2(1) (1975), 6-18; *Origins* 6(1) (1979) 30-44; *Origins* 10(2) (1983), 93-95.

52) R.H. Brown, "Radiocarbon Dating", pp.299-316.

53) R.H. Brown, "C-14 Age Profiles". Brown's sympathetic review of R.E. Taylor's *Radiocarbon Dating: An Archaeological Perspective* in *Origins* 14(1) (1987), 29-30. And in a recent article Brown tried to correlate C-14 age with the biblical time scale: *Origins* 17(2) (1990), 56-65.

54) For the position of Pearl, see Henry F. Pearl, "Letter To Hackett", (March 11, 1976). Originally Pearl presented this view in his master thesis in 1963(?). For an assessment of the Brown's argument, see Ross O. Barnes, "Time—and Earth's History", *Spectrum* 3(1) (1971), 29-47.

55) To see the changing attitude of Brown to C-14 dating, see R.H. Brown, "The Interpretation of C-14 Dates", *Origins* 6(1) (1979), 30-44; "Implications of C-14 Ages vs Depth Profile Characteristics", *Origins* 15(1) (1988), 19-29; "Correlation of C-14 Age with the Biblical Time Scale," *Origins* 17(2) (1990), 56-65.

56) Brown's position was discussed well in M. Couperus, *Spectrum* 10(4), 82-83.

Under the leadership of Brown and his successor, Roth, the GRI held fast to flood geology and criticized C-14 dating. Those who did not accept the great flood could not find themselves a footing in the GRI and had to leave the institute. Today, with a few exceptions, the SDA holds fast to flood geology and literal interpretations of Genesis days.⁵⁷⁾

The strongest professional defense of the C-14 method by an Adventist scholar was offered by R. Ervin Taylor, director of a radiocarbon dating laboratory at the University of California at Riverside.⁵⁸⁾ After reviewing various dating experiments, he suggested that C-14 dating was reliable. He emphasized that the C-14 dates were supported and confirmed by many other methods such as obsidian hydration, thermoluminescence, archaeomagnetic data, the potassium-argon method, fission track dating, dendrochronology, varve dating, fluorine diffusion and archaeological sequences.⁵⁹⁾ Based on C-14 dating, Taylor tried to reinterpret the biblical chronology.⁶⁰⁾ Besides, even Ross Barnes admitted that the literal interpretations of Genesis are incompatible with scientific dates.⁶¹⁾ Couperus said that Christian faith "should not be affected by views on the age of our planet, be it young or old."⁶²⁾ Lawrence T. Geraty held the same line as Taylor and Couperus.⁶³⁾ But most of those who accepted C-14 dates and the antiquity of the earth did not represent the Adventist camp still advocating the literal interpretation of the Bible.

2. American Scientific Affiliation

The American Scientific Affiliation was formed in 1941 to serve as the principal forum of evangelical Christianity "To promote and encourage the study of the

57) For inner political dynamics of the Adventist church and the GRI, see Numbers, *The Creationists*, Ch. 14.

58) R. E. Taylor, "Genesis and Prehistory", (op. cit., n. 6), 33-34.

59) R. E. Taylor, "Concordances between Radiocarbon and Racemization-based Dating of Bone", Carnegie Institution of Washington Conference: Advances in the Biochemistry of Amino Acids, Warren, Virginia, October 29 - November 1, 1978. It was cited by M. Couperus, "Tensions between Religion and Science", *Spectrum* 10(4) (1980), 84. Taylor recently published a comprehensive review on the C-14 dating: *Radiocarbon Dating: Archaeological Perspective* (Orlando, FL: Academic Press, 1987).

60) Taylor, "Genesis and Prehistory".

61) R. O. Barnes, "Time-and Earth's History", *Spectrum* 3(Winter, 1971), 43-44.

62) M. Couperus, "Earth's History", *Spectrum* 3(Winter, 1971), 5; "Tensions between Religion and Science", *Spectrum* 10(4) (1980), 81-84.

63) Lawrence T. Geraty, "The Genesis Genealogies as an Index of Time", *Spectrum* 6(1/2) (1974), 5-18. See Couperus, "Tensions between Religion and Science", 80.

relationship between the facts of science and the Holy Scriptures."⁶⁴ The ASA influenced other evangelical institutions such as Wheaton College,⁶⁵ the Inter-Varsity Christian Fellowship (IVCF),⁶⁶ the Evangelical Theological Society (ETS)⁶⁷ and the Moody Institute of Science affiliated with the Moody Bible Institute.⁶⁸ The ETS which had been organized in 1949 shared many mutual interests with the ASA, because "the theologian needs the guidance of the scientist, even as the scientist of evangelical persuasion needs the input of the theologian."⁶⁹ Both the ASA and the ETS have held at least six conferences together. The IVCF also held a joint conference with the ASA in 1965 and shared members with the ASA. The Moody Bible Institute contributed to the birth of the ASA. The ASA was born from a meeting of "orthodox" scientists hosted by Irwin A. Moon, then an associate president of the Moody Bible Institute. In 1947, F. Alton Everest (b.1909), the first president of the ASA, joined Moon in founding the Moody Institute of Science, and then became assistant director of the institute. He remained affiliated with the institute until 1970. Besides the above-mentioned organizations, the ASA contributed to founding or development of other Christian organizations in other fields of study.⁷⁰

64) See the first constitution of the ASA (May 1942), cited in F. Alton Everest, *The American Scientific Affiliation: Its Growth and Early Development* (1986), p.118.

65) Wheaton College has been the strongest supporting institution of the ASA since its very inception. As shown in "The American Scientific Affiliation Membership List-August, 1946", several faculty members of the college such as the biologist Russell L. Mixter, the geologist Cordelia Erdmann, the chemists Marion David Barnes and Roger J. Voskuyl, the archaeologist George R. Horner, participated in the ASA.

