THE CANOPY AND ANCIENT LONGEVITY

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It is commonly held that the pre-flood vapor canopy shielded the earth from cosmic radiation and also reduced surface ozone levels. These effects supposedly contributed to the longevity of the antediluvian patriarchs. However, radiation studies and research in molecular biology seems to rule this out. Even if the earth were 100 percent shielded from radiation and if ozone levels in the pre-flood world were zero, no appreciable improvement would have resulted. Studies in molecular biology, however, do suggest that possibly certain specific enzymes may have been present prior to the flood and absent afterward, their disappearance resulting the reduction of longevity noted in the exponential decay curve of lifetimes in Genesis 11. Also, increased atmospheric pressure under such a canopy could conceivably have had a minor effect on longevity and also on gigantism.

The earth is constantly being bombarded by radiation from the sun and from deep space. Thanks to the shielding effect of our present atmosphere, life on this planet is effectively protected from the lethal effects of this cosmic assault. However, with a canopy, in which many believe, surrounding the earth, an even greater degree of protection would have been afforded; and one might predict a reduced radiation level. This is often thought to have a possible connection with antediluvian longevity and with carbon 14 production.

Nearly seventy-five years ago, Isaac Vail proposed that the shielding effect of the water heaven reduced radiation levels, and, as a result, the pre-flood conditions simply, "impelled long life."[1] More recently, V. L. Westberg argued that the life shortening of the post-flood patriarchs (see Genesis 11) was caused by accumulated exposure from space radiation that had not been present prior to the flood.[2] In 1961, Morris and Whitcomb suggested that the decrease in longevity was due to increased radiation levels.

> Much of this decline, as well as other effects we have already discussed, can undoubtedly be attributed to the greatly increased incidence of radiation upon the earth's surface and upon its inhabitants.[3]

Donald Patten made the ingenious observation that there seemed to be an exponential variable involved in the decline of longevity of the post-flood patriarchs. Prior to the flood, men lived an average of 912 years, but immediately after the flood, longevity began to decline exponentially![4] Patten attributed this exponential variable to the sudden increase of ultra-violet radiation and to the washdown of ozone with the canopy.

The Exponential Decay Curve in Genesis 11

In order to test the validity of Patten's observation of an exponential variable in the declining longevity of the post-diluvian patriarchs, the age at death versus the number of the generation from Noah was plotted on semi-log paper. When this was done, a straight line described the best fit of the points. A linear regression analysis was made using the data given in Genesis 11 to determine the equation of this line and the correlation coefficient. The data in Table 1 were used for this regression calculation.

In Table 1, it should be noted that Moses did not die at age 70. However, Moses says that in his time, 70 years had become the expected average lifespan:

> As for the days of our life, they contain seventy years, Or if due to strength, eighty years . . . (Psa. 90:10, NASB).[5]

According to the Biblical genealogies,[6] Moses' generation falls in the 17th generation from Noah if Noah's generation is numbered zero. A linear regression yields,

$$Y = 652e^{-0.136x}$$

where Y = the age at death, and x = the number of generations from Noah where at Noah's generation, $x = 0$. In order to find out the statistical validity of this curve, a correlation coefficient must be determined. The correlation coefficient, r, measures the degree of fit of the given points to the least-squares straight line. When $r = 1$, the correlation is said to be exact. When $r = 0$, the variables are said the be uncorrelated with a linear equation. The correlation coefficient derived from Table 1 is $r = 0.95$! That means there is an extremely high correlation between the variables in the above equation, and hence an exponential variable is likely.[7] The plot of the data in Genesis 11 is illustrated in Figure 1.

This result has significant implications. First of all, it gives some degree of credibility to the historical nature

Table 1. This gives the ages at death of some of the patriarchs. Note that the figure 70 is not assigned to Moses himself; rather it seems to be what was common among his contemporaries. Incidentally, the inclusion of data from Exodus 6:16-20 causes very little change in the result.

Patriarch	Age at Death	Number of Generation from Noah
Noah	950	0
Shem	600	1
Arphaxad	438	2
Salah	433	3
Eber	464	4
Peleg	239	5
Reu	239	6
Serug	230	7
Nahor	148	8
Terah	205	9
Abraham	175	10
Isaac	180	11
Jacob	147	12
Moses' contemporaries	70	17

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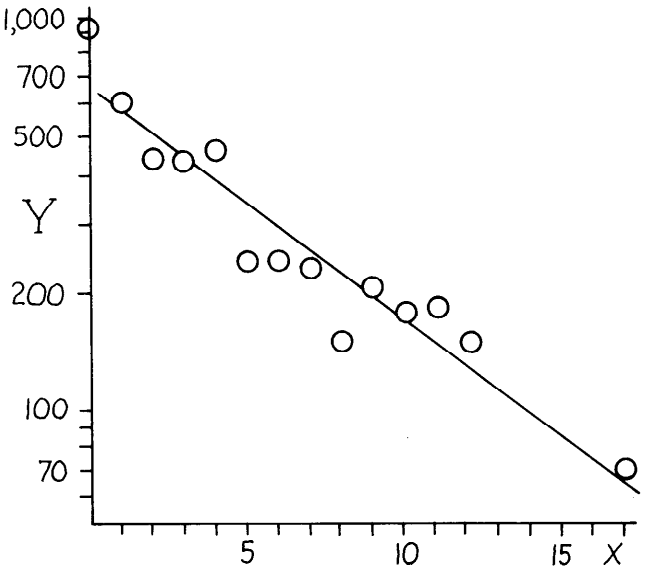

Figure 1. This shows the age *Y* at death of some of the patriarchs plotted vs. *x*, the number of their generation from Noah. The vertical scale is logarithmic; thus the straight line indicates an exponential relationship, as stated.

