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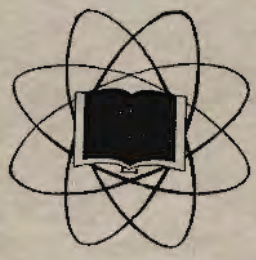

The fear of the Lord is the beginning of wisdom. Psalm 111:10

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A.S.A. CONVENTION HELD AT THE BLACK HILLS, SOUTH DAKOTA, AUG. 26-28

By Mrs. Mina G. Hill
Wheaton College News Bureau

The American Scientific Affiliation, consisting of a group of Christian scientific men from various institutions of learning and industries throughout the country, met at the Wheaton College science station in the Black Hills, South Dakota, for discussion of scientific problems in relation to the Holy Scriptures on August 26, 27 and 28. About 40 were in attendance.

Papers were presented by Dr. J. Lawrence Kulp, professor of geology at Columbia University; John C. Sinclair, graduate student of zoology at the University of California; Cordelia Erdman, instructor of geology at Wheaton College; Peter W. Stoner, chairman, math and astronomy at Pasadena College; Dr. James S. Maxwell, Fairmont, West Virginia; George R. Horner, Doctor of Letters, West Africa, and James Sykes, Government station ranger, Black Hills.

Dr. Paul M. Wright, chairman of the chemistry and geology departments at Wheaton College, presided as chairman and led the visiting scientists on field trips through the northern and southern hills.

Dr. Kulp's paper, **Recent Events in C-14 Dating,** presented the modern viewpoint on the age of man. Carbon 14 technique has revealed the existence of man in America 10,000 years ago. Dr. Kulp hopes to eventually perfect a method dating back 100,000 years which can be used on the more ancient fossil men.

Professor Stoner presented his paper on the **Probability in Biblical Prophecy,** indicating mathematically that events which have occurred according to Biblical prophecy, could not be coincidental as expounded by the modernist.

Miss Erdman's paper on **Stratigraphy and Paleontology** dealt with the mistaken idea generally circulated that a geologist must automatically be an evolutionist. She stated that the geologist is a student of strata which are found to contain certain characteristic fossils, showing some strata much older than others, indicating that some forms are of greater age.

Dr. Horner's and Dr. Maxwell's papers presented **Child Training in the African Bulu Tribe Culture,** and a comparison of the **Leaven of Scripture and the Antibiotics of Today,** respectively. Mr. Sinclair's paper was entitled **Christian Philosophy versus Science.**

Mr. Sykes, government ranger showed colored pictures of the area it was his job to protect. He spoke of the five resources including water, recreational facilities, timber, grass and animal life. He stressed fire prevention and control, also the hazard of over-grazing by cattle.

The Affiliation hopes to hold the eighth annual convention at Grace Theological Seminary at Winona Lake, in 1953.

Book Reviews

Christian Union of Professsional Men of Greece, TOWARDS A CHRISTIAN CIVILIZATION (The "Damascus" Publications, Athens, 1950)

This is a very interesting and helpful book. I cannot find much in it with which to quarrel. It shows that the writers have broken with the ritualism of the Orthodox Church and have sought to apply the Gospel to their thinking on modern problems. They assert very definitely (pp. 73-82) that it is necessary to restore a spiritual Christianity as opposed to a ritualistic Christianity in the treatment of the problems of society today.

Experimental science for these writers has very definite limitations. There must be a "guiding Christianity" in looking at life's issues. This effort at a type of "synchronism" is described as "the dealing with the problems of today, their understanding, and solution, through the eternal power of the Gospel." Scientific thought, anthropology, history, economics, sociology, technology, and political science are all evaluated from this perspective.

Perhaps this can be best illustrated in the treatment of law. Here the authors declare, "Christianity does not found the Law only; it establishes the critique of the positive law (pp. 201); . . . it gives the tone, the spirit and not the concrete contents." (pp. 205) In speaking of the political issues of our time, the authors declare, "The Christian theory . . . accepts the necessity of the State, and builds on Right above law. The Christian theory concerning the State, through the eternal command, which is above State, and which is brought to men by Christian Revelation, becomes the justification of the existence of the State." (p. 206)

Problems of family life, sex education, and education come in for considerable discussion. Scientific theory, especially the idea of progress, is thoroughly reviewed. The entire volume is very stimulating to the thought of one who is interested in the problem of scientific and Christian thought as applied to modern problems.

S. R. Kamm
Prof. of Social Science
Wheaton College

News Notes

We are happy to announce that Delbert Eggenberger has been elected to the executive council of the ASA effective January 1, 1953 to fill the vacancy caused by the retirement of Roger J. Voskuyl. We appreciate very much the services of Dr. Voskuyl during the past five years.

The following Associates were recently elected Fellows of the ASA: J. Oliver Buswell, Jr.; Cordelia Erdman; Robert P. Dilworth; Edwin K. Gedney; Frank E. Houser, Jr.; Paul M. Wright; A. Van Der Ziel. These were elected by a majority vote of the present Fellows as provided in the constitution.

In order to encourage more regional meetings of the ASA, President Mixter has appointed the following members as district leaders: Martin Karsten for Grand Rapids, Michigan; Wilbur L. Bullock for Durham, New Hampshire; Heinrich Holland for Princeton, New Jersey; James O. Buswell III for New York City; Paul B. Mauer for Rochester, New York; Walter L. Starkey for Columbus, Ohio; Charles H. Willits for Corvallis, Oregon; Wesley J. Peterson for Philadelphia, Pa.; Maurice T. Brackbill for Harrisonburg, Virginia; Maurice A. Yoder for Hesston, Kansas.

The California section of the ASA had their first meeting of the current school year on Monday, October

13 at Manchester Boddy Gardens, 1418 Descanso Drive, LaCanada, Calif. At this meeting Dr. Walter L. Lammerts served as host. The meeting was devoted mainly to business and the election of local officers.

The Illinois-Indiana section had their first meeting at Wheaton College on October 25. This was a joint meeting of a local group of the Christian Medical Society and of the ASA.

The committee responsible for the Eighth Annual Convention of the ASA had a meeting at Taylor University on November 29. Dr. William J. Tinkle is general chairman of this committee. The convention is to be held on the campus of the Grace Theological Seminary at Winona Lake, Indiana. The dates are now set for September 1, 2 and 3. Professor O. W. Neher, chairman of the committee on papers, has prepared a letter to the entire membership requesting papers for the coming convention.

*Probability in Biblical Prophecy**

A Technique for Producing Convincing Evidence To A Class That the Bible Is Inspired

PETER W. STONER
Chairman, Mathematics and Astronomy
Pasadena City College, Pasadena, California

This technique has been used with several classes of college students and in each case found to be very effective.

Two simple principles of probability are used in this type of study.

1. If the chance of one event occuring is 1 in m, and the chance of a second and independent event occuring is 1 in n, then the chance that both events will occur is 1 in m times n.

Eg. If the chance that any given infant will graduate from college is 1 in 100, and the chance that any given infant will become bald is 1 in 10, then, since there appears to be no relation between graduating from college and becoming bald, the chance that any given infant will both graduate from college and become bald is 1 in 100 times 10 or 1 in 1,000.

2. If the chance of one event occuring is 1 in m, and the chance that a second and related event will occur after the first event has occured is 1 in n, then the chance that both events will occur is 1 in m times n.

Eg. If the chance that any given infant will graduate from college in 1 in 100 and the chance that any given infant will be a school teacher is 1 in 1,000, then we can not say that the chance that any given infant will graduate from college and be a school teacher is 1 in 100 times 1,000 for there is a relation between being a school teacher and graduating from college. Here we must obtain different data. The chance of any given infant graduating from college being 1 in 100 is satisfactory, but the second question must be, what is the chance that any given college graduate will be a school teacher? If the answer to this should be 1 in 90 then the chance that any given infant shall graduate from college and be a school teacher is 1 in 100 times 90 or 1 in 9,000.

Before estimating the probability for a first and a second event happening, we must be very careful to determine whether the events are entirely independent or somewhat related. If in doubt assume that they are related and use principle 2.

The Technique

When a group is to study a prophecy to determine the human probability of its fulfillment, all data regarding conditions and trends at the time the prophecy was made should be obtained and discussed by the group. Each item of the prophecy should be evaluated separately. Each individual of the group should answer the question: From the human information available to the prophet, and the conditions prevailing at that time, what chance had the prophet of having this item of his prophecy come true? (The lowest estimate that any member of the group will seriously suggest must he accepted.)

On taking up the next item of the prophecy, have the group unanimously determine if this is independent from the first item or related to it. If there is any possibility of its being even remotely related, ask the question: After the first item of the prophecy came true, what was the human chance of the second item coming true also?

After each part has been separately evaluated, multiply the various probabilities together to find the probability of the whole prophecy coming true.

Let us illustrate by repeating the reactions of a class of college students to a prophecy regarding Palestine.

Lev. 26:31-33, written 1491 B.C. and

Ez. 36:33-35, written 587 B.C.

"And I will make your cities waste, and bring your sanctuaries into desolations. — And I will bring the land into desolation: and your enemies which dwell therein shall be astonished at it. And I will scatter you among the heathen, and will draw out a sword after you: and your land shall be desolate, and your cities waste."

"Thus saith the Lord God; In the day that I shall have cleansed you from all your iniquities I will also cause you to dwell in the cities, and the wastes shall be builded. And the desolate land shall he tilled."

This propbecy makes seven predictions.

1. The cities of Palestine shall become waste.
2. The sanctuaries shall become desolate.
3. The land shall become desolate.
4. Enemies shall inhabit the land.
5. The Jews shall be scattered.
6. A sword shall go out after the Jews.
7. The Jews shall return to Palestine, the cities shall be rebuilt and its land shall be tilled.

We are so familiar with the fulfillment of this prophecy that it need not be discussed bere.

Let use consider each prediction separately

1. "The cities of Palestine shall become waste."

This prophecy was made soon after the Lord had led the children of Israel out of Egypt, and into the promised land. It did not seem likely that He would again allow the cities to become waste. What was

* Paper given at the Seventh Annual Convention of the American Scientific Affiliation at Wheaton College Science Station, Rapid City, South Dakota, August 26-29, 1952.

the chance that the Cities of Palestine should become Waste? Lowest estimate given was 1 in 10.

2. "The sanctuaries shall become desolate."
The sanctuary had been kept active even all through the wilderness journey. What is the probability that they shall become desolate with the cities? Lowest estimate 1 in 2.

3. "The land shall become desolate."
What was the probability that another people would not come in and till the ground? Visitors to Palestine, 50 years and more ago, reported that very little of the land was tilled, the great mass of it was a total desolation. Lowest estimate 1 in 10.

4. "Enemies shall inhabit the land."
What was the probability that even though the land was left desolate it would still be inhabited? Palestine became a stronghold of the Moslems, the enemies of the Jews. They inhabited the land. Lowest estimate 1 in 2.

5. "The Jews shall be scattered."
The Jews, even through great persecution had stayed together, whether they were in Egypt, Palestine or the wilderness. What was the probability that they would now be scattered? They have been scattered to every land of the world. Estimate 1 in 10.

6. "A sword shall go out after the Jews."
What was the probability that after the Jews were so scattered they should be severely persecuted? The Jews have been persecuted as no other race on the face of the earth. Their persecution by Hitler, in recent years, is the cruelest recorded in all history. Estimated probability 1 in 5.

7. "The Jews shall return to Palestine, the cities shall be rebuilt and its land shall be tilled."
What is the probability, that, after being so scattered and persecuted, they would again return and reclaim their country? This reclamation has been well accomplished in the last few years. We have all marveled at its speed and the military successes of the Jews in retaking Palestine. Lowest estimate 1 in 50.

Thus for the fulfillment of the whole prophecy we have a probability of 1 in 10^6, by multiplying all of the estimated probabilities together.

