

Creation Research Society Quarterly

Haec credimus:

For in six days the Lord made heaven and earth, the sea, and
all that in them is and rested on the seventh. — Exodus 20:11

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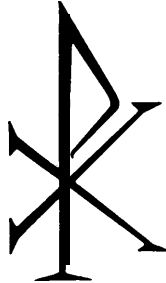
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NUMBER 1

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COVER ILLUSTRATION

Yucca whipplei. "Spanish bayonette" or "Our Lord's
candle" is the first yucca to greet a traveler en route
from Southern California to the Grand Canyon. The
stalk seen here is only a flower stalk as the stem of this
yucca is underground. It is pollinated by its own
species of yucca moth and yet it closely resembles
three other species of yucca pollinated by *Tecetricula*
yuccasella — the usual "yucca moth" species.

—Photograph by George Howe

ERRATA

The Flood date in the book, *The Origin of the
Nations*, is 2518 B.C. rather than 2156 B.C. as stated in
the *CRSQ* 22:146.

Giordano Bruno lived in the 16th, not the 17th
century as stated in *CRSQ* 22:115.

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MEMBERSHIP/SUBSCRIPTION APPLICATION FORM
CREATION RESEARCH SOCIETY

See the current *CRSQ* for membership information

ORDER BLANK FOR PAST PUBLICATIONS

CREATION RESEARCH SOCIETY

History The Creation Research Society was first organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (with graduate degrees in science) and over 1500 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as probably the outstanding publication in the field.

Activities The society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$15.00 (\$17.00 U.S. for overseas) per year and may be sent to Glen W. Wolfrom, Membership Secretary, P.O. Box 14016, Terre Haute, IN 47803. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at \$15.00 (\$17.00 U.S. for overseas) per year and includes subscription to the Annual Issue and Quarterlies. All others interested in receiving copies of all these publications may do so at the rate of the subscription price for all issues for one year: \$18.00 (\$20.00 U.S. for overseas).

Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms.

We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. In 1970 the Society published a textbook, *Biology: A Search for Order in Complexity*, through Zondervan Publishing House, Grand Rapids, Michigan 49506. Subsequently a Revised Edition (1974), a Teachers' Guide and both Teachers' and Students' Laboratory Manuals have been published by Zondervan Publishing House. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

2. All basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was an historic event worldwide in its extent and effect.

4. We are an organization of Christian men of science who accept Jesus Christ as our Lord and Saviour. The account of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Saviour for all mankind. Therefore, salvation can come only through accepting Jesus Christ as our Saviour.

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DEDICATION TO JOHN N. MOORE

One of the most valuable men in service to the Creation Research Society has been Dr. John Moore. Although not one of the original *Team of Ten*, he was present at the first organizational meeting held in Midland, Michigan. Thus he became one of the original guiding spirits of CRS and a subsequent member of the first board of directors. In this position he has rendered many valuable services to the Society. One of the first was his work as the only managing editor of the *Creation Research Society Quarterly*. John was the mentor of the fledgling journal, setting its style, guarding the high quality of its format, and riding herd on the publisher in all its mechanical features. Dr. Moore also served, along with Dr. Harold Slusher, as the editor of the first and second editions of the CRS high school biology text, *Biology: A Search for Order in Complexity*, which was published by Zondervan, Grand Rapids.

John Moore was born in Columbus, Ohio, in 1920. He attended Denison University in Granville, Ohio, receiving the A.B. degree in 1941. He received his M.S. from Michigan State University, in East Lansing, Michigan. His field was botany and plant pathology. John continued his studies at MSU, receiving his Ed.D. in 1952. From the beginning he showed a bent for the classroom, serving at MSU as graduate assistant in botany from 1941-3, and as instructor in mathematics from 1943-4. He was appointed member of the faculty in 1946, rising through the ranks until his retirement as professor emeritus of natural science in 1982. In 1944-6, he served in the U.S. Navy. He is also an honorary member of the Beta Beta Beta. In 1941 Dr. Moore married Marie Proctor, and their union was blessed with two sons, Douglas and Donald.

During his tenure at MSU, he embarked on his career of developing classroom materials for a balanced two-way approach to first origins according to the evolution model versus the creation model. He presented the major principles of physical and biological sciences under course titles of Changing Concepts of the Universe, The Nature and Continuity of Life and Human Bio-Social Evolution. This classroom



experience culminated in his work, *How To Teach Origins (without ACLU Interference)*. He has also been the subject of a book, *Creation: A Scientist's Choice* by Zola Levitt, published in 1976 by Victor Books, Wheaton, Illinois.