The data used here are those from the Masoretic text. The figures given in the Septuagint give about as good an exponential relationship. Thus it is impossible, on this basis alone, to decide which version is preferable.

of the genealogy. The probability that this account with such a variation, was a result of mythical influences is virtually zero. The odds that such a curve could result from anything but an actual historical circumstance are remote. There is nothing comparable in the Sumerian data. It is conceivable that scribes could have manufactured these numbers from exponential functions known in their time;[8] but the data in Table 1 are not *exactly* exponential. They scatter about such a function, thereby attesting to naturalness rather than artificiality.[9]

It must be admitted that this result does not fit Noah himself. The formula found would make his lifetime about 652 years, rather than the actual 950. It may be that his 600 years of life under the conditions prevailing before the flood had a considerable effect on him; and, incidentally, Shem's approximately 100 some on him.

If Noah and Shem are left out of the graph and the calculation, the figure before the exponent becomes 436, and the factor along with the exponent becomes -0.119 instead of -0.136. The correlation coefficient is not much changed.

There seems to be no support in Scripture for the suggestion, which has sometimes been made, that the decrease in the ages at death actually indicates an increase in the length of the year, or what was called a year. Besides, Genesis 7:11 and 8:3 & 4 indicate that then, as now, 5 months consisted of about 150 days. Moreover, to have much shorter periods of time called years would conflict with the fact that Mahalaleel and Enoch begot children at no older than sixty-five. ("No older"; for it is not said that the children mentioned were necessarily their firstborn.) (Genesis 5:15 & 21.)

Finally, the result obtained here would tell against the suggestion of gaps in the genealogy. It would be strange indeed, if gaps were such as to fit in, by being systematic and specific and not random. Thus, unless those who believe in such gaps are willing also to argue that the gaps are consistent and systematic, the mathematical probabilities of the correctness of their view would seem small. Furthermore, an absence of gaps seems to be attested to by Genesis 4:25, 26, in which a father-son (not a father-descendant) relationship is traced through the first three of the ten generations of the pre-flood patriarchs in the genealogy of Genesis 5. Also, Jude 14 informs us that Enoch is the seventh. Thus, there are no gaps in the first seven of the ten pre-flood generations. Finally, the fact that the age at paternity (birth of first child) as given can only be for chronological purposes.[10] This, of course, means that Bishop Ussher was not far off when he calculated the creation of the world in 4004 B.C. The present writer would be inclined, then, to date the flood in the year 2346 B.C.[11]

A final and most significant implication of this decay curve is that it attests to some kind of environmental change that drastically affected the physiology of man and reduced his longevity from an average of 912 years prior to the flood to 70 years 850 years after the Deluge. Such a decay curve is common whenever a system in equilibrium is suddenly acted upon in a way that results in a shift toward a new equilibrium. It can be seen in the discharge of a capacitor in the laboratory and in many other scientific experiments. It suggests that new factors were present in the post-flood environment.

Could this curve be a result of new levels of ionizing radiation that scoured the earth as a result of the loss of its protective vapor shield? Those who answer that question in the affirmative argue from the extensive evidence which has established a definite link between radiation intensity and longevity in radiologists and in laboratory test animals.

The Radiation Flux at the Earth's Surface

The earth is constantly being bombarded by cosmic and other radiation from the stars and from the sun. This radiation is of two basic kinds: electromagnetic and particle radiation. Particle radiation is composed of: that in cosmic rays (streams of positively charged hydrogen nuclei); alpha rays (streams of positively charged helium nuclei); and beta rays (streams of negatively charged electrons).[12] Also, high energy neutron particles play an important part in the production of carbon 14 by upper atmospheric bombardment of nitrogen.

The second kind of radiation hitting the earth is electromagnetic. Table 2 presents the electromagnetic spectrum.[13]

Thanks to our protective atmospheric blanket, very little of these harmful radiations ever reach the surface of the earth. In fact, our atmosphere is so effective in this regard that for instance "essentially all of the incident solar radiation at wavelengths below 2950A is abosrbed by the atmospheric bases, mainly the Hartley band of ozone."[16]

Careful measurements have computed the tota ex-

Table 2. This shows the names, wavelengths, and quantum energies, i.e., energies of photons, of the various kinds of electromagnetic radiation. The wavelengths are in Angstrom units—units of 10^{-8} cm.. These may be converted to microns by dividing by 10,000, or to millimicrons or nanometers by dividing by 10. The quantum energies are in electron volts, the energy involved in moving an electron through a difference in potential of one volt. The larger these energies, the greater the potentiality of the radiation for doing genetic or other damage.