66) For the relationship between the ASA and the IVCF, see C. Stacey Woods, "Inter-Varsity Christian Fellowship and the Role of the American Scientific Affiliation", *JASA* 8(4) (December 1956), 11-14. The IVCF has held the same line with respect to science and Christianity as the ASA since the inception of the ASA. J.L. Kulp (b.1921), who played a decisive role in accepting contemporary geology in the ASA, had been once active in the IVCF, giving talks to college students on science and the Christianity. As a member of the ASA, Cordelia Erdman (b.1924), an IVCF activist, did the same at Wheaton College as Kulp did in the ASA. Currently Charles Hummel is active both in the ASA and the IVCF. The Research Scientists Christian Fellowship (RSCF), affiliated with the IVCF, shared members and theological views on origin theories with the ASA.

67) Burton L. Goddard, "The E.T.S., History and Purpose", *JASA* 7(3) (September, 1955), 5-8; "Biennial A.S.A.-E.T.S. Convention of 1957", *JASA* 9(4) (December 1957), 3.

68) For the relationship between the ASA and the Moody Institute of Science, see Morris, *A History of Modern Creationism*, pp.142-143. For example of specific interaction between them, the Moody Science films were to be "approved" by the ASA prior to release, and the ASA contributed not to release any "creationist film" through the MIS. The ASA also put pressure not to publish *The Genesis Flood* in the Moody Press.

69) Everest, *The American Scientific Affiliation*, p.148.

70) For example, Christian Association for Psychological Studies, Christian Legal Society, Chris-

Since the publication of its first dating in 1947, the C-14 method raised controversy in the ASA. The ASA had a mixed reaction to radioactive dating until the early 1950s when advocates of pro-radiometry began to dominate. As shown in the discussion of Monsma's above-mentioned paper, the responses of key members to geologic ages and the flood varied until 1949. Monsma himself accepted the flood and seemed "to deplore the acceptance by Christians of the ideas of geologic ages." Monsma said, "so temporarily, I think possibly it [a day in Genesis one] was at least very short periods of time." Paul Bender, a physics professor of Goshen College, seemed to have the same opinion. But Everest, Peter W. Stoner, a professor of mathematics and astronomy at Pasadena City College and a supporter of the day-age theory, Russell L. Mixter, a zoology professor of Wheaton College, Delbert Eggenberger, a research chemist of Armour and Company, Cordelia Erdman, a geology instructor of Wheaton College, and especially Kulp were quite hostile to recent creation and a cataclysmic deluge.⁷¹⁾

But this period of confusion did not last long. Right after the announcement of C-14 dating method by Libby, J.L. Kulp, a Princeton Ph.D. in chemistry and assistant professor of Columbia University, prepared a way for C-14 dating to be assimilated into the evangelical Christian circle. Studying at Libby's dating laboratory at the University of Chicago, he mastered the C-14 techniques. He returned to Columbia University to establish his own C-14 laboratory, and pioneered in the various applications of C-14 dating to geology. He eventually became one of the nation's top authorities in C-14 dating.⁷²⁾

Kulp played an important role in converting ASA members to C-14 dating. Although Kulp himself did not leave many writings about his role in the ASA, articles of that time undeniably revealed his influence.⁷³⁾ The first article was presented in the symposium proceeding of the *Age of the Earth*, which was edited by himself and was already mentioned before.⁷⁴⁾ In it Kulp added many brief editorial comments to all papers presented and finally his own paper showing the validity and limitation of the assumptions of radioactive datings. At the end of his paper, Kulp discussed the basic requirements, the effective range, and some applications of C-14 dating. Bearing in mind criticism of some conservative Christians on radioactive dating methods, he

tian Medical Society, Institute for Advanced Christian Studies and Institute for Christian Studies.
See Everest, *The American Scientific Affiliation*, p. 148.

71) Discussion of the paper of E. Y. Monsma, *JASA* 1(3), 20-26. For the hostility to recent creation and a cataclysmic deluge, see Morris, *A History of Modern Creationism*, p. 134.

72) For a brief biography of Kulp and his role in the ASA, see Numbers, *The Creationists*, Ch. 9.

73) See, e.g., the discussion session of E. Y. Monsma, "Some Presuppositions in Evolutionary Thinking", *JASA* 1(June, 1949), 15-30; J. L. Kulp, "Deluge Geology", *JASA* 2(1) (1950), 1-15.

74) American Scientific Affiliation, *A Symposium of "The Age of the Earth"*, ed. by J. L. Kulp (1948).

pointed out that “(a) The half-life will not be the limiting factor. . . . (b) [Enriching C-14] has been done successfully. (c) The matter of addition or subtraction must be considered with each find as a special case.”

Another article showing the transition of ASA members’ attitude toward radioactive dating and the flood geology was Kulp’s paper, “Deluge Geology” in *JASA* (1950). This paper was an open attack on the young earth and flood geology and its proponents, and played an important role in orienting the ASA toward accepting radioactive dates and refuting the flood geology. Discussing the basic errors of flood geologists, Kulp pointed out their ignorance of recent scientific discoveries associated with C-14 dating.⁷⁵⁾ Henry M. Morris wrote a rebuttal to it, trying to answer his various arguments, but the *JASA* editors did not publish it.⁷⁶⁾

What then made Kulp so important in the ASA? It was his professional background in geology, specifically geochemistry. As Kulp stated in Monsma’s article in 1949 in *JASA*, “Over the last fifty years there have been practically no Christians in the field of geology.” He was trained as a chemist before he felt that “the Lord wanted me to go into geology.” He said, “Most of us do not understand enough geology to appreciate the geologist’s method of securing geological data.”⁷⁷⁾ In his own article attacking the flood geology, Kulp pointed out that proponents of the flood geology lacked a formal education in geology.⁷⁸⁾ In the discussion of the Monsma’s article, Kulp used his geological knowledge to persuade other ASA members to accept C-14 dating. In contrast to confident Kulp, those who opposed him, not being professional geologists, had to be very careful in presenting their opinions in geological matters. For example, to a question raised by Erdman, Monsma said, “I would not dare to answer that question because I am not a geologist.” Bender also said, “I am not a geologist, but have been interested in geology for some time”⁷⁹⁾

Kulp’s paper, “Deluge Geology” became only the beginning of Kulp’s rebuttal of the flood geology and the idea of young earth coupled with the flood. In a paper presented at the Los Angeles Convention of the ASA, Kulp argued that “preliminary work indicates Neanderthal remains (the youngest stratigraphically of the prehistoric fossil men) are at least older than 25,000 years.” His argument on the human antiquity based on C-14 dating persuaded many in the ASA who had previously believed in a recent creation of man.