Let no one misunderstand. The above estimates were made by a group of college students and are herewith reported without revision. I do not agree with all of the estimates and you, no doubt, also disagree with some. If the values given to the different probability items were to be defendable, one would have to do a great amount of research work and statistical investigation to determine such a value for each probability. This method of estimating, however, is satisfactory to a group. All members of these groups were convinced that these estimates were very conservative, for the smallest estimate made by any member was taken for each item of prophecy and every member thought that most of the estimates accepted were unreasonably low. They felt as a group that the total estimate should have been larger.

A number of prophecies should thus be considered and evaluated by the group. If the prophecies are all independent, all of the probabilities should be multiplied together to obtain an estimate of the probability of all of the prophecies studied being fulfilled.

My class of college students also considered the following geographical prophecies: 1. Tyre, Ez. 26:3-5, 7, 12, 14, 16. 2. Samaria, Micah 1:6. 3. Gaza and Ashkelon, Zeph. 2:4-6, Amos 1:8 and Jer. 57:5. 4. Jericho, Joshua 6:26. 5. The Golden Gate, Ez. 44:1-3. 6. Zion Plowed, Micah 3:12. 7. Jerusalem Enlarged, Jer. 31:38-40. 8. Moab and Ammon, Zz. 25:3, 4, 9. 9. Edom, Jer. 49:16-18. 10. Babylon, Isa. 13:19-21 and Jer. 51:26, 43.

This college group agreed that some other group might assign smaller estimates, but if they did, more prophecies could be studied until a total result equal to or greater than the estimate which they had agreed upon was obtained.

When the above prophecies were all evaluated and the total resulting probability computed it was found (from the student's judgment) that the prophets, if they wrote from human knowledge, had only one chance in 8×10^{63} of having all of the prophecies come true. But they all came true.

An attempt was then made to visualize this probability by supposing that we had this number of silver dollars and we made them into solid balls the size of our sun. (The volume of the sun is more than 1,000,000 times the volume of the earth.) We found that we would have 10^{32} such balls. If we had such a ball to replace each of the estimated 30 billion suns in each of 2 billion galaxies, which probably do exist, the operation would have to be repeated every second for about 70,000 years to use up all of the 8×10^{63} silver dollars. Now imagine that one of these silver dollars was marked before they were made into suns. Let us blindfold a man and tell him to go out and pick up the marked dollar. We would say that he had no chance of producing it. But his chance is about the same as the chance of all of the prophets took in the above 11 prophecies, if they wrote from human knowledge alone.

It should be pointed out that the number of fulfilled prophecies is tremendous, and in no case has any biblical prophecy been found false. We are still waiting for the fulfillment of many prophecies, but no event has ever taken place contrary to a prophecy.

We have discussed the field of prophecy dealing with geographical places. Other types of prophecies may be studied. Another class of college students studied and computed the probability of fulfillment of 48 prophecies, from the Old Testament, regarding the first advent of Christ. They arrived at the combined probability of their fulfillment by any man living from the day of the prophets to the present time as about 1 in 10^{181}.

An attempt to visualize this probability was made by taking objects the size of the electron and packing all space out to 2 billion light years solid with them. We found that we would have to repeat this 5×10^{53} times to use up all of our electrons.

It is absurd to say, let us blindfold a man and send him out to find the marked electron. No wonder Christ said, "Search the Scriptures . . . they are they which testify of me."

We may ask, what is the human chance that these geographical and the prophecies referring to Christ should all come true? The answer, of course, is the product of the two probabilities or 1 in 8×10^{244}.

These results have left the realm of evidence and have become as near an absolute proof as the mind can conceive of and greater than the physical universe can represent.

Discussion

Dr. P. Bender: What was the student reaction?

Mr. P. Stoner: There is no question but that they were convinced that the Bible is inspired. This was the reaction of both Christian and non-Christian.

Dr. J. Maxwell: I think we should commend this paper. Science goes ahead by the times that it finds

a new technique with which to work. Here is a new technique. When we find a new way to present the truth of God we ought to develop it; but not over develop it.

Mr. F. Everest: A fuller treatment is soon to be published by Van Kampen.

*Christian Philosophy vs Science**

JOHN C. SINCLAIR
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University of California in Los Angeles

An ugly monster labeled science has raised it's gory head in opposition to the Christian Faith, and Christian theologians and philosophers have felt compelled to attack it. So attack it they have, showing it is not based on absolutes (hence is not trustworthy in its pronouncements), and that it is producing "A" and "H" bombs (and so is to be feared and rejected); Our alternative? Faith in God! But science as such is not the monster we fear but Satan in the hearts of unregenerate scientists and scientific philosophers. These men are irresponsible concerning the implications of their theories. They may not teach atheism and immorality yet these are the results of their theories and the way they are taught. Few scientists would deny the existence of moral values such as honesty and truth but because they lack instruments by which they can be measured they might as well not exist, and in the thinking of their students they do not exist.

It is not surprising then that our Sunday School literature reflects a feeling of distrust of science. **The Teacher:** April 1, 1951, published by the Southern Baptist Convention stated, "As we study Genesis we are not to look for a scientific account of the origin of the world, and we are not to be disturbed by scientist's criticisms of the Genesis account." **God's Plan of the Ages,** Book T-91, page 7, published by Gospel Light Press: "In the Bible there is no human science. The Laws of God's Word spurn the ever changing theories of men." **Concordia Teacher's Quarterly,** vol. 36, 3, page 61 April-June 1951, "No one was present at the beginning of things. Either we shall accept the only satisfying answer to the question, which the Bible gives or we shall remain ignorant and unsatisfied. Christians humbly accept the Biblical account."

These quotations are illustrative of many more that could be given. Unfortunately, however, Sunday School literature authors have gone to the extremes of ridicule and extravagant interpretations of their own that have done great harm to the faith of our youth when the truth was learned. For our youth supposed that it was the Bible that was in error. In the Los Angeles, American Scientific Affiliation Sunday School literature survey, Peter Stoner said, "In my experience of dealing with college young people, with questions of faith, I have found the reconstruction theory (that man was created 4004 B.C., after a general reorganization of the chaos of a former creation) to be the chief killer of faith."

Walter Lammerts says, "My experience, in dealing with the problems of Christian students, is that unscientific teachings in Sunday School and church are the main problem of Christian young people."

Robert Keesey, "Of the many and varied controversial issues in the Bible, those which involve a conflict with scientific theories are probably the most effectual in causing a loss of faith."

F. Alton Everest, "Presenting one interpretation of a highly controversial passage as the Word of God is intellectual dishonesty. We should admit that this is an area in which we do not know."

We must say, however, that not all cases of apostasy are caused this way. There are some students that forsake the Christian faith who, though raised in the church, have never experienced the salvation of God, so when faced with the attacks of unbelief are caught without the ministry of the indwelling Spirit of God, Who alone can keep them.

Let us consider now some of the thinking behind the scenes. Does anything have to happen twice in order to happen once? In other words, is science justified in rejecting the miraculous because it cannot be repeated in the laboratory? Wherever possible new phenomena must be capable of repetition as a proof of validity. In some cases a thing has to happen several hundred times before we can be sure that it has really happened and is not just chance. Note that I said before we can be sure it has really happened. The Virgin Birth of Christ by its very nature is something that cannot be repeated, hence other tests of validity must be used, His sinless life being one of them.

There are two parts to science, (1) **observed facts,** and (2) **the interpretation of them.** The facts are not subject to revision but the interpretation of them may be totally reversed by subsequently observed facts. All experimental observations must be interpreted to have meaning. Hence all scientific meaning is in a state of flux. The confusion that this implies is not as profound however, as some philosophers who are accustomed to thinking in absolutes, would have us believe. For most interpretations are so highly probable that they are facts to all intents and purposes. For example, if I were to drop this paper it would fall to the table. This is the observed fact. The most probable interpretation is that a force we know as gravity has pulled it down. Some people, being faced with facts apparently out of harmony with what they believed the Bible taught, have rejected the whole Bible as untrustworthy. This fallacy of absolutes or mania for consistency would, if applied in the sciences, lead to the rejection of all knowledge. For there is no field of science I know of, that doesn't admit basic contradictions somewhere in the phenomena they study. To them it is proof of incomplete knowledge. Can't we say we don't know in Biblical exegesis too?

The general principle of uniformity is neutral and can be used for good or evil, and has been used both ways in scripture. In II Peter 3:3-4, 13-15, the scoffer ridiculed the idea of coming judgment because things were uniform, but Peter says this uniformity is evidence of God's longsuffering. Our common experience of the dependability of nature is used by the Lord to

* Paper given at the Seventh Annual Convention of the American Scientific Affiliation at Wheaton College Science Station, Rapid City, South Dakota, August 26-29, 1952.

convince us of the faithfulness of our covenant-keeping God, Jer. 31:35-36, and Matt. 6:26. The miracles of the Bible are consistent with the nature of God and are in harmony with the laws of His creation, though we may not know them. This is obviously so, for a house divided against itself cannot stand. The Bible is a revelation of God to man and so should be more understandable to us than the less specific manifestations of God in nature. Still to have an absolute knowledge of spiritual truth it is necessary to have an absolute comprehension as well as an absolute source of knowledge. It is possible through the indwelling Spirit of God to have absolute comprehension, but few if any of us attain to it. Just as God has made it possible for us to be free from sinning, though none of us attain to this holiness. Science's uniformity in a sense takes God's grace for granted, which one day shall be revealed as a horrible mistake.

I don't believe that Dr. Edward J. Carnell, in "HIS" magazine, means to say that Dr. Laurence Kulp is a neodeist with all that that implies; but that Dr. Kulp's line of reasoning is the sort of reasoning that the neodeists base their doctrine on. If Dr. Kulp succeeds in establishing the validity of this sort of uniformitarianism, the neodeist doctrine is without refutation, Dr. Carnell feels. I believe, however, that the remedy that Dr. Carnell proposes, that is, that there is **no** uniformity in nature, is a little extreme. A young chemist was once asked why he was working on war explosives, his answer was that he had to eat! So the questioner attempted to prove that he did not have to eat and hence did not have to work on war explosives. Just because the neodeists claim that their doctrine is the logical outcome of the uniformity of nature, that does not mean that this is so, any more than the young chemist's claim that he had to work on war explosives in order to buy food to eat.

Dr. Carnell's attitude makes it evident that Christian men of science need to foster philosophical thinking that will adequately express our faith in the God we know and love, the Creator and Sustainer of the Universe we study. I had once hoped that Christian philosophers and theologians might work in harmony with Christian men of science to our mutual edification and for a united witness to our Lord and Saviour Jesus Christ; but I fear our fields are too mutually exclusive. The only hope I can see now is that we might believe in our Lord's ability to inspire men in disciplines foreign to our own and depend upon them for matters properly within their sphere. And conversely, be counted on ourselves to contribute on matters within our sphere, such as writing Sunday School lessons on Creation, the Flood, etc.; and doing personal work with young people who come to pastors with doubts of a scientific nature. It is ineffectual and wrong in principle to try to give Bible School and Seminary students a stock answer for those troubled by the theories of science. However, as good personal work does not attempt to answer all of the arguments of unbelief, but presents Christ as the One who is able to save to the uttermost all those who draw nigh to God by Him, so we should not attempt to answer all the arguments that might be conceived, but present Christ as the Creator and Sustainer of the universe, weaving into the account all the science we know.

The Bible states that Christian maturity is attained by the exercise of our senses to discern both good and evil. (Hebrews 5:14). If philosophy can help us to discern these differences it shall be our benefactor. How then do we determine absolutes from our experiences of differences? Our assurance of the Deity of Christ is not based on one obscure passage of Scripture but on a great mass of direct and indirect evidence from the Word of God. (I am assuming the Bible to be a source of evidence.) By this evidence we conclude that Christ is different, He is God. In like manner the laws of Genetics have been deduced statistically from a great mass of experimental data. The more differences you have that all point to the same conclusion, and the less differences that seem to contradict it, the more sure you can be of your conclusion. To me the criteria of knowledge in spiritual and scientific matters is the same. They are both based on human experiences of differences. Christ assumed this basis of knowledge when He questioned how men trained in discerning differences in nature could be lacking in spiritual discernment. Matt. 16:1-4, and Luke 12:54-57.