I will always remember with pleasure the several times I had the privilege of joining Dr. Moore on the lecture platform. Actually, he has been active on the lecture platform before college, university, service and church groups in 23 states, which is quite an impressive record.

Among additional works that Dr. Moore has authored is *Questions and Answers on Creation/Evolution*, published by Baker in 1976. He has also participated in several films, especially *Footsteps in Stone*.

CRS is honored to present its most recent fellow, Dr. John N. Moore.

Wilbert H. Rusch

EDITORIAL COMMENTS

Several of the papers in this issue deal with teleology and design. If one lives in certain sections of the U. S. (and certain other parts of the world), the precipitation of summer usually comes in the form of afternoon and evening thundershowers. I was curious if there was purpose in such a schedule for rain. So I invited several creationists to participate in a mini-symposium on the subject. I present an overview of the topic and John Klotz, Edmond Holroyd III, George Howe and Don DeYoung offer excellent evidence that there is purpose in the process and these showers are of benefit to men and the earth.

George Howe's thorough research effort on yuccas of the Southwest presents evidence of design which has enabled these amazing plants to survive in many

different environments. Gerald Heyes claims that the stereochemistry of geometric isomers also is evidence of design. These two papers indicate that teleology cannot be ignored in science.

Tom Barnes defends the concept of a young earth in his invited paper on the decaying magnetic field of the earth. Other topics covered in this issue are a discussion of why the English peppered moth is not evidence for evolution and how the laws of thermodynamics can offer creationists an insight into the nature of the universe and the Creator. I urge you to comment in writing to me on any of these subjects or any aspect of the creation model of science.

Emmett L. Williams, Editor

INSTRUCTIONS TO AUTHORS

1. Manuscripts shall be typed and double spaced.
2. An original plus two copies shall be submitted to the editor of the Quarterly.
3. All submitted articles will be reviewed by at least two technical referees. The editor may or may not follow the advice of these advisors. Also, the prospective author may defend his position against referee opinion.
4. The editor reserves the right to improve the style of the submitted articles. If the revisions of the editor and referees are extensive, the changes will be sent to the author. If the changes are not suitable to the prospective author, he may withdraw his request for publication.
5. Due to the expense involved, manuscripts will not be returned to authors.
6. All references (bibliography) must be presented in the style shown in the Quarterly. If a prospective author is not familiar with the CRS format, the editor will furnish an example reference page. A new referencing system has been introduced. All authors are to follow the style of referencing in the Howe paper on yuccas (pp. 12-20).
7. All figures and drawings must be prepared professionally. No sloppy hand drawings or freehand lettering will be accepted. The editor reserves the right to approve submitted figures. Unacceptable illustrations will result in rejection of the manuscript for publication.
8. Any manuscript containing more than 25 pages is discouraged. If a topic cannot be covered to the author's satisfaction in this length of pages, the author *must* divide his material into separate papers that can be serialized in the Quarterly.
9. The Quarterly is a journal of original writings. Only under unusual circumstances will I reprint previously published manuscripts. Never submit an article to two or three journals, including ours, hoping all of them will publish your work. I consider this practice unethical. When submitting an article, please state if the material has been published previously or has been submitted to other journals.

MINI-SYMPOSIUM

SUMMER AFTERNOON AND EVENING THUNDERSTORMS: A TELEOLOGICAL APPROACH

OVERVIEW

Introduction

In many parts of the world during hot weather precipitation occurs primarily as late afternoon and evening thundershowers. Is this process purposeful or simply an accidental circumstance that evolved with the other features of nature? Also when reading many agricultural bulletins, one is often advised that the best time of the day to irrigate or water crops and lawns is in the morning hours to reduce the chance for the development of plant diseases. Did the Creator goof when he apparently ordained this shower cycle after the Flood?

This "mini-symposium" approaches the topic from a teleological perspective, i.e., there is purpose in the process. The editor will provide an overview of the topic and other participants will explore the subject from other viewpoints.

Convective Precipitation

Summer late afternoon and evening showers are a form of convective precipitation since rising hot, humid air from the ground causes the phenomenon.

Thus on a hot summer afternoon, when surface heating is intense, and condensation abundant, the towering cumulonimbus clouds resulting from convective ascent may be several miles in vertical depth, and precipitation from them may be copious. Convective ascent is usually associated

with the warm season of the year and the warm hours of the day. Since it is essentially a vertical movement of warm, humid air, cooling is rapid and the rainfall resulting is likely to be in the form of heavy showers.¹

The resulting precipitation is referred to as thundershowers because of the noise or thunder that develops due to the violent expansion of the air caused by the tremendous heat of accompanying lightning.² Such showers are a major source of rain in the summer. For instance, 61 percent of the rain in June in Hungary falls on days with thundershowers.³

Benefit to Man

Since the Earth was created for habitation by man, late afternoon and evening showers should be of benefit to him.