75) Kulp, *The Age of the Earth*, pp.1-15.

76) Morris, *History of Modern Creationism*, p.137.

77) E. Y. Monsma, *JASA* 1(3), 20-21.

78) Kulp, *The Age of the Earth*, pp.1-2; Bernard Ramm also pointed out the lack of geological training in flood geologists: B. Ramm, *The Christian View of Science and Scripture* (Grand Rapids, MI: Eerdmans Pub., 1954), p.126.

79) E. Y. Monsma, *JASA* 1(3), 24.

Kulp's role was also prominent in the Sixth Annual Convention at Shelton College in 1951. In a paper presented at the Convention, Roy M. Allen, a metallurgist, summarized the conditions that complicated the accuracy of radioactive dating, and then criticized the uncertainty of radioactive dates. But in the discussion session, Allen's paper was placed under the attack of Kulp. Kulp, after pointing out the lack of geological training of the author, spurned Allen's criticism one by one. In addition to his total commitment to contemporary geology, young Kulp's partisanship and power of persuasion contributed to convert the ASA to C-14 dating and the doctrine of the old earth and human antiquity.⁸⁰⁾

What other factors helped Kulp in his mission to convert the ASA? It was the fact that since the first decade, the ASA had many active scientists working in fields related to radioactive dating such as geology, archaeology and anthropology.⁸¹⁾ Besides Kulp, there were already several other professional geologists (Gedney, Eggenberger and Erdman), archaeologists (MacRae), anthropologists (Buswell), biologists (Mixer and Tinkle). They all had been trained in the contemporary scientific traditions. B. Ramm well summarized the intellectual atmosphere of the ASA in early 1950s, which generally accepted current scientific ideas. In supporting Kulp in his criticism of the flood geology, Ramm said, "If uniformitarianism makes a scientific case for itself to a Christian scholar, that Christian scholar has every right to believe it, and if he is a man and not a coward he will believe it in spite of the intimidation that he is supposedly gone over into the camp of the enemy."⁸²⁾ The ASA was ready to follow scientific evidence rather than a literal interpretation of the Bible.

Kulp lined up his allies within the ASA and played an active part in the background to ensure that "the ASA's publications gave neither aid nor comfort to the flood geology."⁸³⁾ Kulp served for a term as a member of the Executive Council of the ASA, replacing Edwin Y. Monsma, a believer in recent creation and a cataclysmic deluge,

80) In contrast to Allen's criticism, Eggenberger, Holland and Erdman already accepted radioactive dating. See other papers appearing in *JASA* in the early 1960s: Delbert Eggenberger, "Methods of Dating the Earth and the Universe", *JASA* 3(March 1951), 1-3; H.D. Holland, "Recent Concepts of the Origin and Evolution of the Earth", *JASA* 4(December 1952), 23-28; Cordelia Erdman, "Stratigraphy and Paleontology", *JASA* 5(1)(March 1953), 3-6; Roy M. Allen, "The Evaluation of Radioactive Evidence on the Age of the Earth", *JASA* 4(December 1952), 11-20.

81) See "The American Scientific Affiliation Membership List-August, 1946", *The Yearbook of the ASA* (1946); "The American Scientific Affiliation Membership List-August, 1948", *The Yearbook of the ASA* (1948); "The American Scientific Affiliation Membership List-November, 1950", *JASA* 2 (4)(December 1950) Appendix; "Directory of the American Scientific Affiliation", *JASA* 5(4)(December 1953), 19-29.

82) B. Ramm, *The Christian View of Science and Scripture* (Grand Rapids, MI: Eerdmans Pub., 1954), p. 171.

83) Numbers, *The Creationists*, Ch. 9.

in 1948. Though he eventually dropped out of the ASA, “not because it had become liberal, but because it was too conservative for him,” Kulp widely influenced the ASA to accept the radioactive dates, the antiquity of the earth and life on earth. With the emergence of Kulp, supporters of the young earth and flood geology were gradually isolated within the ASA.⁸⁴⁾

3. *The Genesis Flood*

In the 1950s, through the influence of Kulp and his followers, ASA members began to split internally into two groups: liberal evangelicals and fundamentalist evangelicals. In 1960s, there was evidence of personal and organizational factions among evangelical Christian circles. In reaction to the liberalism of the ASA, accepting the idea of old earth and the uniformitarianism, a revival of the flood geology occurred in the early 1960s.

The most significant sign of this revival was the publication of *The Genesis Flood* by Whitcomb and Morris in 1961. What began as Whitcomb’s dissertation in 1957, *The Genesis Flood* was perfected by the addition of several technical chapters by Morris. As a teacher of Old Testament at Grace Theological Seminary, a fundamentalist institution in Indiana, Whitcomb was deeply distressed by Bernard Ramm’s *The Christian View of Science and Scripture* (1954) which contained what he deemed an unbiblical notion of the local flood. Ramm’s book, as Whitcomb confided to Morris, provided him a direct motivation to write the 450-paged dissertation on “The Genesis Flood”: “Even if I had no other reasons for wishing to write a dissertation on Creation and the Flood, Dr. Ramm’s book would be sufficient incentive form.”⁸⁵⁾

In this book the authors summarized the basic assumptions of C-14 dating: (1) the constant concentration of C-14 in the carbon dioxide cycle; (2) the constant cosmic ray flux on a scale of centuries; (3) the constancy of the C-14 decay rate; (4) no alteration of dead organic matter with respect to its carbon content by any activity, biologic or otherwise; (5) the constant content of carbon dioxide in the ocean and atmosphere; (6) the constant reservoir of oceanic carbon, (7) the equilibrium between the rate of formation and the rate of decay of C-14 atoms.⁸⁶⁾ The authors of *The Genesis Flood* argued that all these assumptions are highly questionable “in the context of the events of Creation and the Deluge.” They maintained that any correlation of the C-14 dates with known historical chronologies “is limited only to some time after the

84) Morris, *History of Modern Creationism*, p.137.