I believe it is possible for us to recognize the God of the Bible, as being the same Person Who created and is maintaining the universe. True, the Bible and nature are distinct manifestations of God, but they are not so unique that the essential being of God is not seen in both. My knowledge of God is the basis of my belief that life as we know it is the handiwork of God. The lack of a knowledge of God by the unchristian scientist leaves him no explanation but chance. Thus evolution is the unbeliever's alternative to faith in God. The Positivist philosopher is trying to make logical what evolution intimates, that is, that there is no purpose or design, only chance. The first position of evolution was that of showing man he is an animal and could not expect to live differently from them; but it now finds he is only matter and cannot frustrate the random activity of physical entities, if there are such.

Rather than contend with the darkened reasoning of an Evolutionary philosophy, why not hit the major premise itself? If anything at all can be shown that is not due to chance, then the whole theory of evolution is false. Perhaps the philosophy vs. science problem lies in an incompetent attempt by Christian philosophers to do what Christian men of science so far have failed to do—to raise an alternative to this satanic concept. The whole controversy might well disappear if we would turn on Evolution and tear it apart! Politically it predisposes us to communism; economically to materialism; and religiously to atheism.

In conclusion we have seen that there is a real lack of understanding between Christian philosophers and Christian men of science. A lack that hazards the faith of our youth. The things we disagree on are the nature of knowledge, whether relative or absolute; and the question of uniformity. But behind both disagreements is the diabolic theory of Evolution.

Discussion

Dr. W. Tinkle: I especially like the statement that the criteria of truth of science and of religion are the same. I thoroughly believe this. It has so often been stated that they are different . . . We run into the difficulty of saying that in religion we have to take just what somebody tells us, i.e. we have to be credulous . . . I do not wish to be that type of person because I have seen morons who were very credulous.

We have faith in religion because we have a good basis for our faith. It agrees with the knowledge that we have. We know that God is faithful. Again, we

have faith in science because we have knowledge. There are many gaps in science; however, we believe those theories that are most creditable. I believe that it is very important that we keep in mind that criteria in science and religion are really the same.

Dr. H. Hartzler: I would like to ask two questions. What is Neo-deism as used by Sinclair and Carnell? What is this subject of uniformitarianism? I believe there are many here who need to have these subjects explained as a basis for our discussion.

Mr. J. Sinclair: I wish that Carnell were here because I am not a philosopher; however, I have done my best to convey the thinking of that group. Neo-deism is a new theology. Every once in a while we get a new theology. I believe it is similar to the old Deism. I believe that Dr. Edman could more adequately discuss it for the members.

Dr. V. Edman: Deism became a prevalent mode of philosophy in the later part of the age of enlightenment, i.e. the later part of the 18th century and the first part of the 19th century. Its center of prominence was in England and to some extent on the continent. It was born first of all with the passing of the credulity of the middle ages and with the coming of the protestant reformation . . .

It said that there was a God, that he was the creator but in effect had wound up the universe and then had gone out and left it. It has run on like a clock. Thus it calls for a great gulf between mankind and the creator. God—yes
Universe—yes
Salvation—no
. . . Just a cold, cruel universe into which we are born and die and leave no mark.

Mr. J. Sinclair: It was also asked that uniformitarianism be defined. In essence it says that the laws which we can now observe changing the shape of the earth involve the same laws which governed the stratigraphic depositions. Rocks which we see in the canyon were formed according to known physical and chemical laws which we are now able to observe in the open.

Mrs. Stam: What is the difference between the new Deism and the old Deism?

Mr. J. Sinclair: Neo-Deism is a coined word, I believe by Dr. Carnell, in which the new theory is the same as the old.

Dr. H. Hartzler: How does C-14 dating, etc., fit in with the new Deism? I don't see the connection.

Mr. J. Sinclair: I believe that Carnell thinks the neo-deists are of the opinion that it would be impossible for God to come into nature and perform a miracle. If he did, it would be chaos in the thinking of the Neo-deists since they believe that God set the laws of the universe in motion and cannot set them aside because He has withdrawn from the universe. So that if you believe in this form of uniformity, then there are certain limitations on God. Carnell feels that the concept of uniformity that the geologists talk about will be used to exclude the possibility of God's entrance into nature to perform miracles.

Dr. P. Bender: I believe that Sinclair presented two different definitions of uniformity. The first was the concept of uniformity as used in geology, that by studying the processes which we see changing the face of the earth we can understand to some extent its past history. The other definition used by Mr. Sinclair is that used by Science in general, i.e. a uniformity of laws based on the belief that the same laws will operate in the same way today as it did yesterday. This is, of course, modified by the concepts of statistics and probabilities which were mentioned.

Dr. P. Wright: I would like to enlarge on the Geologists' definition: "The present is the key to the past." But that doesn't say that the processes have been going on at the same rate, for example, the same rate of deposition or erosion. The amount of sediment that a stream carries increases very rapidly as its velocity increases, and with it the erosion and deposition. The law is the same, but the rate is not constant.

Dr. B. Sutherland: The statement that we arrive at the knowledge of spiritual things the same way we arrive at a knowledge of scientific things is true in a way . . . The evidence is not the same kind . . . Historical evidence is unique in that it happens only once. Physical sciences are concerned with arriving at facts that occur over and over again and these must be uniform in nature before there could be a miracle. God does not perform miracles promiscuously.

Dr. P. Stoner: There is a problem involved that is most critical. That is a lack of agreement between science and philosophy. Philosophy is suspicious of the sciences. I attended in Pasadena a series of lectures given by a prominent philosopher on the relationship between science and Scripture. Night after night he presented the conclusions of science regarding certain events recorded in the Bible. As far as I can remember, in every case, science was grossly misrepresented and the conclusions were of course erroneous. Science and philosophy should get together.

Mr. F. Everest: There is a tremendous difference between the method of approach of the scientist and the philosopher. As long as the philosopher insists on God creating trees with rings in them and light half way between earth and stars he will be in conflict. It is not a question of whether God could do those things. It is only a question of whether God's nature would allow it. There is the crux of the disagreement.

Mr. J. Sinclair: Recapitulation—I believe we got away from the point of the paper. Dr. Barnhouse wrote a defense of Dr. Kulp. I do not believe that is the issue. Dr. Carnell does not believe that Kulp is a Neo-deist but only that this concept of uniformity which Dr. Kulp is using is the sort of thing that will strengthen the argument of the Neo-deists, and will leave us without a defense against them.

As to whether God could have created a world of deception, i.e. trees with rings, etc., I believe there are things that God cannot do, things for example that are not consistent with his nature. God cannot lie.

"Child Training, the Mechanics of Culture Formation"

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I.
Introduction

"Train up a child in the way he should go; and when he is old, he will not depart from it." (Proverbs 22:6)

In one of the many recent studies in anthropology we find a parallel to this verse. As Haring writes: "With due allowance for physical and regional limitations and for cultural history, the unique aspects of any society are determined and maintained by emotional habits learned in infancy by a majority of the participating individuals. Much of this learning occurs before the infant learns to talk."[1]

From these investigations into the genesis of human culture origins, there has come the following generalization: All normal children born into any society are equipped with the same physical and psychological structures which will allow them to become normal adults in any human society.

In this paper we will assume that the basis for different cultures is due to the emphasis each culture makes to various basic forms and to the degree each culture values these forms. We will not assume, as some writers do, that cultures result from qualitative, evolutionary differences of inherited physical or psychological traits.

This concept of culture formation may be illustrated in this way: A child born into any society is like a blade of grass. As the blade grows its course is directed, in part, by the objects with which it comes into contact. These objects direct and often change the course of the growing blade, sometimes producing a lasting impression upon it. So with a child.

Throughout the child-hood period of the infant its cultural environment directs the course of the child's life. Its parents and elders, themselves fashioned by the same cultural traditions, help the child to learn the same traditions by: "do this, don't do that," as well as to learn such cultural values as are found in the ethos, mores, customs, rites and behavior of that particular culture. When all of the experiences of all the children are similar (not exactly the same), we have a group which has been moulded in a pattern of culture.[2]

The approach to this study that we are about to undertake is non-evolutionary. We do not assume various levels of cultures; nor human beings in various stages of evolution when either the cultural levels or the human stages are based upon differences of kind.[3] We gladly admit to differences in degree or development, if these differences are based upon a one-level theory of interpretation.

A one-level, horizontal as opposed to the evolutionary vertical, theory of culture interpretation must assume a basic similarity of culture forms and that these forms have developed either independently, or by borrowing, from a common center.

Most cultural historians agree that all cultures have the same forms and that the place of origin of most cultural forms was Mesopatamia. Bishop, for example, says: "As we have seen civilization (culture), appeared earliest in the Near East. There, certain animals were domesticated, certain plants brought under cultivation . . . " Speaking of Eastern Asia he continues, "Nothing has been found to suggest their independent origin there, while in certain instances we found definite evidence of their ultimate derivation from the West." He concludes by saying, " . . . the stimulus imparted by cultural diffusions from the ancient Near East must have been due (to) the origin and fundamental type of that civilization which eventually took form in Eastern Asia."[4]

This horizontal interpretation of one-level culture can, perhaps, be better understood if we use a wagon wheel for an illustration. The hub may be considered as a common point of origin of all cultural forms. It also implies that most cultural forms were found in a common point of origin. The spokes, radiating from this hub, are cultures extending into the world, each culture stressing one of the cultural forms more than others. As one comes nearer the rim the greater the separation between the spokes, so, in like manner, the greater the cultural differences between societies. Time differences are also noted. The nearer the hub, the older in time; the nearer the rim, recent and modern times.

Some cultures have gone farther in one direction than others. For example, American culture has emphasized "technology" more than any other culture. Our "spoke" has gone toward that cultural end more than, for example, Navaho culture. On the other hand Navaho culture, stressing "religion" and cosmological concepts, has gone farther in that direction than the West whose religion seems to be materialistic and economically flavored. In this way we are better able to appreciate the differences between cultures and not the evolutionary superiority of one above another.

All cultures have these and more forms in common: a basis for human relationships so that person A will call person B by some relationship term; language, so that A may communicate with B; social distinctions and relationships, so that A may marry C without fear of incest; a belief in a Supreme Being or Creator, so that life will have meaning and the culture enjoy a common goal; a behavior based upon sex, age, status and role, so that A's society will be well organized, although recognizing a minimum of individual differences. Other forms may be added to

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1. Haring, D. "Aspects of Personal Character in Japan," **The Far Eastern Quarterly**, Nov. 1946, p. 14. Also Mead, Linton, Kluckhohn, Gorer and others.

2. Horner, George R. **La Litterature orale:** son emploi comme technique pour l 'etude de la structure sociale et psychologique des tribus indigenes. Doctorat thesis, Sorbonne, Universite de Paris, June, 1950, p. 45.

3. Such as in L. Morgan, **Ancient Society**, Chicago, 1877, pp. 3-18. A modern champion of cultural evolution, among the anthropologists, seems to be L. A. White. "Evolutionism in Cultural Anthropology," **American Anthropologist**, Vol. 49, 1947, p. 410. He writes: "I have repeatedly emphasized its (evolutionary) importance in all fields of science and have pointed out that cultural anthropology and orthodox theology are about the only places of hospitality and refuge for a philosophy of anti-evolutionism at the present time. I believe . . . that this era of reaction will again become not only hospitable to, but employ with skill and vigour, this basic concept of all science." See also his book, **The Science of Culture**, New York, 1949, chapter 13.