Band of radiation	Wavelength, Angstroms	Quantum energies, electron volts
Cosmic rays	0.0005-0.005	2.5×10^{7}-2.5×10^{6}
Gamma rays	0.005-1.4	2.5×10^{6}-9,000
X-rays[14]	0.1-100	1.25×10^{5}-125
Extreme UV[15]	100-1,000	125-12.5
Far UV	1,000-2,000	12.5-6.25
Middle UV	2,000-3,000	6.25-4.2
Near UV	3,000-4,000	4.2-3.2
Visible	4,000-7,000	3.2-1.8
Infra-red	longer than 7,000	less than 1.8

posure to the sex cells of men that come from these and other radiations, both natural and man-made. Table 3 records these data.[17]

The Biological Effects of Electromagnetic Radiation

It has long been observed that short electromagnetic radiations such as X-rays have serious biological effects on human beings when absorbed in sufficient doses. In 1957, for example, Shields Warren reported:

> There is much evidence that overdoses of radiation lead to premature aging. Both animal experiments and observation of the life spans of radiologists indicate that doses of 1000 roentgens received over a long period of time may well shorten the life span about 10 percent. Data on the longevity of more than 82,000 physicians indicated that the average length of life of those not known to have had contact with radiation in the period 1930 through 1954 was 65.7 years, as against an average life span of 60.5 years for the radiologists.[19]

Radiation has an effect on both body tissue (somatic)[10] and sex cells (genetic). When X-rays or gamma rays hit a human sex cell, they ionize the cell and cause it to mutate.[21] These mutations are nearly always harmful and result in a general weakening of the species. The more seriously undesirable they are, the more likely they are to be removed by natural selection. The sum of these deleterious genes in the gene pool is called the genetic load. The size of the genetic load depends upon two factors: the rats of production and of removal. When the rate of removal equals the rate of production, a condition of genetic equilibrium is reached and the level of occurrence of that gene remains stable over the generations.[22]

When earth's vapor canopy shield condensed, the exposure to solar radiation increased and undoubtedly had an effect in increasing the genetic load. Could this have had any possible effect on longevity? The answer seems to be "probably not." As will be discussed below, the levels of radiation necessary to have significantly burdened the gene pool with "weakening" genes are not present today in natural background radiation.

It might be theorized that when the canopy condensed, a "burst" of radiation flooded the gene pool with new mutations. However, the wavelengths which produce ionizing effects on the germ cells would never have penetrated the present atmosphere. Even if the protective ozone layer were distributed when the canopy precipitated (which it must have been), X-rays and gamma rays would never have penetrated to the surface, and it is these rays that cause genetic effects—not ultraviolet rays. Even if some X-rays did make it through and by chance mutate a sex cell of one of Noah's sons, it would have had to mutate a specific gene loci, i.e., one related to aging.[23] Then the problem is that this same loci would have to be mutated in all three of Noah's sons in order for the decrease in longevity to be explained. In view of the fact that nearly 10 million different combinations of chromosomes are possible in the sex cells of a single individual,[24] the probability that the same gene loci on all three individuals could be affected is small. Thus even though the genetic effects in experimental test animals have indicated a decrease in the longevity of their descendants after exposure to certain types of radiation,[25] it is highly unlikely that this analogy is applicable to the post-flood patriarchs.

From Table 3 it can be seen that less than 25 percent of the radiation the germ cells receive is from atmospheric sources. Furthermore, it is now known that less than 1 percent of all human mutations are caused by background radiation.[26] Thus, even if 100 percent of all background radiation were removed by the canopy (and only 25 percent of them could be removed), it would have absolutely no effect on the mutation of human sex cells, and hence on the decreased longevity of Noah's descendants; nor could it have had any bearing on the longevity of the pre-flood patriarchs.

It is generally acknowledged today that somatic mutations are a major cause of the aging process. Could the reduction in radiation levels prior to the flood have had any bearing on a decreased rate of somatic mutation in human body tissue? Could a burst of radiation with the condensation of the canopy have any effect on radiation? The answer to both of these questions seems to be "no."

Many studies have been performed on mice to determine the effects of X-rays and gamma radiation on longevity.[27] As for humans, present evidence suggests a shortening of human life of 11 percent per 1,000 rads[28] for an entire lifetime. Since from Table 3, the average dosage a man receives is only 12 rads in a lifetime (0.192 rad/yr × 67 yrs), it can be seen that present radiation levels have no effect on reduced longevity. Furthermore, these studies involve bombardment with X-rays; and, even without a canopy, no X-rays reach the surface of the earth. Only ultraviolet radiation reaches the surface in any appreciable amount. Ultraviolet radiation is not very penetrating and will not penetrate deeply below the skin.[29] Thus, while it is probable that somatic mutations have an effect on the aging process,

Table 3. This shows the exposures, common in the United States, to radiation which might have some genetic effect.

	Millirems/yr.[18]	
Natural Sources		
A. External to the body		
1. From cosmic radiation	50.0	
2. From the earth	47.0	
3. From building materials	3.0	
B. Inside the body		
1. Inhalation of air	5.0	
2. Elements found naturally in human tissues	21.0	
Total, Natural Sources		126.0
Man-Made Sources		
A. Medical procedures (X-rays, etc.)	61.0	
B. Atomic energy industry, laboratories	0.2	
C. Luminous watch dials, television tubes, radioactive industrial wastes, etc.	2.0	
D. Radioactive fallout	4.0	
Total, Man-Made Sources		67.2
Overall Total		193.2

it seems fairly well established that cosmic radiation contributes only in a minor way to somatic mutations.