85) J.C. Whitcomb, “A Questionnaire on Creation and the Flood”, unpublished document (1955); J.C. Whitcomb to H.M. Morris, October 8, 1955; both in the Whitcomb papers. All this was cited in Numbers, *The Creationists*, Ch.10.

86) Whitcomb and Morris, *The Genesis Flood*, pp.371-372. Among these assumptions, (a) and (b)

Flood and Dispersion." Quoting Libby, "The first shock Dr. Arnold and I had was that our advisors informed us that history extended back only 5,000 years. in fact, it is at about the time of the first dynasty in Egypt that the last historical date of any real certainty has been established."⁸⁷⁾ In order to refute the assumptions of C-14 dating, Whitcomb and Morris quoted academic writings of the C-14 dating expert who significantly contributed to create or refine C-14 technique.⁸⁸⁾

According to Whitcomb and Morris, the history of the earth was divided into two periods: antediluvian and postdiluvian. They insisted that in the antediluvian period

the ratio of ordinary carbon to radiocarbon in the atmosphere was much higher than at present, mainly because of the global semitropical climate and the vast amounts of plant life found around the world. This effect would have been augmented by the smaller amount of carbon sustained in the ocean then than now it would be still further augmented by the shielding effect of the thermal vapor canopy, which would have prohibited the formation of radiocarbon in the high atmosphere. All of these factors would have reduced the ratio of radiocarbon to ordinary carbon to a much smaller fraction than now obtains.

Therefore, they suggested, "antediluvian organic matter would probably now have little or no radioactivity if preserved as fossils, even though they may actually have been buried by the Flood only a few thousand years ago." Even for the postdiluvian period, they argued, the radioactivity of C-14 increased with time, approaching the present equilibrium between the formation and decay rates of C-14, and that is why only those C-14 dates within last four thousand years correlated with historical chronology. They concluded, therefore, that "the Deluge and associated events adequately explain the data from Carbon 14 studies, ..."⁸⁹⁾

The reaction within Christianity to *The Genesis Flood* were mixed, from high praise to severe criticism. Several Christian magazines praised *The Genesis Flood* for its defense of *Genesis*, while scientists including ASA members criticized the book for its total attack on contemporary science. Most of the evangelicals who accepted the gap and day-age theories did not accept the flood geology and the idea of young earth, recognizing that the main arguments of the flood geology on the whole was incompatible with their theories. Whitcomb, in a letter to Morris, expressed his embarrass-

were already pointed out in J.L. Kulp, "The Carbon-14 Method of Age Determination", *Scientific Monthly* 75 (November 1952), 261; (b) and (c) were also pointed out in Woods, "How Old Is the Earth?", 8-9, 15.

87) W.F. Libby, "Radiocarbon Dating", *American Scientist* 44 (January 1956), 107.

88) See the footnote of *The Genesis Flood*, pp. 370-377.

89) Whitcomb and Morris, *The Genesis Flood*, pp. 374-378. Similar arguments were raised by Woods, "How old is the Earth?".

ment that practically everyone he knew accepted either the gap or day-age theory, "even though they seem to be happy about our [their] position on the Flood!"⁹⁰⁾

In contrast to the critical response of liberal evangelicals, however, many fundamentalists and fundamentalist institutions heartily accepted *The Genesis Flood*. Soon after its publication, the authors were invited to numerous meetings. Particularly, Morris who had a prestigious scientific background, was forced to adapt a jetset lifestyle in order to meet the nation-wide talk engagements. Baptists invited him most frequently, but conservative Presbyterian, Lutheran, Reformed, Episcopal, Wesleyan, Mennonite and even Pentecostal institutions heard his flood geology and his arguments of a young earth. Moreover, Tennessee Temple College, Biola College, LeTourneau College, Bob Jones University and Los Angeles Baptist College and Seminary invited him to become a faculty member.⁹¹⁾ Such an explosive reception of *The Genesis Flood* by fundamentalists was an explicit sign of a revival of the flood geology.⁹²⁾ Actually, this book was an impetus for the creation of organizations such as Bible-Science Association, Creation Science Research Center, Creation Research Society (CRS) and Institute for Creation Research (ICR). Among these, the CRS and the ICR were the most prominent in spreading out the flood geology and the idea of the young earth, which were the most distinct features of the so-called scientific creationism.

4. Creation Research Society

The organization most critical of C-14 dating was the CRS. It was started in 1963 by a group of strict creationists who were disappointed by the changing position of the ASA. Walter E. Lammerts, a geneticist and devout Missouri Lutheran, led this group, and in its second year, the CRS began the printing of *Creation Research Society Quarterly* (CRSQ).⁹³⁾ As Philip B. Marquart stated, "If the ASA had remained true to the doctrines and principles on which it was founded, the Creation Research Society

90) J.C. Whitcomb to H.M. Morris, June 19, 1961, Whitcomb Papers. It was cited by Numbers, *The Creationists*, Ch.10. For a sample review of *The Genesis Flood*, see S. Hugh Paine, "Review of *The Genesis Flood*", *Wesleyan Methodist* 119(June 7, 1961). For Paine's own views, see S. Hugh Paine, "In the Beginning, God Created", *Houghton Milieu* 54(March 1979), 2-7.

91) Numbers, *The Creationists*, Ch.10.

92) Reception of *The Genesis Flood* was shown in its selling record, in its 35th printing as of May 1991.