4. Bishop, Carl W. "The Beginnings of Civilization in Eastern Asia," **Journal of the American Oriental Society** (Supplement), No. 4, Dec. 1939, pp. 60-61.

this list such as handicrafts, war, social control, property rights, etc.[5]

We will now preceed to our study of child training, the mechanics of culture formation, using the Bulu culture to illustrate our thesis.

II.

The Bulu life-cycle

The Bulu belong to a group of south-eastern French Cameroun tribes who have a tropical rain-forest culture in common and who speak a similar language. They live in an area extending from about 3 degrees north of the equator, to, from about 10 to 13 degrees east of Greenwich.

All cultures in all parts of the world use the life-cycle period of its members to teach the cultural values and goals thought important by a culture. Of the eight or so stages recognized by the Bulu in their life-cycle, we shall consider the first five. They are as follows:

English	Bulu sense	Bulu equivalent[6]
pre-natal	"in the mother's belly"	abum
infant	"carried in the mother's arms"	nkengele mon
child, 1-2 years	"still nurses from mother"	etume mon
child, 2-4 yrs.	"after period of lactation"	mon
adolescence, 5-12 yrs.	"boy or girl"	mongo

A.

Pre-natal - abum

Bulu men and women believe that they are guided through life in proportion to their good relations with the Unknown or with their ancestors.

One of the most "dangerous" periods of life, times when the most "care" must be exercised, is during pregnancy. The future of the unborn child, it is believed, rests jointly upon its future father and mother.

There seems to be at least two general kinds of behavior expected of each parent: (a) a series of negative restrictions and taboos and (b) a positive behavior which will have lasting influence upon the embryo. These can be illustrated in the following personal experiences:

(a) Bulu culture usually permits the man and not the woman to eat the tiny wood-antelope (okbae). During pregancy neither the husband nor the wife are permitted to eat it. If they do it is believed that the child will be born tongue-tied and foolish like that antelope. This type of negative taboo presents a strong control upon both parents and there are hundreds of similar examples which are conscientiously observed.

(b) A mother or father must do certain things to insure a healthy child. One day while traveling through a village, I noticed a pregnant woman with the entire lower part of her abdomen, including her legs and feet colored dark red. Upon asking "why?", I was told that the color "would give the baby a good dark color at birth". Sometimes there is a compromise between the following of the old tradition and being Western when the modern girls redden only their ankles!

B.

Infant, nkengele mon.

A newly-born male child takes the name of its father plus a given name. In addition it has a "nick-name," usually describing a behavior characteristic of the child. For example, a child, soon after birth, may make dove-like sounds; "U-U-u-u-U-U", in a rising and falling register. Such a series of sounds would soon give the child the nick-name of "zum," the Bulu word for wood-dove.

Although the Bulu prefer a girl for the first child they are happy to have a boy. Often a spear is placed along side of it so that the boy will become a good hunter and a provider when an adult.[7]

Later, on the first day of his life, its father and grandfather wash the baby with special water and instruct it with the following words: "all you desire will be yours . . . you will be rich with fifty wives." At this time they give the baby "power" to have many other riches and withstand the evil workings of the sorcerer (nbenba'a). Personal and family taboos are recited to it at this time. In later life the father will remind the son of these. One man told me that as a child he was forbidden to eat chimpanzee meat because it was a personal and a family taboo, although others in the tribe could eat it without resultant danger to them.

A cultural pattern is beginning to be observed here. Although there are similar negative and positive culture forms of this type found on a world-wide distribution, the Bulu apply meanings and usages to goals peculiar to their own cultural survival pattern and environment.

The negative traits are prohibitions. You can't do certain things or evil will befall you or your village (jal). Atonement must be made as quickly as possible, usually with the services of the feticher (bekungo).

The positive traits are good for through them one can attain cultural-goals or ideals considered important. These ideals and goals give meaning to the otherwise meaningless traditions.

The cultural goal of the Bulu child is for it to grow up to be a rich man (nkukum) with riches of animals and many wives. When there is such a "capitalistic" cultural goal it can normally be expected that the society is highly competitive. Such is the case of Bulu society and culture. The Bulu have placed a value upon acquiring riches more than on any other cultural trait. This is due to (a), the general belief that at death a man would enjoy a similar social level as in life (b) wealth gives a man high status and prestige. Wealth is measured in the number of "things" a man possesses—wives, goats, sheep, etc. All these, and more, represent "liquid assets" in the Bulu value system.

For this reason a girl is preferred as a first child rather than a boy. The boy represents an outgoing of securities at marriage while a girl represents an increase of capital. It must be clearly understood that wealth is also valued in a social and religious sense as well as economic, in fact there is no compartmentalization of cultural meanings such as we consider them in Western culture.

At infancy there is an unconscious learning or conditioning to one's cultural environment. The Bulu

5. Murdock, George P. "The Common Denominator of Cultures." **The Science of Man in the World Crisis**, (Linton ed.), Columbia, 1945, p. 124.

6. Key to the pronunciation of Bulu: Bulu i as in English kay; e as in say; o as in o.k.; o as in aw; e as in prefix eu.—Europe; a as in ma; a-final as in cat; and u as in you. Consonants have practically the same value as in English, except n as ng - sing; ' glotal stop and b as implosive. The last letter is formed by a sudden implosion of air into the oral cavity, instead of an explosion as the b in book.

7. The root of this word "nken" also means "spear," suggesting the influence the spear should have on the boy's life. Bates, George, **Handbook of Bulu**, Elat, Ebolowa, Africa, pp. 135-142, 1926.

child enjoys a closer relationship to its mother than is normally the case in Western society. The Bulu child is never separated from its mother's side from birth until after the period of lactation, about two years. By night the infant sleeps at its mother's side, while by day it is fastened to her back. It is a mother centered child. Its mother serves it whenever it cries. The father has little to do with it during this stage of the life-cycle.

However, it is not unusual for the mother to hand her infant over to another woman to nurse or to hold. Later, the child is made to feel at home in any house in the village, reminding us that the child is both the child of its parents as well as its village.

There is little or no discipline for the child, it never receives, for example, any toilet training. The Bulu child is learning to be dependent in the sense that it depends upon others even at this early age. The American child, by comparison, learns to be independent. It is encouraged to be independent. It sleeps in its own crib shortly after birth. The American mother believes in leaving her child alone for rather long periods of time while she tends to other work. Even the American child's feeding is put on a definite discipline, of feeding at only certain hours. The mother of the American child separates herself from it with at least one material object: a crib, bassinet, buggy, stroller, pen or swing.

The two children, Bulu and American, are learning different patterns and values of life. By the time they reach adulthood, they will be different, they will have been configured by different life patterns.[8]

Even though both the Bulu and the American culture are "capitalistic" the former emphasizes social and religious concepts of capitalism instead of the technological and material based upon money of the American.

C.

Child - etume mon

A Bulu child stops nursing at about the age of 2-3 years. Ordinarily, at that time, its mother expects another child. Just as she and her husband must refrain from sexual intercourse for two years during her period of nursing her first child, so she must become pregnant as soon as the first child stops nursing. In this way, they think, she will be highly honored and respected by her husband, his family and village. A definite goal for a woman to attain is to have many children.

A change of attitude is noted toward the first child after the birth of the second. The first baby is forcibly pushed away when it tries to nurse from its mother. It is no longer carried but made to walk whenever the mother carries the second child on her back.

At the same time two important social relationships take place for this seemingly neglected first child. (a) A little girl (mone kal) is assigned to care for the older child's needs for another year or two. She must carry it wherever she goes whether it be to the spring for water or to the garden to work and (b), the child begins to call every other woman in the village by the term mother (nyua). In this way it is made to feel at home in all the village houses. It calls all of the other village children brother or sister. A learning process, a realization of a cultural goal, is a work which will later give the child a sense of group solidarity, a social identification with all others in the village.

These relationships are not so strongly marked, if at all, by the American child and family. An American mother doesn't usually take care of one child more than another; if she does, it is usually without the little ones realizing it. Nuclear family loyalty is stressed in the West instead of the composite village family of the Bulu, with the Western mother and father taking an equal interest in the children. There is certainly no "village" loyalty, as understood by the Bulu, in America.

D.

Child, mon

Play, as a form of recreation, is unknown to the Bulu child. True, the little girls dance, but they are learning particular dance rythms to be danced, for example, at the next wedding. Or the little boys play with miniature traps, but they are learning to be hunters, for if, per chance, they succeed in catching a bird or an animal, this animal goes into the family larder. Play is not only "for keeps" but it is cultural education toward a known end.

About this time in the life-cycle the boy is circumsized. He is admitted into the men's group where, at night, they all sit around a smouldering camp-fire of the palaver house (aba) listening to the professional story-teller spin tales about the forest people: the turtle (ku), leopard (ze), red-antelope (so), the elephant (zok), the gorilla (ngi) and the rooster (nnome kup). Each animal represents a human type to be shunned or emulated. Each folktale has a morale behind it giving the Bulu boy simplified lessons in cultural goals and individual values in the Bulu reality system. The turtle (ku), for example, is wise, generous, just, good and at the same time, two-faced, a liar and often dishonest, ethical values which reflect Bulu personality with unusual fidelity.[9]

The Bulu girl, living in the kitchen and in the garden close to her mother day in and day out, plays house in earnest. Often a little four year old will be seen coming along the forest path with a stick of wood on her head. Older girls will have baskets of produce upon their heads, or upon their backs strapped to their shoulders.

A girl will learn from her mother how to make a garden, hoe it, rotate the crops, how much land will be necessary for a year's supply of taro. She learns what grows best in various seasons and when harvest time comes for the various kinds of food plants. Her future marriage depends upon how well she gardens and keeps house. Wherein an American girl is interested in the beauty of her face and the slightness of her figure, the Bulu girl will strengthen her arms and legs, for survival depends upon strength and not so much beauty.

In the home the Bulu girl spends hours grinding, preparing and cooking food. If there are younger children she must watch for their every need and supply it if possible. She is a permanent "baby-sitter".

Her mother teaches her daughter about men: to talk well to them; to lie to her husband if necessity demands it; how to live in her husband's village and how to get along with her future mother-in-law. She teaches her dance steps and songs and meanings of certain dances, for they are often symbols of life's deeper values, presented in a non-emotional manner.

In turn, the boy changes his loyalty from his mother

8. Configuration is Benedict's original term. Later she introduced the phrase "patterns of culture". Benedict, R. "Configurations of Culture," **American Anthropologist**, Vol. 34, No. 1, 1932. Benedict, R. **Patterns of Culture**, New York, 1st ed. 1934.

9. Horner, George R. **Litterature orale**, p. 189.

to his father. He accompanies him on a hunt; helps cut the bush for his mother's garden; learns to use a cutlass; build a house and make the mat roof; learns the names of all the economically important animals; to stay away from the village (jal) girls who are in effect his sisters. His father teaches the boy the intricate rhythms of the dance drums and the drum language so that he can send messages across the miles of jungle to the next village. If he belongs to a special family he is taught to become a feticher, an iron-smith, or a carver of wood and ivory.

Both boys and girls learn about the unseen things which cause fear: about the nbe and the evu. The former, the evil within certain men who sometimes become sorcerers; the latter, evil spirits who fly at night crying the eerie cry of the white owl and eating the hearts of sleeping men or women causing death. The Bulu believe that all death is murder.

To the American child of this age, play is recreation and not an essential factor for survival. We protect our children as much as possible from the cruel realities of life, introducing them to life's competition after high-school or college graduation. There is no such protection for the Bulu child, hence there is no difficult period of adjustment in later adolescence for these Africans.

E.

Adolescence, mongo

The latter years of the mon stage and the beginning of the mongo are merged. Life's competition and responsibilities weigh heavier upon the shoulders of both the boy and girl of this age level.