> It should not be inferred that radiations cause the mutations responsible for natural aging. The natural background radiations of our environment, caused by cosmic rays, etc., are very much too weak for that. The cause of these mutations is not yet known.[30]

Experiments have been conducted in which mice were placed hundreds of feet below the ground to shield them from all cosmic radiation. There was no indication of an increase in longevity in either the parents or their offspring.[31]

Thus, it appears that canopy theorists have been in error when they appealed to the shielding effect of the canopy as a possible explanation for antediluvian longevity. Furthermore, it also seems incorrect to posit that increased levels of radiation after the canopy precipitated had any bearing on the decrease of longevity. This is true because the levels of radiation experienced today are insufficient to have any effect; and are moreover of the wrong kind, i.e., mostly ultraviolet instead of X-ray, gamma ray, etc. Furthermore, even if there were a "burst" of radiation when the canopy precipitated, there would be no permanent effects on aging. This is because that burst would consist largely of ultraviolet light which had been shielded out by the ozone in the upper levels of the canopy. Ultraviolet light has no effect on germ cells and hence could only effect longevity of Shem, Ham and Japheth. Shem might have died early due to skin cancer caused by this burst, etc.; but this gives no explanation for the continuing decrease in longevity observed in the descendants. This is so because the ozone shield once disturbed will gradually build itself up to present levels within thirty years, and present levels of ozone shield out the majority of ultraviolet radiation.

It appears that some *sustained* environmental change other than radiation must be the explanation of decreasing longevity.[32]

The Canopy and the Cross-linkage Theory of Aging

The exponential variable discussed above in decreasing longevity requires explanation. At present it does not appear possible to explain it fully. This difficulty is increased by the fact that there is no certainty as to exactly what causes the aging process.[33] Thus, before the speculations on how the canopy may be related to aging can be advanced, science must first unravel the secrets involved in senescence.

At the present time, the cross-linkage theory of aging seems to be the only one gaining general acceptance. The theory suggests that, beginning at birth, certain cross-linking agents begin to form bridges or links between large molecules in the body. In this way, the giant molecules of the body are rendered progressively more and more inactive. Over a lifetime, large aggregates of these cross-linked molecules accumulate, resulting in a greater and greater inability of these molecules to carry out biological functions at the molecular level. When genetic matter is involved in these cross-links, mutations are often induced.[34]

> In a lifetime billions of crosslinkages will thus unavoidably be formed. Most of these can be reversed, but some of them cannot. These latter will accumulate over the years. The resultant aggregates are composed of proteins, nucleotids, polymeric fats, polysacharides, and any available large molecule at all which can react with any crosslinking agent at all, or which can be directly interlocked, will form parts in the resultant aggregates.[35]

When these aggregates of cross-linked molecules become dense enough, the body enzymes that aid in the dissolving of these aggregates can no longer penetrate, and cellular function is lost. It has been noted that the body produces more of these enzymes with increasing age. Thus, the quest for the fountain of youth is presently being focused on the discovery of enzymes of low enough molecular weight that can penetrate these aggregates and dissolve them. Bjorksten argues that it is self evident that the enzymes which can cope with these (cross-linked molecular aggregates), exist "for otherwise, large fossil deposits of such crosslinked proteins would have been found."[36]

One such enzyme now being produced commercially under the name, Microprotease MPB, was isolated in 1973.[37] However, it has not yet been tested in human populations. In fact, no experimental work has yet been done to establish the potentially beneficial effect of this enzyme, although it has been used to dissolve cross-linked aggregates taken from autopsy victims.[38]

It appears, then, that in order to connect the canopy

with longevity it will be necessary to demonstrate that conditions under the canopy were such that the body might have naturally produced this enzyme, and that conditions after the canopy condensed hindered the natural bodily function of these enzymes in some way. Another possibility is that in the post-flood era certain chemical changes in the environment, and notably in the atmosphere, may have introduced additional cross-linkage agents into the human body that were not present prior to the flood.[39]

Gigantism in the Fossil Record

One of the marvels of the ancient world was the surprisingly large size of its faunal inhabitants. When we were young children, our hearts have been stirred as the pages of books on dinosaur history were turned. Giant lizards weighing over 40 tons were common. Why is it that these animals flourished at one time and are now absent? Why are there no giants (except for aquatic animals like whales) today? Since climatic conditions that are thought to have prevailed in ancient times do prevail today in certain areas of the earth, it is unlikely that gigantism can be explained in terms of abundant food supply and tropical climate. A number of discussions of why ancient climates may have been favorable to gigantism have been published. Some have argued that "spacing" was a factor.[40] Fewer animals per square mile of forage area, it is argued, would mean less effort in acquiring food. For a large animal that requires much food, this would enable him to survive more easily in that there would be less competition.

It has also been pointed out that the large size of dinosaurs would have been favorable for the maintaining of a constant body temperature in a cold-blooded organism. Large size means large heat capacity and resistance to minor climate variations. Hence, a cold-blooded animal could have survived more easily if it was larger because its body temperature was regulated by ambient temperature.[41]

Neither of these explanations accounts for why there are no giants today. It would be plausible if their absence could be explained by some environmental condition that is not present today but that may have been present then. One such environmental condition could have been increased oxygen partial pressure in the atmosphere.

Gigantism and Oxygen

The large size of these animals raises the theoretical question of how they were able to supply oxygen to their tissue mass. This question is also relevant to the gigantic insects and shells which used to live on the earth, as well as to vertebrates. Insects and shells, arachnids, and many other invertebrates, taken in oxygen at least partly through the skin, by diffusion. This raises the question of how large such an animal could become before it would be unable to acquire sufficient oxygen to maintain its metabolism:

> Further, if oxygen can make its way in only by diffusion from the surface, the bigger an animal the lower, under given conditions, will be the concentration of oxygen at its center. It is obvious that there must be some size at which the concentration becomes too low for activity, and that animal cannot exceed this size.[42]

Thus, the invertebrates can exist only up to certain size limits; for the oxygen from the atmosphere has to diffuse to the center in sufficient concentration to sustain metabolic processes. Why are insects with 25-inch wingspans no longer found? Why are the giant shells, spiders and other invertebrates not in existence today? If these animals lived in an atmosphere where the partial pressure of oxygen was greater than today, they would have been able to grow to larger sizes.