93) The first inner-core steering committee of the CRS included the following : T.G. Barnes, C.L. Burdick, D.T. Gish, J.J. Grebe, R.L. Harris, J.W. Klotz, W.E. Lammerts, K.W. Lisenmann, F.L. Marsh, E.Y. Monsma, J.N. Moore, H.M. Morris, W.H. Rusch, H. Slusher, W.J. Tinkle, D.A. Warriner, W.L. Webb, P.A. Zimmerman. Among these, Harris, Klotz, Lammerts, Marsh, Monsma, Morris, Tinkle were members of the ASA.

would never have been necessary."⁹⁴⁾ The CRS was "committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms."⁹⁵⁾ Since its inception in 1964, *CRSQ* has published more than two dozen papers critical of C-14 dating. As a leading creationist organization, the CRS successfully recruited several ASA members, most of whom were disappointed by the liberal ASA. It also greatly diffused the tenets of scientific creationism. And *CRSQ* was the only American journal devoted to scientific creationism until the Adventist's journal, *Origins*, began publication in 1973.⁹⁶⁾

The arguments of CRS members against the C-14 method were essentially not much different from the early arguments of the Adventists.⁹⁷⁾ In 1966, Melvin A. Cook, a Mormon metallurgist and professor at the University of Utah, criticized the assumption of a C-14 equilibrium in the biosphere. This assumption stated that a dynamic equilibrium had existed in the earth's reservoirs of carbon for several tens of thousand years. Cook denied the existence of this equilibrium: "the rate of decay of radio-carbon shows that C-14 may not be in steady state in the atmosphere."⁹⁸⁾ In 1970, Robert L. Whitelaw, a professor of mechanical engineering at Virginia Polytechnic Institute, presented more quantitative arguments on the nonexistence of equilibrium among the major carbon reservoirs.⁹⁹⁾ Using the amount of carbon in the exchange reservoir, 7.8 gm/cm², which gives a larger value of the specific production rate of C-14 atoms, 27 atoms/gm-min, Whitelaw calculated the creation date to be about 7,000 years ago. Similar calculations were made by Cook.¹⁰⁰⁾ Later Henry M. Morris, director of the ICR, pointed out that for the time-period prior to dynamic equilibrium, the C-14 age would be much larger than true ages if calculated from the equilibrium model.¹⁰¹⁾ It is notable that Libby already recognized the nonequilibrium and regarded the difference between the production rate (18.8) and the disintegration rate (16.1 ± 0.5) as an experimental error: "The agreement seems to be sufficiently within the experimental errors involved, so that we have reason for confidence in the theoretical

94) Philip B. Marquart, "Letter to the Editor", *JASA* 15(3) (September 1963), 100.

95) *Creation Research Society Annual* (1965), inside the front cover.

96) In 1940's, Adventist scholars published journals of flood geology such as *The Bulletin of Creation, the Deluge and Related Science* and its successor *The Forum for the Correlation of Science and the Bible*, but they were discontinued in the late 1940s.

97) Actually, many contributors to the *Creation Research Society Quarterly* were Adventists.

98) Melvin A. Cook, *Prehistory and Earth Models* (London: Max Parrish and Co., Ltd., 1966), p. 1.

99) Robert L. Whitelaw, "Radiocarbon Confirms Biblical Creation (And So Does Potassium-Argon)", in Walter E. Lammerts ed., *Why Not Creation?* (Philadelphia, PA: The Presbyterian and Reformed Publishing Company, 1970), pp. 90-96.

100) M. A. Cook, "Do Radiological Clocks Need Repair?", *CRSQ* 5 (October 1968), 70.

101) H. M. Morris, editor, *Scientific Creationism* (El Cajon, CA: Master Books, 1974) p. 166.

picture set forth above." ¹⁰²⁾

The next critique was concerned with the possibility of the contamination of C-14 samples. It was stated thoroughly by Robert E. Lee, an assistant editor of *Anthropological Journal of Canada*, in a paper of *CRSQ*. Lee pointed out the possibility of contamination in the whole dating process from collecting samples in the field to the final measurements in the laboratories. ¹⁰³⁾ To him, foreign organic matter could possibly intrude into old material. Charcoal and peat, frequently favorable samples for C-14 dating, were noted for their ability to absorb foreign substances. In fact, Bolton Davidheiser, a Johns Hopkins Ph.D. in zoology and later a biology professor at Westmont College and Biola College, also pointed out that C-14 dating seemed to be much more reliable when the materials tested were from areas with dry climates, such as Palestine and Egypt. ¹⁰⁴⁾

The third critique was concerned with the variation of earth's magnetic field intensity. The first person who systematically investigated the variation of the magnetic field of the earth throughout its age was Thomas G. Barnes, a physicist and member of the inner-core steering committee of the CRS. ¹⁰⁵⁾ According to his study, the magnetic field of the earth decays exponentially. Based on figures from 1835 to 1965, he calculated the half-life of the magnetic field of the earth to be 1,400 years. The greater the magnetic field, the less the cosmic ray influx. If the magnetic field in the past was many times stronger than it is today, there would have been less cosmic ray entering the atmosphere, and consequently less C-14 would have been produced. Therefore, any C-14 date taken from samples of that time period would appear older than it really was. ¹⁰⁶⁾ Although some evangelical scholars opposed Barnes' view, his arguments widely influenced the conservative Christian circles. ¹⁰⁷⁾

Although Woods accepted the constancy of decay rate, Morris, a key member of the CRS, claimed the variation of the decay rate of C-14. ¹⁰⁸⁾ Don B. DeYoung, a Grace Brethren physicist, also reported the variation of the half-life of several radioactive elements under various physical and chemical stimuli or human and natural

102) Libby, *Radiocarbon Dating*, p. 7.

103) Robert E. Lee, "Radiocarbon: Ages in Error", *CRSQ* 19(September 1982), 117-127.

104) Bolton Davidheiser, *Evolution and Christian Faith* (Philadelphia, PA: The Presbyterian and Reformed Publishing Company, 1969), p. 296.

105) Woods, "How Old is the Earth?", pp. 8-9.

106) The implications of the variation of the magnetic field in the radioactive dating were discussed in Wysong, *The Creation-Evolution Controversy* (op. cit., n. 3), p. 161; Weston W. Fields, *Unformed and Unfilled* (Nutley, NJ: The Presbyterian and Reformed Publishing Company, 1976), Ch. 11.