Their culture has pretty well impressed its pattern upon their lives. They are looking forward to the end of this period so that they can marry, have children and enjoy, for the first time, social recognition, independence and status, being finally recognized in a social sense as male or female, for up to this stage in their life-cycle, they have been considered as neither. Bulu society doesn't recognize them until the next stage as a marriageable boy (ndoman) or a girl (ngon) and, finally, when they are either a man (fam) or a woman (minga).

Physical differences and awareness are becoming more marked, but unlike the American counter-part, the Bulu boy or girl does not pass through a series of crisis periods, climaxed in tears or frustation, wondering what the future will bring. The Bulu youth, with a security in their traditions and their way of life, are just as sure of tomorrow, all things being equal, as they are of today.

The girl becomes demure and modest. She eagerly listens to the conversations of her married village sisters telling about eligible boys in their villages. The girl hopes that her sisters will tell the boys and their parents about her so that one will come to visit her. She will soon be a marriagable girl (ngon).

The boy joins the red antelope (so) society. He learns the laws and geneologies of his family (village, ayon). His sisters will tell him of the eligible girls in the next village. Soon he will go to meet one and talk of the possibility of marriage to her and her parents, for his father must have time to start the dowry (nsuba). The boy will soon be a marriageable young man (ndoman).

Both the boy and the girl can now do all the things their parents have taught them in the traditions of their culture.

III.

Conclusions

The Bulu baby, born with the physical and the psychological plasticity to fit into any known culture has developed into a true Bulu.[10] The baby has been singularly configured and moulded by all of the goals and patterns of its culture.

He or she will now say in response to the question, "why do you do this?" "because my (fore-) fathers did it." "It is our custom." Any other way will seem strange and foreign to him, he can not understand it.[11]

In this paper we have sketched the mechanic of Bulu culture formation through child-training. We have seen how a particular culture makes use of a world-wide cultural forms and applies them in a special way —a way of life. We note that Bulu culture is not a result of ignorance, superstition or that it is a result of a people on a lower evolutionary scale than ourselves. Rather, it is a well-balanced mixture of cultural forms which give life meaning, survival and goals to a group of people as they are taught, through childhood, to become a part of it.

10. "Every individual at birth has the capacity to fit into any known culture," Parsons, Talcott. Essays in Sociological Theory, Free Press, 1949, p. 46.

11. The Bulu seem to be becoming rapidly Westernized. Protestant Christianity has been among them for more than sixty years. Many of the older customs, like the sorcerer and the fetticher have been substituted with the functional substitute seemingly found in Christ. On the other hand, Westernization has only changed the outward appearances while the same covert, social and cultural goals remain the same. In fact Christianity and Western culture have been the means permitting the Bulu to achieve their goals faster than ever before, in having things and becoming rich.

Instead of disorganization, Western culture has given the Bulu a greater solidarity and "oneness" than they ever realized before, in, using the French language, their concept of "la race boulou".

*The Evaluation of Radioactive Evidence On The Age of the Earth**

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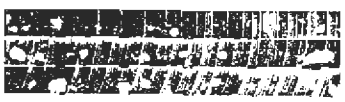

Man is naturally an inquisitive being, ever anxious to know the answer to every question arising to vex his imagination. "How old is the Earth, and when did life begin upon it?" are two over which mankind has been pondering for many years. Ussher's chronology was but one attempt to supply the answer. It sufficed so long as believers in the inspired Scriptures interpreted the Genesis record to imply six solar days transpiring between Genesis 1:1 and the creation of Adam. Realization that the "yoms" of creation were "God's days," defined elsewhere in the Scriptures (Ps. 90:4, and II Pet. 3:8) apparently for the specific purpose of throwing light upon Genesis 1, together with unbiased analysis of the record itself resulted in a reorientation of Christian thinking. It should be emphasized in this connection that this has not been

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at the expense of belittling or questioning the inspired record. Rather does it serve to prove its literal accuracy when properly read.

It has not been primarily those accepting the inspiration of the Scriptures who have been responsible for pressing the birthday of the earth back into a remote past. Mechanistic evolutionists who require an enormous amount of time for the operation of any of their numerous theories have ever been the aggressors along this line.

Many are the approaches to a solution of the question tried out as yardsticks with which to measure earth time, among which might be cited: The salt concentration of the seas; the stabilization of the tides; the time required for the earth's crust to reach its present temperature; the rate of attrition of surface rocks; their re-deposition and solidification as sedimentary rocks, together with many others.

To apply any of these involves the making of certain assumptions but such procedure is common in scientific reasoning. The main objections to their testimony lie in the lack of agreement between them and their failure to indicate as great an age for the earth as mechanistic evolution requires. It is not surprising, therefore, that a "made-to-order" yardstick such as radioactive disintegration should be pressed into service. In the beginning, early estimates of the earth's age, as proposed by Kelvin, Rutherford, and others were around 400 to 500 million years although a few men of science went as low as 20 million. All figures were soon increased materially, Sir James Jeans putting it at 1450 million years. Later estimates went to 2000 million while the present tendency is to place a possible ceiling appreciably higher than this, even exceeding 3000 million years.

The Symposium on "The Age of the Earth" published by the A.S.A. in 1948 constitutes a fine presentation of the fundamentals involved in radioactive methods of dating. It makes unnecessary at this time a further review of the methods themselves, of which there are several. Briefly summing up the evidence on which radioactive dating is being accomplished, we can itemize it as follows:

1. All radioactive elements are continually decaying or decomposing (through giving off energy) into elements of lower atomic weight.

2. The rate of decay is specific for each element; some so slow their lives are measured by many billion of years; others, largely intermediate radioactive elements, may have lives measured in minutes (or less), hours, days, or years. The average life of radium, which is itself an intermediate element, is around 2500 years. To reach complete decay requires a much longer time than this. For practical purposes the rate of decay is expressed in half-life, that is, the time when one-half the original total energy would be gone. Then the average life is equal to 1.45 times this figure, a value derived by integrating the curve of total life.

3. It is possible to determine the half-life of all radioactive elements very accurately.

4. The rate of decay in every case has been found to be absolutely constant. These rates, so far as we are able to determine, are unaffected by any known external condition (e.g., such as temperature, etc.) and by such evidence as is available, identical in past ages to the present rates of decay.

5. The end products resulting from decay of natural radioactive elements have all been determined. In the case of those of higher atomic weight than lead the stable end product is some isotope of lead and the gas helium.

6. These conditions being so, we can understand the logic of assuming that an analysis of any rock or mineral originally containing a radioactive element, e.g., uranium for example, to determine the ratio existing between the element and its lead isotope present with it (and perhaps the helium ratio also) will indicate the age of the rock or mineral in question.

Numerous conditions prevail which complicate the making of accurate determinations. For instance: 1. Leaching out of some of the uranium. This will indicate an older rock than actually is the case. 2. Lead may have migrated from the mineral under test, giving too low a figure.

3. Helium may have diffused from the mineral (which appears to be a common condition) also resulting in a low figure, usually lower than the corresponding U/Pb ratio from the same sample.

4. There is always the possibility of helium being present in the rock which did not originate as a radiogenic product.

5. The same can be said for the possible presence of lead not resulting from the decomposition of the uranium. In this case this is always assumed to be indicated by the presence of lead isotope 204 which can be isolated by means of the mass spectrograph.

Other conditions are also recognized, some of which will become evident later, but all in all, radioactive methods of dating appear, at least on the face of it, to have much merit.

It is unfortunate that the majority, if not all of those engaged in this type of research are ones definitely arrayed on the side of mechanistic evolution. Such being the case we can expect a natural bias in favor of a maximum time scale. While, except for one all important issue which we shall consider later, it makes no difference in the literal accuracy of the Genesis account of creation, how old the earth may be or how long life has existed upon it, we are anxious for unbiased facts. This calls for a literal application of Paul's admonition, "Prove all things, hold fast that which is good" (2 Thes. 5:21). Where mechanistic evolution dictates figures our position might well be, **"Timeo Danaos et dona ferentes."**

With this in mind, the question I wish to raise at this time is, "Are there factors in radioactive dating which have not been taken into consideration, or given due weight?" I believe there are and that the A. S. A. should present these to the scientific world for further study.

The first issue will take us back to that time considered "the beginning." In what stage was the earth then, as indicated by radioactive evidence? That a beginning of some sort is predicated is apparent from the assumption that uranium (and other radioactive elements present at that time) had not yet evidenced any decay. This is equivalent to saying that radioactive elements did not exist previously. They therefore must have been formed at some specific stage in earth formation. This is certainly in accord with Genesis 1:1.

Regardless of what theory one elects to accept as to how the solar system came into being, the fact remains that all evidence points to a common origin for the sun and its planetary system. The formation of all the elements, probably starting with hydrogen (since this still represents 81.76% of the total volume

of the sun, helium accounting for 18.17% of the remainder) and progressing to those of higher atomic weight according to some fixed law ordained by the Creator, must have been a part of the creative process.

As to the origin of radioactive elements, it is logical that radioactive decay be a reversible process. Just as the formula for decay is U^{238} — energy = Pb^{206} + He, so the formation of uranium in the beginning can be expressed Pb^{206} + He + energy = U^{238}. How the Creator brought about conditions in the beginning to effect this synthesis must be considered at this time, as far as positive knowledge is concerned, one of the "secret things belonging unto God," (Deut. 29:29). There is, however, in the known existence of cosmic radiation, perhaps millions of times greater in earth's formative period, one suggestion of the means He might have employed. Also present processes for producing transuranium elements offer other explanations.

Presumably all the steps involved in the decay of U^{238} to Pb^{206} were reproduced, in reverse order. But notice this involves the pre-existence of both helium and all the natural isotopes of lead. Stable isotopes 206, 207 and 208 frequently are referred to as radiogenic since they represent stable end products of radioactive decay. The assumption appears common that these came into existence through decay processes. There is not only no logic in this assumption but ample evidence it is not correct. Nor is it an assumption held by research workers in age determinations.

Of all known elements about three out of every four have from one to several natural isotopes. This is true of lead also. The atomic weight of ordinary lead is 207.21. This figure results from the relative abundance of all stable isotopes of lead, usually found together in the following percentages (Nier's figures):

204 — 1.48%
206 — 23.59%
207 — 22.64%
208 — 52.29%

Helium and lead are both present in the sun but no radioactive elements of higher atomic weights than lead are known to exist in it. The sun apparently represents a condition where their presence is not possible, although the building blocks out of which they can be formed are at hand from which they can be produced under proper conditions.

Regardless of the state of formation the earth was in when the reaction producing the radioactive elements was completed it would appear to be the time indicated by radioactive evidence as "the beginning." But still an uncertainty exists.

In a reversible process such as under discussion there are obviously three stages to consider, all of which conceivably might be included in the **total** age of the earth, viz:—

1) The formative period during which energy was in excess and utilized in the formation of radioactive elements. If this were a slow process, as appears logical, it might even be measured in terms of billions of years. This would mean nothing to an eternal Creator. This time would not be indicated by radioactive decay.

2. An equilibrium stage during which energy was not flowing in either direction. Here again might be involved a long time period.

3) The present unbalanced condition in which energy flows out of radioactive elements. The beginning of this stage would be dated by radioactive evidence. Even here, however, another factor might affect the time figures. While all evidence indicates decay rates have always been constant, there exists the possibility that transition from a state of perfect equilibrium to one of normal decay might have been so gradual as to retard materially the decay rate at the start. Such would again increase the actual age of the earth over that indicated.