Thus, for both the giant lizard and the invertebrate, the theoretical possibility exists: that the reason they no longer exist in these large sizes is because of the partial pressure of oxygen in our atmosphere has dropped. If the earth had been surrounded by a vapor canopy containing enough water to sustain a global rainfall of 0.5 in/hr for 40 days (40 feet of precipitable water), the atmospheric pressure would have been 2.18 atm, and partial pressure of oxygen would have been 348.73 mm of Hg[43] instead of today's value of 159.97.

An increase in the partial pressure of oxygen does not increase the amount of oxygen carried by the hemoglobin in the blood of vertebrates. But it does increase the oxygen tension in the plasma. Presently, the oxygen tension in man in the alveolar sacks is about 100 mm of Hg. By the time it passes through the capillaries, it is reduced to about 45 mm of Hg. Since the oxygen tension in the interstitial fluids (body fluids between the capillaries and the cells) is only 40 mm of Hg, there is a net diffusion driving force of at least 5 mm of Hg of O_2 forcing oxygen into the cells of the body through the interstitial fluids. Could it be that, due to the greater oxygen requirements of the large vertebrates, they required more oxygen than the present diffusion driving force could supply? If the oxygen tension in the alveolar sacks was doubled due to increased atmospheric pressure, this would increase the oxygen diffusion force (it would probably not be a linear increase) and hence enable the animal effectively to deliver more oxygen to its body cells.

Due to the variables involved, there seems to be no way of meaningfully extrapolating back to ancient animals to check this. But a reduced oxygen tension in the atmosphere due to the condensation of the vapor canopy could have been one change which might have some bearing on why giant animals do not live today.

Presumably, Noah would have taken young dinosaurs on the ark. As they entered the post-flood environment, and grew, they would have been unable to survive in the lower concentration of oxygen and would actually have suffocated!

Longevity and Oxygen

There is evidence that higher oxygen tension can be decidedly beneficial to biological systems. When a team of aquanauts were submerged in a diving bell for two weeks at 10 atmospheres, a striking healing occurred after one of them severely cut his hand. It was reported that the wound completely healed in 24 hours! It was theorized that the reason for this was that the higher oxygen tension created a greater diffusion driving force and imparted more oxygen at a greater rate into the

wound. As a result, experiments in high-pressure surgery were begun, and hyperbaric surgery is now a common practice in certain situations. Also, it has been discovered that an effective treatment for some kinds of gangrene is to place the patient in a high-pressure chamber for a period of time.[44] Thus, it would seem that a higher atmospheric pressure could have resulted in conditions that were favorable for the cure of some illnesses, and hence could have some bearing on longevity of life indicated in Genesis 5.

At the HBO Center in Lauderdale-by-the-Sea, Florida, Claude Kirk has been administering hyberbaric oxygen treatments for many years with startling results. Patients treated (for short periods of time) at 2.5 atm of pure oxygen and gradually decompressed showed remarkable relief from the effects of aging. Dr. Edgar End of Milwaukee, one of the nation's leading experts in hyperbaric oxygen treatment, said,

> Unquestionably, hyperbaric oxygenation can often reverse the effects of aging. I've seen it work in scores of cases. It improves memory, increases energy and works remarkably well with men and women who were demonstrably senile. In addition, it is a highly effective treatment for strokes. I've had patients carried into the hyperbaric chamber after a verified stroke and walk out after the first treatment. It has been used successfully for gas gangrene, ostomyelitis, smoke inhalation and other problems.[45]

While 2.5 atm of pure oxygen (1520 mm Hg of O_2) is considerably greater than the partial pressure of oxygen under a 40-foot vapor canopy (348.73 mm of Hg), the remarkable effects of this treatment do suggest an area for fruitful research. Could a relatively small increase in the partial pressure of oxygen when extended over an entire lifetime have similar or even greater effects than hyperbaric oxygen administered to senile patients in their 70's?

Dinosaur Size and Longevity

The great size of some of the dinosaurs may indicate longevity. It is well known that, within size and skeletal limitations, reptiles continue to grow until death.[46] In this respect, reptiles are different from mammals. Mammals have secondary centers of ossification in the growing ends of the bones. When these centers have replaced most of the surrounding cartilage, they fuse with the bone shaft so that no further increase can take place. Most reptiles do not possess these secondary centers; so their bones are free to grow throughout life.[47] Thus, great size is sometimes an indication of old age in these animals. If the dinosaurs lived to great ages this would correlate well with the biblical data that state that men did so also (Genesis 5 and 11).

Ozone and the Canopy

Donald Patten has suggested that the presence of the canopy would have reduced ozone levels at the surface of the earth and resulted in increased longevity. He suggests that, in the pre-flood world under the canopy, the ozone concentration at the surface varied from zero to several parts per trillion.[48] However, when the possibility of reduced ozone levels having any significant bearing on longevity was presented to Dr. Johan Bjorksten, he pointed out that present levels of ozone concentration have only a minor effect in the production of cross-linked molecules, and thus if all ozone were removed, the gain in longevity would be negligible.[49]

Carbon 14 and Ancient Longevity

One effect of a vapor canopy would be to shield the nitrogen below the canopy from cosmic radiation. Under such conditions, no carbon 14 would be produced. It has been suggested that, even though the absence of radiation would have a negligible effect on longevity, as discussed above, yet the absence of carbon 14 might have an effect, perhaps as follows.