107) Several publications from the Institute of Creation cited and employed Barnes' data. And in *Creation and Evolution Controversy*, R. L. Wysong cited Barnes' arguments as scientific evidence supporting the young earth doctrine.

108) Morris, *Scientific Creationism*, p. 162; Wysong, *The Creation-Evolution Controversy*, p. 150.

influences.¹⁰⁹⁾ DeYoung pointed to industrialization as a human factor. Since the Industrial Revolution, coal, oil and gas have been burned in quantity, and the carbon dioxide produced in the process has been liberated into the atmosphere. Although the Industrial Revolution was less than two centuries old, Morris pointed that the effect of this carbon dioxide must be taken into account in C-14 dating.¹¹⁰⁾ Another human factor was the release of neutrons by nuclear reactors and nuclear weapons. These released neutrons increased the amount of C-14 in the atmosphere.¹¹¹⁾

As for natural factors, Davidheiser cited volcanic activity which usually added a huge amount of carbon dioxide into the atmosphere. Davidheiser argued that within the past 50,000 years large amounts of nonradioactive carbon dioxide had been released into the atmosphere by volcanic activity.¹¹²⁾

Flood geologists presented another natural factor, the changing state of vegetation on earth. According to them, in the past there was much more extensive and vigorous vegetation than now.¹¹³⁾ Thus there would be significantly more carbon dioxide in the atmosphere than now. The flood geologists presented a great flood that occurred 4,000-5,000 years ago, and the radically different environment of the prediluvian period as possible explanations for C-14 dating errors. Therefore, they argued that C-14 dates older than 5,000 years would be highly suspect.¹¹⁴⁾ This argument had much to do with the water-vapor canopy in the upper atmosphere of the earth. According to the flood geologists, this vapor canopy would have contributed to form a global subtropical climate by means of a greenhouse effect; also there would have been a much greater proportion of land surface to water surface than at present. Consequently, there would have been huge vegetation, this being indicated by the vast amount of coal deposits. Thus, live organisms at that time would have only a very small C-14/C-12 ratio, and their remains would have contained no C-14 at all,

109) Don B. DeYoung, "The Precision of Nuclear Decay Rates", *Creation Research Society Quarterly* 13 (June 1976) : 38-41; "Creationist Predictions Involving C-14 Dating", *CRSQ* 15 (June 1978), 14-16.

110) Morris, *Scientific Creationism*, p.295.

111) R.H. Brown, "Radioactivity Dating Indicates a Young Earth," in Lammerts, ed., *Why Not Creation?* (op. cit., n.99), p.83.

112) Davidheiser, *Evolution and Christian Faith*, p.295.

113) R.H. Brown in *Why Not Creation?*, p.87.

114) There are many articles dealing with the relationship between the great flood and C-14 dating : e.g. Morris and Whitcomb, *The Genesis Flood*, pp.374-378; Davidheiser, *Evolution and Christian Faith*, p.295; Brown in *Why Not Creation?*, pp.87-88; Harold W. Clark, *The Battle Over Genesis* (Washington, D.C. : Review and Herald Publishing Association, 1977), pp. 132-137; Morris, *Scientific Creationism*, p.163; A.J. 'Monti' White, "Radio Carbon Dating", *CRSQ* (December 1972), 157.

appearing to be much older than they actually were.¹¹⁵⁾ Another effect of the vapor canopy was to suppress the reaction of cosmic radiation with air molecules, resulting in a reduction of neutron production. Reduced neutron production means reduced C-14 production. It would have reduced the ratio of C-14/C-12 to a much smaller fraction than now, finally leading to excessive old age. The specific radioactivity in living organisms would increase as the C-14 content approached the level at the present time. Therefore, flood geologists concluded that organisms alive before or immediately after the flood would contain much less C-14 than present organisms and therefore would appear to be older than they really were.¹¹⁶⁾

5. Institute for Creation Research

The Institute for Creation Research was founded in 1972 by Henry M. Morris. Through numerous publications, popular talks and lectures and public debates, the ICR greatly influenced evangelical thought. From its start, as expected from the founder's background, the ICR adhered strictly to the doctrines of the flood geology and a recent creation, and, hence, the C-14 dating method was severely criticized by it.¹¹⁷⁾ Among the ICR publications, *Critique of Radiometric Dating* (1973) and *Scientific Creationism* (1974) became the prototype of ICR critiques on C-14 dating. The ICR's criticism was essentially not much different from what appeared in *CRSQ* and *The Genesis Flood*.

Recently the ICR built a C-14 dating laboratory in El Cajon, California. This lab seems to be the first C-14 dating facility run by an evangelical Christian organization, committed to test the C-14 dating assumptions and to take their own data by C-14 critics. The C-14 dating project is led by Gerald E. Aardsma, a Ph.D. in nuclear physics from University of Toronto and a research coordinator of the ICR. Aardsma published a monograph, *Radiocarbon and the Genesis Flood* (1991).¹¹⁸⁾ In addition to his specialization in radiocarbon technology, Aardsma was also "committed to the doctrine of Biblical inerrancy, including literal six-day creation and the global cataclysmic deluge." He was "in full agreement with the ICR tenets, convinced that true science must conform to Bible revelation."

115) Morris, *Scientific Creationism*, p.163; Morris and Whitcomb, *The Genesis Flood*, p.375.

116) *ibid.*, p.377.

117) The first reference to C-14 dating in an ICR publication was by H.M. Morris, "The Young Earth", *ICR Impact* 3(8) (September 1974). See also the recent critique of Rybka on the constancy of radioactive decay: Theodore W. Rybka, "Consequences of Time Dependent Nuclear Decay Indices of Half Lives", *Impact* 11(April 1982).

118) Gerald E. Aardsma, *Radiocarbon and the Genesis Flood* (El Cajon, CA: Institute for Creation Research, 1991), p. 82.