Our reasoning thus far relates to the energy factor only. Others have to be considered. As stated, both lead and helium must be present, probably in abundance, judging from the percentage of both existing in the earth today. Since a natural process of producing radioactive elements is not known to be operable in the earth under present conditions (except for the formation of C^{14}) the limiting factor must have been the supply of high potential energy. When this was used up, or conditions on the earth so modified radioactive element building could no longer continue, the process stopped, even though both lead and helium were present in excess. By analogy, the condition existing might be likened to the formation of silicate minerals in the presence of excess silica. The latter finally forms the free silica of acid type rocks. In a case of this kind, how are we to prove that some of the helium and lead isotope found in a given analysis are not in part residual, remaining **in situ** within the mineral from the beginning? A simple illustration may serve to make this possible condition evident.

I own a French clock, bought over forty years ago. It was guaranteed to run 400 days with one winding. Through the years I have proved this claim justified. A friend visits me and becomes interested in the clock. I tell him of the 400 day operation and by coincidence while he is at my home the clock stops. I see him take out a pencil and start figuring. Soon he announces that I must have wound the clock on or around July 1st of the previous year. He has believed me and had faith in the clock. No wonder he is surprised when I tell him he is wrong, for I remember winding it on Christmas day. Is the fault with his mental process or figures? Not at all; I explain that when I wound it I was in a hurry so did not take time to wind it all the way up! Just so, like the portion of unwound spring in the clock, the presence of untransformed helium and lead isotope (206, 207 or 208, as the case may be) associated with a radioactive element could throw all calculations as to the age of the earth entirely off; the indicated age would be too great. This condition has been recognized and all possible means to nullify its effect on accurate age determination have been employed. But still the uncertainty persists because the only indication of untransformed lead is assumed to be the presence of Pb^{204} also. When mass spectrographic analyses indicate the presence of Pb^{204} the presence of ordinary lead $Pb^{207.21}$ is suspected.

Were it not for the fact that radioactive decay, comprising as it does three different radioactive elements altering the proportions of lead isotopes so that ordinary lead ratios presumably no longer hold good, it should be possible to multiply the percentage of Pb^{204} present by 66.5 (i.e., 98.52/1.48), then subtract this value from the total lead of all isotopes present, considering only the remainder as radiogenic lead. But this, of course, will not work. About all that

can be assumed is that some of the lead present was not radiogenetically produced and that the true age of the rock is under that indicated.

It is interesting to note in Nier's classic work the common absence of Pb^{204}. In only a few instances does it show up to confuse the determination. He assumes its absence to indicate all the existing isotopes of lead to have resulted from disintegration of U^{238}, U^{235} or Th. But if the synthesis (we will call it that) of radioactive elements commenced with ordinary lead ($Pb^{207.21}$) it would be selective from the start and the various isotopes would soon cease to be lead, in their progress upward toward the end of the series. Unfortunately we cannot know the conditions existing in the formation of the earth at this time, hence can only theorize. Should the temperature have been high, as appears reasonable the lead would have been in a molten state but after a time the element under formation would possess a higher melting temperature. For instance, lead melts at 327°C (620°F), radium at 960°C (1760°F), and uranium and thorium at around 1850°C (3360°F). When freezing temperature of any intermediate radioactive element was higher than that of the earth or the rock magma in which it was located it would solidify. Unaltered lead (e.g., all of Pb^{204} and such portion of the other isotopes as remained) would still be fluid and might be dispersed elsewhere. In this case we would not expect original lead to be present. It is also possible, on other grounds, that radioactive element generation, even in its incipiency would affect a segregation of all lead isotopes, Pb^{204} being rejected while the others, having an affinity for helium in the presence of energy (especially if catalytic action played any part in the synthesis) were retained. Varying local conditions might result in different final results, hence, as in the case of one of Nier's analyses, the presence of 0.884% of Pb^{204} could be accounted for. It is the numerous uncertainties in the problem which render true interpretation of analyses, when translated into terms of earth age difficult and inconclusive.

Once it is realized that minerals like uraninite are not chemically pure combinations as we would expect, but (to employ a modern expression understood by all) contain a little of everything but the kitchen sink, the force of this line of reasoning is appreciated. Dana's analyses of 26 different specimens of uraninite emphasize this fact. They show in addition to lead,—iron, silicon, phosphorus, zirconium, manganese, magnesium, bismuth, copper, zinc, arsenic, sulphur, and elements of the rare earth series. But most suggestive of all is the universal presence of nitrogen in fairly large amounts. Of course analyzing for helium was not done at the time these analyses were made, but assuming the accuracy of the determination we can see the strong possibility that nitrogen accompanied the helium. In this connection it should be noted that next to hydrogen and helium the elements occurring in the sun in greatest volume are respectively oxygen, magnesium and nitrogen. Since nitrogen is not in combination with uraninite it must have been occluded in its atomic lattice from the beginning. Of course there is a possibility of an error in determining the gas as nitrogen, it might have been helium. It was not until several years later that Ramsey discovered helium in the mineral uraninite.

An interesting sidelight on radioactive dating comes from a comparison of age figures compiled from these analyses of uraninite (Dana's "System of Mineralogy," 6th ed., reprinting of 1922, first printing 1892) with figures of Goodman and Evens (1941) quoted in Dr. Rex's article in the A. S. A. symposium. Dana's analyses cover 26 mineral specimens, made prior to the discovery of radioactivity. In compiling figures from them it was necessary to consider the UO^2, UO^3 and ThO^2 as a unit, in checking against PbO. Two groups of Connecticut uraninite are given. Five from Glastonbury average 234 million years and three from Branchville 310 million. These compare with Goodman and Evan's figure for Connecticut uraninite (locality not stated) of 366-371 million years. Even though the figures themselves are a good check they suggest the presence of some of the factors I am pointing out, since all the pegmatites of Connecticut should be of substantially the same age.

Five analyses of Norwegian specimens in Dana's list average 775 million years while two more (Arendal) give a higher figure of 925 million years. These compare with Goodman and Evan's value of 1085 million years. Again a fair check but the same comments apply. It also suggests the present tendency to establish as high a figure as possible. Dana also gives an analysis for Colorado uraninite in which the PbO is only .70%, yielding an age figure of 52 million years. This figure compares favorably with one determination by Goodman and Evans of 54 (He) or 69(Pb) age, quoted by Professor Stoner in the symposium.

There yet remains another, and I believe more plausible, objection to figures derived from radioactive determinations as they are now accepted. If the premise of the origin of radioactive elements through reversible addition of energy to lead isotopes be allowed, the logic of a step-by-step build-up through intermediate elements is sound. Action and reaction should be equal but opposite in direction.

It is, of course, well known that uranium does not transform directly to lead, but through a multitude of steps, or intermediate elements, all radioactive themselves, some with long life, others extremely short. Granted a reverse process, at any stage of build-up all these intermediates would be present after sufficient time had elapsed to allow the initial process to reach the last of the series, U^{238}, or other, as the case may be. Stop the process at any instant and a portion of the element which started out as a lead isotope would be present in each transitional radioactive element. In other words, radioactive equilibrium should be present in a buildup process just as much as in decay. This means that should decay commence following the stopping of the process, every intermediate element would begin decay as a parent element in that their contained energy has never attained a higher level. Helium and lead would be produced which never originated in the beginning of the series. Consider the possibility that only a fraction of the additive energy had opportunity to reach the level of U^{238}, with a correspondingly larger portion resided in U-II (U^{234}). U^{238} has a half-life of 4.51×10^9 years while U^{234} has a half-life of but 2.33×10^5 years. Still other percentages of Pb^{206} (and helium) would be located in Ionium (8.3×10^4 years) and in Radium (1590 years) and so on all down the line. Today we could be measuring the Pb^{206} ratio and assuming it all originated in U^{238}. This same situation could apply in principle to every radioactive method so

far suggested evcept the C^{14}.

Let us consider the problem from still another angle. The fact that the Pb^{207}/Pb^{206} ratio in a given determination is employed as a check comparison (and considered as one of the most reliable of all radioactive methods) against U/Pb ratios is an implication that the origin of U^{238} and U^{235} was contemporary, both starting decay at the same time. Since both are first in their corresponding cascade series this seems logical, but raises another question. The average life of U^{235} is roughly only about 1/6th that of U^{238}. Assuming that whatever energy formed U^{238} was also available for U^{235}, the percentage of their corresponding lead isotopes available as building blocks being almost identical, (i.e., 23.59% and 22.64% respectively) the amount of each uranium isotope in the beginning should have been about equal. Due to their different rates of decay there now exists in the earth only .72% of U^{235} as against 99.276% of U^{238}. This ratio of 1:139 is quite constant throughout the earth, wherever uranium is found. Does it not suggest the true yardstick with which to measure time is U^{235} and not U^{238} and the maximum age of the earth is nearer the average life of U^{235} than the higher figures set by other ratios?

Nier appears to have sensed the validity of this argument and by figuring backwards on the basis of relative decay rates comes to the conclusion that U^{235} originally was not present in so large a proportion as U^{238}. However, granted a difference in the degree of complete synthesis to end products as I have suggested and also a tendency of one to commence decay at an earlier date than the other, his estimated original percentages may be entirely off. This is a line of research that should be followed up in every one of its possible ramifications.

An approach to the age problem, not primarily of the earth but of the universe as a whole has been via the constitution of meteorites. Apparently the original idea responsible for this line of research was the establishing of a firm basis for the helium method, since there should be no loss of helium from a meteorite. While this constitutes a valuable line of research and should yield important information of a cosmological nature, actually it is subject to the same factors entering into the origin of radioactive elements as earth studies.

Helium ages, as determined from some meteorites have exceeded those from terrestrial determinations, being appreciably higher than those derived by other means. Even here, however, the picture is not clear since recent evidence indicates that considerable of the helium of meteorites may have been derived from cosmic radiation. Such would nullify age figures derived from meteorites by the helium method. If age figures determined from meteorites can be considered as evidence of the time of radioactive element formation throughout the entire solar system (or the galactic universe) it raises questions of vital importance relative to age dating in the earth. For instance:

1. Was the general formation of radioactive elements simultaneous throughout the solar universe?
2. If so, what was the spread of time required for the operation of the process and was it completed universally at substantially the same time?
3. Did disintegration begin universally at approximately the same time? In other words, did age time clocks start ticking all together?
4. Can we agree that the time when radioactive decay commenced constituted the true birthday of the earth, that is, the greatest age indicated by any radioactive age determination either on the earth or in a meteorite?
5. If so, is the age of minerals showing a great divergence from maximum age of two or three billion years to possibly as low as 20 million to be predicated on a recrystallization of the radioactive mineral with partial or complete elimination of previously formed end products during a reforming of the rock masses in which they occur? Is this a logical assumption?
6. Is the alternate assumption of radioactive element formation simultaneously with the origin of the rock masses logical?

These should be thought-provoking to everyone interested in this age determination problem. It is not my intention to analyze them in detail. I shall merely mention some implications which must follow as a result of applying them to the dating of geological ages. Granting the premise of uniform radioactive element formation at some distant period in the past and subsequent initial decay, let us say roughly three billion years ago, then follows, **pari passu**, that any radioactive mineral showing an age less than this has undergone modification and re-crystallization at a later date. Such processes can be demonstrated petrographically with practically every other known mineral, hence appear logical with radioactive minerals also. The problem then becomes one of demonstrating the degree of elimination of earlier formed end-products. Some of these must have been eliminated else all age determinations would be identical. But it does not appear possible by any known means to solve this problem. In view of this every age figure except the highest, determined from truly primeval rocks unaltered from the beginning, and the lowest, where elimination of previous end products has obviously been complete, can be viewed with suspicion.

If we take the other horn of the dilemma and assume original formation of radioactive elements to have occurred at the time of formation of a given rock we must admit that so long as radioactive element formation was taking place the earth was still in an embryonic state of development and therefore its true age is that of the youngest rock, possibly only 20 to 50 million years old. In this case the spread between maximum and minimum figures (three billion to twenty million) represents the time the formation of the earth was in a state of flux, a period of gestation, as it were, of an earth about to be born. Then figures for events transpiring on a substantially completed earth should be predicated on the minimum age figure.