Under present conditions, all living things have a certain amount of carbon 14 incorporated into them, and in particular into their DNA. In time, the carbon 14 will decay into nitrogen 14, which has 3 bonds, not 4. Thus one adjacent bond would be left open; and it might hook a cross-linked molecule. See Figure 2. Thus the presence of carbon 14 might contribute to the formation of cross-linkages; or might block a body molecule or act as a point mutation; or the result might act to block biochemical pathways. In some of these ways, then, the presence of carbon 14 might contribute to aging; and, if so, its former absence would have contributed to longevity. This whole matter needs further study; for it seems quite possible that the amount of carbon 14 present might have built up in a way which would correlate with the decrease in longevity.

It must be added, however, that Dr. Johan Bjorksten, in a personal communication, expressed great doubt that the amount of carbon 14 in living things would ever have been enough for such an effect to be important.

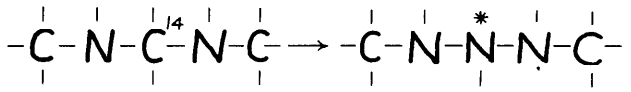

Figure 2. This shows how, if a molecule of e.g., DNA contained an atom of carbon 14, upon the decay of that atom to nitrogen a dangling bond would be left somewhere adjacent. The formation of enough such dangling bonds might have something to do with the formation of cross-linkages, as discussed in the text. Note that atoms of carbon not marked otherwise are of ordinary carbon 12. The asterisk shows where an adjacent bond might be left dangling.

Conclusion

At present, it is not clear what was the cause of antediluvian longevity. Creationists should be careful about attributing longevity to either the shielding effects of the canopy against radiation or to reduced ozone levels. The ideas concerning increased partial pressure of oxygen are still only speculative and lack any long-term laboratory testing, as are those about carbon 14 and cross-linkages.

For some reason, the biosystems of pre-flood animals apparently produced an enzyme that cleaned out cross-linked molecules. Subsequent to the flood, either due to inbreeding, mutation, a radiation burst or some unknown cause, this enzyme was gradually eliminated and longevity declined.

References

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[2]Westberg, V. L., The Master Architect. Napa, California: By the author, p. 13.

[3]Morris, Henry M., and John C. Whitcomb, 1965. The Genesis Flood. Presbyterian and Reformed, Philadelphia. p. 404.

[4]Patten, Donald Wesley, 1966. The Biblical Flood and the ice epoch. Pacific Meridian Publishing Company, Seattle. pp. 214-216.

[5]It is generally agreed that Psalm 90 was written by Moses. The only serious objection that can be raised against this view is that Moses, Caleb, and Joshua are all said to have lived longer than 70 years. Yet Perowne has observed, "There is no evidence that the average duration of human life at that period was extended as that of the few individuals who are named. On the contrary, if we may judge from the language of Caleb, who speaks of his strength at 85 as if it were quite beyond the common lot (Josh. 14:10), the instances mentioned must rather be regarded as exceptional instances of longevity." See Perowne, J.J.S., 1966. The Book of Psalms. 2 vols. Grand Rapids: Zondervan, 2:162 for discussion.

[6]See 1 Chron. 2:4-11 where Amminadab is the 17th from Noah and lived around 1520 B.C., the period of the rise of Moses (Deut. 34:7). After Jacob the sequence goes: Judah, Perez (1 Chron. 2:4), Hezon, Ram, Amminadab. Amminadab's date is based on the dating of Robert Young, Analytical concordance to the Bible (Grand Rapids: Eerdmans, n.d.), p. 32.

[7]Others have performed the regression analysis with similar results using the year after the flood for the horizontal axis. For discussion see Strickling, J. E., 1973. "A quantitative analysis of the life spans of the Genesis patriarchs," *Creation Research Society Quarterly* 10(3):149-54.

[8]Exponential functions were used in the Old Babylonian period for computation of compound interest. Neugebauer, O., 1957. The exact sciences in antiquity, 2nd ed. Brown University Press, Providence. p. 34.

[9]See Clough, Charles, 1968. A calm appraisal of *The Genesis Flood.* Th.M. Thesis, Dallas Theological Seminary. pp. 99-100.

[10]For full discussion of the exegetical basis for the gap view and the no-gap view of these genealogies, see Clark, H. David, 1967. The genealogies of Genesis five and eleven. Th.D. Dissertation, Dallas Theological Seminary, Dallas, Texas.

[11]This obviously creates immense problems in correlating the Biblical dates with those attested by archaeology. It may be that the answer to this conflict resides in a greatly inflated time scale in the Egyptian historical material. Donovan Courville has argued that the Egyptian documents are inflated by some 800 years, and that a complete overhaul of ancient dating is necessary. See *The Exodus Problem and Its Ramifications* 2 vols. (Loma Linda, California: Challenge Books, 1971) for full discussion. All ancient dates are correlated with Egyptian dates for the time period in question (2500 B.C. to 1200 B.C.) and hence an error there could drastically affect other dates as well. Note also Long, R. D., 1973. The Bible, radiocarbon dating, and ancient Egypt, *Creation Research Society Quarterly* 10(1):19-30; and Courville, D. A., 1976. The use and abuse of astronomy in dating, *Creation Research Society Quarterly* 12(4):201-210, where he answers his critics who claim that astronomy has independently verified Assyrian and Egyptian dates.