Aardsma did a good analysis of the published data, "showing that the usual steady-state assumption in a radiocarbon dating is invalid." He insisted that all previous radiocarbon dates would be reduced, "bringing them much closer to the Biblical chronology." From the equation describing the radiocarbon buildup, however, he determined the date of the great flood 12,000 B.C.! Although this data "should not be accepted until he or someone else has made a much more critical analysis of the assumptions and correlations used in dendrochronology," Morris recognized, to our surprise, that "his study has real merit and should be made available to the wider readership." It is not easy to predict exactly the function of Aardsma and his C-14 lab. Without doubt, however, Aardsma's research would contribute to broadening an intellectual horizon of fundamentalist evangelicals.¹¹⁹⁾

6. Reaction of "Liberal" Evangelicals to "Fundamentalist" Evangelicals

Since the late 1970s, one of the most crucial events was a debate between liberal and fundamentalist evangelicals, which was triggered by Davis A. Young's two books, *Creation and the Flood* (1978) and *Christianity and the Age of the Earth* (1982).¹²⁰⁾ Young was a geology professor at Calvin College and leading member of geologic section of the ASA. Young flatly opposed the idea of a young earth and the flood geology. Rejecting the fundamentalists' criticisms on the antiquity of the earth, Young pointed out that the decay rate of radioactive elements was constant, that dating elements were not lost or gained during geologic time, and that the original amount of daughter element was determined with reasonable accuracy.¹²¹⁾ He also refuted the flood geologists' critique on C-14 dating method. But his argument on C-14 dating was not as thorough as his evaluation of the age of the earth, that being the primary aim of this book.¹²²⁾ Young, as a Bible-believing evangelical, successfully found shelter in the day-age theory. He harmonized his belief in the Bible with his geologic knowledge through the day-age theory: "There is biblical evidence to indicate that the days of *Genesis* 1 were long periods of indeterminate length, consistent with the day-age hypothesis, ..."¹²³⁾ He played an important role in defending the radioactive dating

119) Aardsma, *Radiocarbon and the Genesis Flood*, "Foreward" by H. M. Morris.

120) Davis A. Young, *Creation and the Flood* (Grand Rapids, MI: Baker Book House, 1977); *Christianity and the Age of the Earth* (Grand Rapids, MI: Zondervan Pub. House, 1982). A full-fledged criticism of Young's second book was raised by H. M. Morris, *Science, Scripture and the Young Earth* (ICR, 1983), pp.15-34; See also Stephen F. Barnett, "Literature Review", *Origins* 10(1) (1983), 37-40.

121) Young, *Christianity and the Age of the Earth*, Ch.7.

122) *ibid.*, Ch.10.

123) *ibid.*, Ch.11. The quotation is from p.160.

and an old earth in evangelical circles since 1970s.

IV. Concluding Remarks

The numerous critiques raised by strict creationists were not taken seriously by the secular scientists and even by some evangelicals such as ASA members. Why was this so?

The key factor was the ready availability of the gap and day-age interpretations of *Genesis* 1. In fact, most evangelicals, and even Adventists who refuted the flood theory and the idea of the young earth could accept one of these interpretations without seriously compromising the evangelical tenets. For example, Edwin K. Gedney, Peter W. Stoner and Davis A. Young accepted the day-age view.

The second reason was the overwhelming number of practicing scientists who accepted C-14 dating. Most of the strict creationists with exception of G.E. Aardsma at the ICR were not technical experts of C-14 dating method and did not have advanced degrees in geochronology, geochemistry, or radiometry. If we were to compare the backgrounds of those critics of C-14 method who published in *CRSQ* with those who supported C-14 dating (such as Kulp, Gedney, Taylor, Hare and Young etc.), the contrast would be very evident. In 1950, Kulp already pointed out a lack of geological training of the flood geologists :

The authors of the articles in the flood geology bulletins [*The Bulletin of Flood Geology*] include two M.D.'s, one Ph.D. chemist and the others who list no degrees. The other prominent writer on Flood geology is H.W. Clark who has a master's degree in biology. None of these men have done any professional geologic field work such as mapping or studying paleontological or structural sequences.¹²⁴

There were few liberal or non-Christian scientists who believed in the antiquity of the earth and "seriously" challenged the validity of the basic assumptions¹²⁵ and the specific data¹²⁶ of C-14 dating.

124) J.L. Kulp, "Deluge Geology," *JASA* 2(1) (January 1950), 2.

125) J.J. Anderson, "Non-Poisson Distributions Observed during Counting of Certain Carbon-14 Labeled Organic (Sub) Monolayers", *Journal of Physical Chemistry* 76(1972), 3604; J. Anderson and G. Spangler, "Radiometric Dating: Is the 'Decay Constant' Constant?", *Pensee* 4 (Fall, 1974), 34; C. Renfrew, *Before Civilization* p.109.

126) M. Kieth and G. Anderson, "Radiocarbon Dating: Fictitious Results with Mollusk Shells", *Science* 141(1963), 634; B. Huber, "Recording Gaseous Exchange under Field Conditions", in K. V. Thimann ed., *The Physiology of Forest Trees* (New York: Ronald, 1958); E.A. von Fange,

Third, with few exceptions,¹²⁷⁾ "serious" criticism about C-14 method appeared mainly in religious journals. Major religious journals criticizing C-14 method include *CRSQ* (since 1964), *Origins* (since 1974 by the Seventh-day Adventists) and *Impact Series* (since 1972 by the ICR). All of them were conservative or fundamental publications. Among them, *CRSQ* was the most prominent in criticizing the C-14 method, publishing more than 25 critical papers to date. In addition to journals, most of the religious books critical of C-14 dating were written mostly by fundamentalist evangelicals¹²⁸⁾ and published by religious publishers, and their distribution was limited to Christians.