On the whole, the former premise appears more logical since it is difficult to conceive of radioactive decay going on for some billions of years while at the same time reverse build-up reactions are occurring at other places possibly not far removed. Nevertheless this provides no accurate dating for various so-called geologic ages. On the basis, however, that substantially consistent conditions prevailed in the formation of all rock masses, relative ages of various rocks can be correct even though the figures themselves be on the high side. On such assumption a complete new scale of rock ages could be worked out independent of those established from fossil dating. Much has been made of the fair degree of correspondence in figures derived from various radioactive methods of dating (though Th/Pb^{208} and U^{238}/Pb^{206} often fail to agree) but if the same factors enter into

all methods alike this should be expected. Errors should be consistent all along the line.

This analysis of radioactive age determinations has not been made with the idea of condemning the methods **per se,** but rather for the purpose of putting them on a more firm foundation. Properly interpreted they can be of great value in establishing geophysical facts. It is these facts we want and proper methods of approach will ultimately yield them.

It would seem the past tendency to establish the age of the earth from the beginning, dividing this time into various ages, is the wrong approach. As pointed out, this beginning means little, if anything, from a practical standpoint. A far better method would be to establish recent dates accurately, then work backward into the past, little by little.

From the standpoint of the fundamental A. S. A. position there exists what might well be accepted as the basis on which to calibrate all types of pre-human dating. Reference has been made to the one exception to long-time dating on which we, and every Bible believing Christian must take an absolute stand. It is in regard to the time when the man created in the image and likeness of God came on the scene. Mechanistic evolution is more concerned in placing the origin of Homo sapiens in the far-distant past than in achieving any other single objective in its program. The reason is not far to seek. The great gap existing between man and the highest of the anthropoids (not on physical or anatomical grounds but on the cultural side) on the basis of an evolutionary development demands almost an eternity of time. Those of us who have followed evolutionary estimates in this respect can recall how the figure, starting years ago at around 25,000 years has been continually increased, to 50,000, 100,000, and now to many times this latter figure. And it has always been predicated on the gradual development of an entire race of beings.

Contrasted with this concept is the Scripture pronouncement that man did not evolve but was created a single individual from whom the entire human race came. This man, created in the image and likeness of God was endowed with God-like attributes from the beginning. Man, as he exists on the earth today is actually a degenerate, possessing in many respects only vestigial evidence of what Adam was before he sinned. And on top of all this he is spiritually dead, typically animalistic in nature, (See Ecc. 3:18, II Pet. 2:12, Jude 10) hence the need for the new birth to restore what man lost in Adam.

The Scriptures provide only a rough estimate or approximation of the time of Adam's creation, such being deduced from a study of the complete written Word in the light of secular human history and archeological (not paleontological) evidence. On the basis of the genealogical record in Genesis 10 the date of the flood must be moved back to at least 3000 to 3500 B.C. to meet definite secular history. If the pre-deluge genealogies are incomplete (which on the face of it appears unlikely) the time of the beginning of the human race logically can be set at 7000 to 8000 years ago, certainly not over 10,000 years as a maximum. To concede more than this is merely accepting the unproved claims and assumptions of evolution.

The question might be raised at this point,—What has this figure to do with radioactive age dating? The connection is a subtle one and possibly overlooked, even by scientifically trained fundamental believers. It can be illustrated by a simple object lesson. Suppose we take an elastic cord, say 12 inches long in its unstretched condition and on it mark off the inches with ink dots. Next we stretch it until it is three feet long. What is now the measure of an inch. It has become three inches.

Whatever the age of the earth from the beginning, evolution has divided it into time inches, or ages, ascribing to each a portion of the whole. We are not at this time interested in the relative percentages alloted to each so-called age although an obvious re-adjustment of these is possible. For instance, if pre-Cambrian time actually were 95% of the whole instead of the 75% usually credited to it, it would modify all other figures accordingly. The point to he stressed here is the effect on **all** time values, especially that credited to man's advent, when the overall time is stretched beyond its correct figure. It is this correct figure, whatever it may be, in which we are vitally interested. To obtain it the first move must be to take the tension out of the elastic cord until an inch actually measures such.

In other words, let us repudiate any dating of positive human finds on which evolution places a figure in excess of 10,000 years as a maximum. Rough stone artifacts associated with obvious human remains need not testify either to a great age or to "stone age" man in an early upward advance. With equal reason they can witness to degenerate man of the race of Adam, probably pre-deluge and of the line of Cain. The Scripture record puts Cain in the land of Nod (Wandering) from the beginning, hence he and his progeny may have reached the confines of all land areas of the earth in the Scripturally alloted time of 1650 years ante the flood. Certainly no one claims the stone artifacts in use by the American Indians less than 500 years ago to testify to stone-age man in an upward progress. The degree of culture evidenced by the Toltecs, Mayas, Aztecs and Incas a thousand or more years before, completely nullifies such conclusion. This entire concept is based solely on a mechanistic evolutionary belief.

It is not my intention to discuss the pros and cons of paleontological evidence but brief mention of it is pertinent to the complete picture. To one accepting the Scripture record of man's early history, devoid of all evolutionary bias, the travesty of mechanistic attempts to demonstrate a great age for man on the earth is pitiful in the extreme. First we have them digging up a lone tooth, a jawbone, or mayhap a portion of a skull-cap which often is not exhibited to all the world for examination and opinions as to its true identity. This is followed by some pronouncement claiming its human relationship, though often disputed by other authorities who do not agree. Sooner or later, however, contra opinions are forgotten or dismissed as of no value and it is read into the record as a definite proof of man's early origin.

On the whole the greatest argument against acceptance of such occasional finds as human links is the paucity of the finds themselves. On Scripture grounds alone the evidence should be more conclusive. From Adam on the record (Gen. 5) states "they begat sons and daughters." This implies an absolute minimum of four children for every generation, let us say an average of six. Granting a generation to be 50 years (i.e., longer than at present) there would be 33 generations in the 1650 years between Adam and the flood. In 12 generations Cain's descendants alone would number nearly one million while in the remaining 1000

years before the flood the number would go into staggering figures. Add to these the descendants of Seth and any other children of Adam and the population of the earth must have been large indeed. Where are the bones of all these? But the real argument is,—"If man did not start with Adam but existed on the earth for countless ages prior to his time, where are the literal billions of remains of all these?" Let us stand fast on this one issue, though we concede eons of earth time prior to God's creation of man.

One of the best, as well as the most recent of radioactive methods is C^{14} dating. The results of late tests reported by Arnold and Libby (Science, Vol. 113, 2927, Feb. 2, 1951) are extremely valuable and enlightening. It is to be hoped this method will not be suborned by those desiring to make it prove more than direct determinations indicate. It is easy to do this by tying together organic material and assumed human remains without positive proof they are of the same age.

It would seem desirable to make radioactive determination on uranium-bearing minerals completely altered from their original form, such as gummite, coracite, carnotite, autunite, torbenite, uranosphaerite, etc., as possible follow-ups of C^{14} dating. They might extend the range of the latter. Yet even with altered minerals consideration should be given to the question as to whether alteration has effected separation of earlier end products. A case in point is Nier's determinations on two samples of Bedford (N. Y.) cyrtolite giving figures of 300 and 375 million years. These are consistent with other values from the nearby Connecticut pegmatites, all of which should be of the same geological age. But cyrtolite is an altered zircon, changed during relatively recent years, so gradually as to retain all the original constituents of the parent mineral. Incidentally, in connection with uranosphaerite, because of its Bi^{209} content a study of this mineral might yield data on the $4n + 1$ radioactive series and add knowledge of this group of elements, the existence of which in the natural state has been questioned.

A practice which should be adopted as standard is the blind determination of uranium-bearing rocks and minerals without knowledge of the supposed geological age of the speciment under test. This would achieve two results—nullify previous bias as to what ought to be expected, and with results freed from possible error, indicate the true age of the rock. The force of this suggestion is evidenced by a quotation from Goodman and Evans, "More specific geological dating is needed in the formulation of a useful lead time scale." No comment is necessary.

It appears more attention should be given to the mineralogical occurrence of uranium and thorium minerals. For instance, why do they occur largely with the acidic rocks rather than the basic? Ordinarily one would expect them to be associated with the basic ferromagnesium rocks (like the metals of the platinum group) because of closer agreement in specific gravity. What of the over-all metallic content of the rocks in which they occur most abundantly? How about relative ages of the acid and basic rocks themselves and their relative position in the earth's crust? I am referring, of course, to the distinctly deep-seated plutonic series and not volcanic or hypabyssal rocks. Attention to such considerations might help to throw light on the age question through the correlation of all possible data.

Another suggestion might be made at this time. Radioactive age dating research has largely been confined to minerals found in rocks the ages of which are assumed to be indicated by basic stratigraphical evidence. It is generally accepted that sedimentary rocks themselves cannot testify directly. This assumption may be incorrect. All radioactive minerals originally present in the rocks from which the comminuted material was derived must still exist, even though widely disseminated. Because of their high specific gravity it should be possible to separate out enough of these comminuted minerals to test for U/Pb ratios. This type of test could be tried out through preliminary study of unconsolidated sands and detrital material. Even in this case some errors on the high or low side might be expected. Certainly tests on relatively pure zircon and monazite sands, also magnetically separated magnetite and ilmenite should prove interesting.

As a part of the complete picture it may be of interest to consider pleochroic halos and the help which might be derived from them. These are discussed in F. Alton Everest's contribution to the symposium. So far interest in pleochroic halos in relation to radioactive studies has been confined to evidence of the constancy of radioactive emanations over long periods of time. There is a possibility, however, that further study of them might provide age data also. Presumably this would have to be done on a petrographic basis, supplemented by microchemical methods.

While halos are frequently referred to in the literature, it would seem that much of the information regarding them is derived from Joly's work on them, supplemented by that of Henderson. Inasmuch as most of their work on them was done on split biotite rather than with petrographic sections, it is not at all complete.

Pleochroic halos are mentioned as occurring in about a dozen different minerals, a few of which may be questioned due to false interpretation of the petrographic slide. They are common in pleochroic minerals and those with marked absorption in one crystallographic direction, such as biotite and other micas, tourmaline, cordierite and some of the amphiboles. The halos invariably surround a nucleus of some other mineral of which there are also about a dozen recognized. The more common ones are zircon, titanite, cassiterite, thorite and uraninite. That the cause of the halos is the presence of a radioactive element was announced by Joly in 1907. Previous to this they were a mystery. That the extent of the halo beyond the nucleus represents the length of the paths of alpha particles of the various radioactive elements in the nucleus as they penetrate the matrix mineral is also known. A few items of interest regarding them which I have observed in my own study of them within petrographic sections may be of interest.

1. They occur only in rocks which are definitely acidic. With the disappearance of free quartz the halos are absent. Examination of many hundred petrographic sections in my own collection has confirmed this.

2. As already noted, they occur only in minerals which are themselves pleochroic or dichroic. No matter how acid the rock may be, if only quartz and feldspar are present no halos are evident. Yet the radioactive element responsible for them may be there since they show up as soon as biotite occurs in the

same rock. This suggests a more common occurrence of radioactive minerals than evidenced by halos. One point I have not been ahle as yet to check as thoroughly as I should like is whether the feldspars in rocks containing halos always include some of the potassium series, orthoclase, microcline, or anorthoclase Should this prove to be the case it might indicate that formation of radioactive elements was brought ahout through catalytic action of potassium. Catalysis plays so important a part in straight chemical combinations, may it not also have been an agent in the synthesis of common elements and energy?

3. The radioactive element responsible for halos apparently can occur in any one of three forms, viz., (a) As a minute particle of a pure radioactive mineral,—uraninite, thorite, radium, or other; (b) As minute inclusions of a radioactive mineral within a secondary host mineral of larger size, evident as opaque particles in an otherwise clear nucleus; (c) As radioactive elements apparently dispersed within the atomic lattice of some host mineral.