[12]For basic discussion see Asimov, Isaac, and Theodosius Dobzhansky, 1973. The genetic effects of radiation. U.S. Atomic Energy Commission—Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830, pp. 22ff.

[13]Adapted from Miller, A., 1966. Meteorology. Chas. E. Merrill Books Inc., Columbus; Coulson, Kinsell L., 1975. Solar and terrestrial radiation. Academic Press, New York, p. 143; and Handbook of chemistry and physics, 56th ed., p. E-206.

[14]Note: there is an overlap between Gamma rays and X-rays.

[15]UV = "Ultraviolet."

[16]Coulson, op. cit., p. 143.

[17]Asimov and Dobzhansky, *op. cit.,* p. 37.

[18]A millirem = 1/1000th of a rem. A rem is the "roentgen equivalent, man." The "rad" = the radiation absorbed dose. A rad of X-rays, gamma rays, or beta particles has a rem of 1, while a rad of alpha particles has a rem of 10 to 20. Also, 1 rad = 100 erg/gm or 6.24×10^9 electron volts/gm.

[19]Warren, Shields, 1957. Radiation and the human body. The Scientific Monthly. (January), p. 5.

[20]For excellent introductory discussion, see Frigerio, Norman A., 1973. Your body and radiation. U.S. Atomic Energy Commission —Technical Information Center, P. O. Box 62, Oak Ridge, TN, 37830.

[21]For general discussion of radiation and mutation rates in humans see Muller, H. J., 1955. Radiation and human mutation. *Scientific American* 193(5):88 *et seq.*

[22]See Asimov and Dobzhansky, *op. cit.,* p. 17; also Wallace, Bruce, 1970. Genetic load, its biological and genetic aspects. Prentice-Hall, New York.

[23]". . . the existence of special genotypes for longevity is probable, although it is not known whether they provide a person with a generally over-all vitality of tissues and organs, or whether they act by way of single organs, such as the heart or some hormone-producing gland." Stern, Curt, 1960. Principles of human genetics. W. H. Freeman and Co., San Francisco. p. 113.

[24]Asimov and Dobzhansky, *op. cit.,* p. 8.

[25]Russell, W. L., 1957. Shortening of life in the offspring of male mice exposed to neutron radiation from an atomic bomb. *Proceedings of the National Academy of Science* 43, (4):324-49.

[26]Asimov and Dobzhansky, op. *cit.,* p. 36.

[27]Iberall, A. S., 1967. Quantitative modeling of the physiological factors in radiation lethality. *Annals of the New York Academy of Sciences* 147, 1-81.

[28]Warren, Shields, 1956. Longevity and causes of death from irradiation in physicians. *Journal of the American Medical Association* 162(5):466 *et seq.*

[29]Asimov and Dobzhansky, *op. cit.,* p. 23.

[30]Curtis, Howard, 1964. What science knows about aging. *Think,* March-April, p. 17.

[31]Dr. Johan Bjorksten, Director Bjorksten Research Foundation, P. O. Box 775, Madison, Wisconsin, personal communication, October 27, 1976. Dr. Bjorksten is one of the leading researchers in the world in the quest for the mechanisms of aging.

[32]An intriguing explanation for the extinction of the dinosaurs involving a burst of cosmic ray flux due to exploding supernovae may have some relevance to the exponential function noted in Genesis 11. Terry and Tucker suggest several incidents in the past involving with such a flux of 1000r of X-rays and gamma rays. Flux of this intensity would make it to the surface and cause vast mutation and loading of the gene pool and mass extinctions, also. See Tucker, W. H., and K. D. Terry, 1963. Biologic effects of supernovae, *Science* 159(3813):421-23; and Terry, K. D., and W. H. Tucker, 1968. Cosmic rays from nearby supernovae: biological effects. *Science* 160(3832):1138-39.

[33]For a review of some of the contemporary theories, see Price, G. B., and T. Makinodan, 1973. Aging: alteration of DNA-protein information. *Gerontologia* 19, 58-70; Upton, A. C, 1957. Ionizing radiation and the aging process, *Journal of Gerontology* 12, 306-13; and Bjorksten, Johan, 1976. The crosslinkage theory of aging: clinical implications. *Comprehensive Therapy* 2, 65-74.

[34]Bjorksten, Johan, 1963. Aging, primary mechanism. *Gerontologia* 8, 179-92.

[35]Bjorksten, Johan, 1976. Some therapeutic implications of the crosslinkage theory of aging. Paper presented to the American Chemical Society, San Francisco, California, September 2. p. 8.

[38]*Ibid.,* p. 17.

[37]Schenk, R. U., and J. Bjorksten, 1973. The search for microenzymes: the enzyme of bacillus cereus. *Finska Kemists. Medd.* 82, 26-46.

[38]Bjorksten, reference 33, p. 72.

[39]For the molecular biologist desiring to pursue the possible connections between canopy-induced environmental conditions and the existence of various cross-linking agents, a discussion of known cross-linking agents is presented by Bjorksten, reference 34, p. 183; and 1971. The cross-linkage theory of aging. *Finska Kemists. Medd.* 80, *23-38.* They include aldehydes, sulfur, alkylating and acylating agents, quinones, antibodies, free radicals induced by ionizing radiation, and many metals and numerous other compounds.