The fourth is the conservative bent of established science. Since C-14 dating was introduced on a wide scale in 1950s, it quickly replaced the older dating methods. Once accepted, "adjustments were made to achieve internal order in the radiocarbon chronology! Once that comforting operation was completed, a feeling of security enveloped the exponents and their followers."¹²⁹⁾ As Flint and Rubin stated, "the consistency of the group of dates under consideration is such as to justify the assumption that all are accurate."¹³⁰⁾ Borrowing a terminology from Thomas S. Kuhn,¹³¹⁾ C-14 dating is enjoying a normal science status in an evolutionary paradigm. Within a normal science, only minor corrections or improvements of a theory, or puzzle solving activities are done. "Once a structure of belief is internalized, it is very resistant to change, regardless of the empirical evidence for or against that structure."¹³²⁾

Besides the above-mentioned, there may be other possibilities: the wide spread acceptance of evolutionary idea, the status of the inventor as a Nobel laureate, no alternative method comparable with C-14 method.

"Time Upside Down," *CRSQ* 11(1974), 18; W. Dort, "Mummified Seals of Southern Victoria Land," *Antarctic Journal of the U.S.* 6(1971), 210.

127) For examples, Robert E. Lee, "Radiocarbon: Ages in Error", *Anthropological Journal of Canada* 19(3) (1981), 9-29, reprinted in *CRSQ* 19(September 1982), 117; Harold S. Gladwin, "Dendrochronology, Radiocarbon, and Bristlecones", *Anthropological Journal of Canada* 14(4) (1976), 2-7, reprinted in *CRSQ* 15(June 1978), 24-26.

128) For example, M. A. Cook is a Mormon, R. H. Brown is a Seventh-day Adventist, R. L. Wysong has a Jehovah's Witness background, and most of the others have a fundamentalist background.

129) R. E. Lee, "Radiocarbon: Ages in Error", 124.

130) R. F. Flint and M. Rubin, "Radiocarbon Dates of Pre-Mankato Events in Eastern and Central North America", *Science* 121(1955), 649-658.

131) Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: The University of Chicago Press, 1962).

132) Jerry Bergman, "Reality: Real or Conventional?", *CRSQ* 19(June 1982), 62.

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So far I discussed various responses to C-14 dating. The controversy over this method has not yet been settled. Till the late 1940s, radioactive dating was not taken seriously by evangelicals. Although there might be some trace of internal tension, there was not much strife over it among Christians. But the emergence of J. L. Kulp as a member of the ASA Executive Council was a watershed. It caused a split in the evangelical Christian community: One group was the liberal evangelicals who accepted radioactive dating, the antiquity of the earth and life on earth; and the other, the fundamentalist evangelicals who believed in the global flood and a young earth. The liberal evangelicals interpreted the Bible from the scientific discoveries, while the fundamentalist evangelicals tried to fit the scientific discoveries to the literal interpretation of the Bible. Largely because of Kulp's influence, supporters of the flood geology and a young earth found themselves increasingly isolated within the ASA. Eventually the turning of the ASA generated reactions in the fundamentalist evangelicals, the publishing of *The Genesis Flood* and numerous publications in the same line, the founding of the CRS, Creation Science Research Center, and the ICR—all were evidences for a revival of scientific creationism since 1960s.

Adventists had no Kulp by the late 1950s. Although Hare played a similar role, he failed in persuading major Adventist scholars. Many orthodox Adventists remained critical toward C-14 dating. They joined the CRS in their activities and contributed to the *CRSQ*, even after starting their own journal, *Origins*. But in the late 1950s, R. Ritland and P. E. Hare opened fire on the tenets of the fundamental creationists. They indirectly challenged the authority of the writing of Ellen G. White, founder of Adventist church. Unlike the ASA, however, the community of orthodox Adventist scientists did not split, owing to the strong doctrinal bonds of the church.

Before closing this essay, I would like to mention two crucial aspects in the discussion of C-14 dating. The first is related to the great flood. Although some creationists, such as some ASA members, did not accept the global flood itself, strict creationists employed the great flood and the global water-vapor canopy as the basis for their argument of C-14 criticism: the non-equilibrium of C-14, the variation of cosmic ray influx, the changing level of C-14 and even the variable decay constant. But nobody could prove or disprove, by direct evidence, the great flood and the vapor canopy. The pre-flood world could not be traced back from the present world, because of the lack of direct evidences concerning the past. Several secondary evidences, like large vegetation, coal and oil formation etc., were presented as a possible evidences for the flood, but most of them also had alternative interpretations of the uniformitarianism. Therefore, the great flood presupposition acted as a "black hole" or "singular point" in the C-14 dating controversy.

The next is related to the non-scientific aspect of the controversy. The fundamental issues in opposition to C-14 method were mostly theological. The majority of critics who claimed the imperfection of C-14 technique and young ages of life and the earth were strict creationists who held a fundamentalist or conservative position as far as the Bible was concerned. In contrast with them, the proponents of C-14 method held a more liberal position in their interpretation of the Bible and some of them expressed their convictions on the evolutionary idea.¹³³⁾ Some argued that "the [radioactive] ages have been in agreement with the order already worked out by geologists on the basis of stratigraphy and structure,"¹³⁴⁾ the first idea of uniformitarianism and the extended age of the earth had been independent of evolutionism. But those were quickly taken by the evolutionists camp, as the explicit concept of evolution was proposed in the 19th century. In the case of the C-14 method, it was developed and employed on a purely scientific basis. But soon the whole bunch of C-14 results was used to support an already established evolutionary scheme. It was why strict creationists regarded the proponents of radioactive dating as a synonym of the proponents of macroevolution.¹³⁵⁾

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133) One of the representative Christian organizations which accepted radioactive dates and the evolutionary idea was the American Scientific Affiliation. It has nearly 2200 domestic and international membership and publishes *Journal of the American Scientific Affiliation*. For the position of the ASA, see F. Everest, "What is the 'Position' of the ASA?" *The American Scientific Affiliation*, Ch. 6.

134) J. L. Kulp, *JASA* 2(1950), 12.

135) See the doctrinal statements of the Christian Heritage College (El Cajon, CA), totally committed to strict creationism. H. M. Morris, director of the Institute for Creation, one of the founders of the college and the ICR, is affiliated to the college.