4. The extent of the halos in every case must be measured from the outside contour of the nucleus mineral. The shape of the halos conforms to that of the nucleus. Most references to them call them spheres but this is true only when the nucleus mineral itself is an approximate sphere. They can be oval, angular, or extremely irregular.

5. While reference to halos in the literature refer to the nucleus as being extremely minute, actually they occur also around mineral grains of fairly large size.

6. The extent of the halos around the inclusions varies over a wide range, even with the same nuclear material in the same matrix, but all sizes fall into definite groups. My measurements are, in microns, 5, 7, 10, 17, 20, 23, 27, and 33. Joly's figures correspond with these except he does not include the smaller sizes and does include 39 (38-40) which I have not run across. Halos sometimes show two, or even three definite rings or zones, indicating the presence of more than one radioactive element, each with its own specific alpha ray path. Another frequent condition, probably also explained by the same mixture of elements is the amount of diffusion at the border of the halo. The halo can be extremely sharp at its outer edge or very diffuse, with all gradations between.

7. Halos are manifested in two ways,—one which shows as a definite color or absorption when viewed in non-polarized light and independent of the rotation of the stage, and a second which is only evident in plane polarized light, varying in intensity with the rotation of the stage. In this latter case the direction of greatest absorption always corresponds with that of the mineral in which the halo occurs. These phenomena are associated with the crystallographic direction in which the matrix mineral is cut and are apparently independent of the radioactive element responsible for the halo.

8. There is a great range in the intensity of the halos, even surrounding the same nuclear mineral within the same matrix. This must result from the concentration of the radioactive element in the nucleus. It can be explained either by an old condition where the emanations are dying out, or, as appears more logical, it may result from the initial percentage of radioactive element present in a given nucleus. This latter view receivs confirmation from the frequent presence of identical mineral grains (e.g., zircon) within the same matrix showing no halos whatever.

9. Joly refers to negative halos in biotite which he suggests are analogous to photographic solarization. These are areas where the maximum absorption, which in biotite is normal to the acute bisectrix, or crystallographic C axis, has been completely destroyed. The cause of it is at present unknown although several different theories have been offered to explain it. In rock sections this only shows up as a lighter area around an obvious nuclear inclusion, and is rather rare. More light should he thrown upon this when the relative ages of the biotite where they occur is known.

Discussion

After Dr. Allen's paper was read the session leader, **Dr. I. Cowperthwaite,** called for discussion of the paper.

Dr. J. L. Kulp: I would like to divide my comments on Dr. Allen's paper into two parts. It really was two papers. The latter paper, on pleochroic halos, I would like to commend highly. I have looked over the literature on pleochroic halos and it appears that these pictures are the best compilation I have ever seen. I think that some precision densimetry on them could lead to very interesting results and possibly to some more precise data in the range that has not been obtained before.

The first part of the paper, however, had to do with radioactivity measurements. With all kindness, I would like to state that Dr. Allen's training was that of a metallurgist and therefore he might be excused from making errors of fact and concept in atomic physics. I am sure that I would make many more.

My remarks may be organized into four areas.

First I would like to make remarks on certain propagandistic statements. Secondly, I would like to comment on the new objection which Dr. Allen has raised to the radioactivity method of age determination. Thirdly, I would comment briefly on the accepted problems which he brought up and indicate what they were. You will find the answers to those standard objections. And finally, I will briefly mention what I consider to be minor errors in the text.

It is stated that the evolutionists are the people who wanted to push things back. Radioactivity measurement "was pressed into service" to save the day. Another statement was made to the effect that those engaged in this work have a natural bias for producing the maximum time. Now these come in the first category of propaganda. I think they are quite unjustified. There is no conspiracy between the atomic physicist and the evolutionist in trying to discourage some poor Christian. The atomic physicist would probably delight in making paleontologists turn their fossil orders upside down. They are not in league and are quite independent scientists. They start from different premises and they get answers by entirely different means. The atomic physicist and the physical chemist uses quantitative measurement. There is no getting maximum time. This is very important because Dr. Allen referred to it a number of times, that is, that science has been pushing this date back. As a matter of fact, that is not true. Astrophysicists who are concerned about the beginning of things, Genesis I:1, have brought the accepted time for the beginning of the universe, at least so far as they can measure, from 10^{10} to 10^{12} years down to about 4×10^{9}. That's

a tremendous drop. At the present time the concurrent opinion is that the age of the universe is on the order of four billion years whereas previously—24 years ago—it was 10^{10} or more.

Thus the age of the universe has been brought down rather than pushed up. The age of the earth, however, has been pushed up a little bit. Twenty years ago it was still accepted that the earth was roughly two billion years old, from relatively rough data. Today, more measurements have been made and it is more probable that is is close to three billion. Nobody expects that this is going to continue to be pushed up. The nature of science is such that all of our answers are approximate but they gradually lead us to a mean which is sometimes approximate truth.

Now for the second point; Dr. Allen wants us to worry about the possibility that transformation from the nuclear equilibrium state to one of normal decay might have been so gradual as to retard the decay right at the beginning. He is perfectly right in pointing out that at one point in the history of the universe there was an equilibrium between the building up of uranium atoms and the decaying of uranium atoms. However, what he is worried about is this. He said if this building up process continued considerably into the history of the earth, then obviously if we simply measured the decay rate and used this to calculate the equilibrium time (age of the universe), we would have an anomaly because the building up of the uranium would add to decay. Now, offhand, this might seem like a reasonable objection except for two things: first, the temperature at which atoms are built up and, secondly, the temperature of the earth's surface since it was formed as a planet.

The temperature that is required for atoms to build up is on the order of one to ten million degrees. This is why, for example, you must use an atom bomb to explode a hydrogen bomb because you have to get a million degrees of temperature before fusion takes place, before particles will start sticking together to make bigger particles. Now I hope most of you are aware of the melting point of most silicates in the crust of the earth. It is on the order of a thousand degrees. Obviously therefore, once the earth was formed as a planet and geology started, there could not be any building anymore and that is the time that we are talking about in the beginning of the earth.

I do not think that we should take time to discuss the common objection to the method, since we have done it at other ASA meetings and answers are available in textbooks on nuclear physics. The method of age measurement is straightforward. Consider a series of sedimentary strata: a crack develops, some molten material comes in, and there your elements crystallize in their own particular minerals. Uranium will crystallize into uranium minerals and lead will crystallize into lead minerals. The uranium crystal which is formed at the time that the molten material crystallized is at the time that lead starts to accumulate in that uranium crystal. It is separated by chemical means prior to that. Now that this uranium crystal is in place with lead accumulating in it, the question is what can happen to that to give you an incorrect age. One obvious thing is that uranium might be leached out later in its history by ground water. This is possible. But there are ways of measuring how much has been leached out. There are ways of measuring whether the uranium in a particular crystal is in equilibrium or not by quantitative methods.

In the introduction Dr. Allen stated that one reason we should mistrust these methods is that the methods of getting at the age of the earth give different answers, such as by the salt accumulation in the sea, radioactive methods, and accumulation of sediments.

Now let's take this one simple case. Suppose we have numbers and measurements of any physical property, the correct value of which is 41.00 and suppose we have one kind of machine that can measure this within plus or minus 0.1. Suppose we have another very inaccurate machine which can measure to plus or minus 10. If one method gives 40.95 plus or minus 0.10 and the other 32 plus or minus 10, the results would be in complete agreement. So the methods for estimating the age of the earth vary greatly in precision but are consistent within their degrees of error.

Another suggestion was that uranium 238 and uranium 235 at the equilibrium state should be equal. This is not true. They should be proportionate to their stabilities and their stabilities, to the first approximation, are proportionate to their half life.

One other thing that might be mentioned is the matter of the strong evidence for man having been on earth much longer than 10,000 years, as we have presented at some of the other meetings and as written up in the ASA Journal. There is abundant evidence of a qualitative nature that man is much older than 10,000 years. But quantitatively we can measure this now by carbon 14. Unfortunately we do not have as many measurements as we need to fix this to any degree of certainty. However, a number of measurements have proved that man was in North America at least 11.000 years ago. There are many geologists, archeologists, and anthropologists who readily agree that man is very recent, relatively speaking, in North America. If this is true, then quite obviously the attempt to hold a 10,000 year age for man is impossible.

I think it is also interesting, in this connection, that Dr. Allen left carbon 14 out of this problem because of the fact that carbon 14 was not in this original isotopic buildup at the early phase of the universe. In other words, carbon 14 is not subject to this particular objection which he raised.

There are several other methods besides uranium-lead. One very important one is rubidium-strontium. Another one is potassium-argon or potassium-calcium. The Rb-Sr is certainly equally good for old rocks and the fact that by the Rb-Sr method you can get exactly the same age within the experimental error as in uranium-lead, on different metals, from different pegmatites, in the same geologic situation is a very nice independent check on both methods.

Dr. I. Cowperthwaite: Is there further discussion of Dr. Allen's paper? If not I'll ask Dr. Allen if he wishes to comment.

Dr. R. Allen: The time is almost up and I didn't even make notes of all of the comments which Dr. Kulp had but I can show you perhaps a few on which we do not agree. Now, I think that I am absolutely correct in saying that the fundamental concept of the evolutionist, the mechanistic evolutionist, is to get time back just as far as he can for the operation of his theories. Now we're not primarily concerned here with the age of the earth.

Perhaps I was not as clear in making these state-

ments which Dr. Kulp criticized about the tendency to stretch the time as I should have been because I had in mind the fact that the longer you can stretch the earth's history back into the past, the greater the length of time that you have available for life upon the earth and that is evolution's desire, to stretch that just as far as possible ,and I think I could have proven that by quotations from many authorities.

He mentioned, for instance, or gave an illustration here as though the several different methods of evaluating time, apart from the radioactive, all agree if you allowed a sufficient variation in the degree of accuracy. Now, that is not what I had reference to at all. For instance, Lord Kelvin figured out the age of the earth on the basis of the time required for the stabilization of the tides and the announced figure, as I recall it, was 40 million years as the age of the earth.

The evolutionist raised such a holler when he announced that figure that they said they required at least 400 million years for life on the earth and therefore that his figure was wrong. They succeeded in getting him to re-evaluate it and he did boost it up to 100 million years or so but he said, "That's all I'm going to give you."

Now, you see, there is in these various types of evaluating time quite a variation. I didn't intend to go into that phase of the matter at all.

There are many other comments that he made, if I had jotted them down, that I would have liked to have answered. I'm rather surprised that he did not evaluate as well as I would have liked, the primary concept that I gave of the reversible process. It makes no difference as to the time when this occurred. He mentioned, for instance, the fact that I said that the time could be longer because there could be perhaps a greater, that is a slowing down of the reversible process.

Now all chemists, I think, will agree with me that in a reversible process you have between reaction in one direction and reation in another direction a period or a phase in which you have stability. For instance in the manufacture of sulphuric acid through a platinum catalyst, you build up SO^2 in hyposulphuric acid to SO^3 by the addition of oxygen at a certain temperature. Now, when that temperature is exceeded, there is a range there where it is stable and if you go beyond that temperature, it starts to reverse and so you do have that period of stability and that was, in my estimation, a minor point.

I had in mind one other comment that he made but it has slipped my mind now. I wish I'd taken some notes, but I didn't think I was going to have much time to reply so I didn't do it but I would like an appreciation or a denial from him of the logic of my reversible concept because if that be allowed and if there is an equilibrium in the build-up, then it certainly does upset our figures enormously when the disintegation starts and decay commences, a large percentage of the lumps of the Pb^{206} would not start with U^{238} but every one of the intermediate steps, of which there are in the neighborhood of 14, would be for the time-being a parent level, a parent element.

I think the time is getting so short and I don't like to keep you any longer and I don't think I shall extend my comments any further. I certainly thank you for your attention.