[40]Colbert, Edwin H., 1965. The age of reptiles. W. W. Norton & Company, Inc., New York. Pp. 144-145.

[41]See Spotila, James R., et al., 1973. A mathematical model for body temperatures of large reptiles: implications for dinosaur ecology, *The American Naturalist* 107, (955):391-404; Porter, Warren P., and David M. Gates, 1969. Thermodynamic equilibria of animals with environment. *Ecological Monographs* 39, 227-44.

[42]Yapp, W. B., 1960. An introduction to animal physiology. The

Clarendon Press, Oxford. P. 127.
[43]Apparently the upper limit of tolerance of oxygen over an unlimited period of time, incidentally, is 380 mm. of mercury, 0.5 atmosphere. See Mountcastle, Vernon B., 1974. Medical physiology, thirteenth edition, C. V. Mosby Co., St. Louis, Missouri. Vol. 2, p. 1565.
[44]Personal communication from Don Wiggans, Ph.D., Professor of Biochemistry, University of Texas Health Science Center, Dallas, Texas, December 1976.
[45]Martin, Paul, 1977. Stay young with hyperbaric oxygen. *Piedmont Airlines Inflight Magazine* 4, 28. (March-April.)
[46]Cunningham, J. T., 1912. Reptiles, amphibia, fishes, and lower chordata. Methuen and Co., Ltd., London. P. 55.
[47]Bellairs, Angus de'A., 1960. Reptiles: life history, evolution, and structure. Harper and Bros., New York. P. 19.
[48]Patten, Donald, 1970. The pre-flood greenhouse effect, (in) A symposium on Creation. Baker Book House, Grand Rapids. P. 38.
[49]Personal communication from Dr. Johan Bjorksten, November 19, 1976.

LIFE BEGINS AT 140†

CAPTAIN GEOFFREY T. WHITEHOUSE*

The people Georgia in Southern Russia, birthplace of Stalin, are reputed to be the world's longest lived.

From time to time news of these remarkable people reaches a somewhat incredulous outside world. We find it hard to believe that there are, in fact, hundreds of men and women in Georgia, long past the century mark, who are still perfectly fit and active.

In the mid 'sixties the *Sunday Times* magazine thought the matter would be well worth investigating so they sent reporter Gloria Stewart and photographer Eve Arnold to Georgia for that purpose and results were published in the *Sunday Times* magazine on April 3, 1966. Before I give you a resume of what these two investigators found in Georgia, I would point out that when the centenarians of Georgia were born there were no birth certificates. However, ages mentioned have been verified by the Soviet Institute of Gerontology, after years of study, uncolored by any sort of medical nationalism.

At the last census the Republic of Georgia produced two thousand people over the age of 100. The surprising thing about these ancients is their remarkable activity. The investigators, whom I am quoting, found them striding miles over the mountains weighted with cartridge-belts, rifles and long knives. They played a ferocious Georgian version of polo, worked in the vineyards, not infrequently fathered children in their nineties and when the occasion warranted drank unnerving quantities of the local alcoholic dynamite: grape vodka.

"The first place the investigators stopped was at Dzerba, a tobacco-growing village with four centenarians among its 500 people. Here they met Astan Shlarba, a 123-year-old farmer.

"Astan, by Russian standards, is wealthy and in the previous year he earned $1,200 from his farm, and from work on a local collective farm. His income enables him to have plenty of leisure for hunting trips which he loves, when he goes off into the mountains with younger men.

"Apart from this Astan and his 70-year-old wife, Nutsa, live an uneventful life seldom leaving their village. Although many families have television Astan declines to admit its existence. His idea of relaxation is to enjoy a drink with his neighbor Teb Sharmat, a younger man of 101. They sit on Astan's ample veranda and play the tari (a sort of Georgian mandolin) since both are in the famous Centenarians Orchestra.

"Further up the mountains the travelers came to the tea-growing village of Lyxny which has a celebrated Council of Elders, all over 100, who deal with the village delinquents and advise on village affairs, such as running the tea factory.

"Until last year, the council had six members, but the oldest, Anton Pilya, who was 135, married a woman of 27, and died of a stroke five months later. This is generally held among the centenarian community to be a warning not to presume too far against mortality. The senior member is now Senat Dzeniye, a farmer of 120, who strides around the village in a long, goat-hair cloak. Senat, whose family numbers 50, with one son of 95, was elected toast-master at the feast which was given to the investigators by 112-year-old Temur Tarba.

"Temur, his 85-year-old wife, Dusya, and two of their six sons, live in a two-story brick house. As the travelers walked into the courtyard full of chickens, Dusya greeted them in a traditional Georgian mountain fashion. She kissed them on both cheeks, guaranteed that no ill would befall them in her house and 'clean food'. She then brought out a jug of clear, cold water and a snowy white towel. When they had washed their hands she invited them to come inside and seated them at a long wooden table heaped with dishes of food. There was chicken and goat's flesh supplemented by huge plates of steaming *mameliga*, a doughy substance made from maize. This is eaten with everything, and has to be rolled in the fingers and dipped in a sauce of garlic and pepper.

"The drinking of a liquor called *Chacha*, or grape vodka, is a vital part of a Georgia feast of this kind and during the meal which followed many toasts were proposed. These began with Peace and Friendship between Britain and Russia and included the women of the house who were too busy serving to eat and drink themselves.

"We are not told what other foods were eaten at the

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