Most thunderstorms pass through their lifetimes in less than an hour, yielding a few lightning strokes and rain. Provided no one is struck by lightning these storms do a great deal more good than harm. The rain is usually very beneficial particularly to farms.⁴

On the other hand, for the middle and higher latitudes, convective rain, since it occurs in the warm season of the year when vegetation is active and crops are growing, comes at the most strategic time. Moreover it provides the maximum rain all with the minimum amount of cloudiness.⁵

Spring and summer thundershowers on the Great Plains supply much of the water that makes wheat grow.⁶

Thus the showers are helpful to plant growth during the critical growing season particularly to crops planted by man. But what about the time of day that the showers usually occur?

Time of Day

What if it rains in the summer early in the day and then the weather clears? If the day becomes hot and dry only a small fraction of the morning rain will be available to the plant since most of the water will evaporate.⁷ Thundershowers generally develop as the day progresses, as hot, humid air rises, then the precipitation occurs in the afternoon or evening. For example in the United States:

thunderstorms are most frequent during the warm part of the year. The area of greatest occurrence in the United States extends eastward from Wyoming, Colorado, and New Mexico and includes the entire central and southern sections of the country . . . In the South thunderstorms activity is most frequent during the afternoon: in the Great Plains and the Upper Mississippi Valley, activity is greatest at night.⁸

Is there an advantage for a late-in-the-day shower? . . . water saturation of a plant is essential for its growth. As growth in most plants occurs during night a water supply would be most effective at night.⁹

Growing plants transpire enormous quantities of water which they take from the soil . . . Plants lose water continuously. The lowest loss is at night and the highest at midday.¹⁰

Showers late in the day during the growing season plus the attendant cooling effects, then the onset of darkness leave much of the moisture to soak into the soil and remain on the leaves to aid in the necessary growth process. Much more growth is possible late in the day and at night since not as much moisture will have evaporated.

Also the heavy intensity of most summer convective showers is necessary for plant growth since rain from light showers would evaporate without any material gain to crops.¹¹

Degenerative Effects

Since man exists in a cursed creation every beneficial natural process brings with it a degenerative process. Late-in-the-day showers in warm weather produce conditions favorable for many plant diseases and fungi such as mildew, rust, scabs, and blight.^{12, 13} Also along with thundershowers are other adverse effects such as soil erosion, lightning, hail and floods. Thus a creationist views this as the interworking and interrelation of conservation (rain) and degeneration (disease, disaster) in our world.¹⁴

Conclusion

Afternoon and evening thundershowers are of benefit to man to help in the growth of the crops he has planted. How they occur and when they occur are a definite benefit to man. Even though there are degenerative side effects, the benefits far outweigh the bad features.

References

1. Trewartha G. T. 1943. An introduction to weather and climate second edition, McGraw-Hill Book Co., New York, p. 179.
2. *Ibid.* p. 290.
3. *Ibid.* p. 450.
4. Battan, L. J. 1983. Weather in your life. W. H. Freeman and Co. San Francisco, p. 38.
5. Trewartha. *Op. cit.*, p. 180
6. Large, A. J. 1985. Predicting rain: a tricky science gets new data. *The Wall Street Journal* 206(17):23.
7. Duley, F. L. and J. J. Coyle. 1955. Our ranges and pastures in Water: the yearbook of agriculture. U.S. Government Printing Office, Washington, D.C., p. 407.
8. Baldwin, J. L. 1973. Climates of the United States, U.S. Government Printing Office. Washington, D.C. p. 32.
9. Went, F. W. 1955. Fog, mist, dew and other sources of water in Water: the yearbook of agriculture, U.S. Government Printing Office, Washington, D.C., p. 103.
10. Wadleigh, C. H. 1955. Soil moisture in relation to plant growth in Water: the yearbook of agriculture, U.S. Government Printing Office, Washington, D.C., p. 358.
11. Hiatt, W. E. and R. W. Schloemer. 1955. How we measure the variation in precipitation in Water: the yearbook of agriculture, U.S. Government Printing Office, Washington, D.C., p. 80.
12. Battan. *Op. cit.*, p. 129.
13. Hagan, R. M. 1955. Watering lawns and turf and otherwise caring for them in Water: the yearbook of agriculture, U.S. Government Printing Office, Washington, D.C., p. 475.
14. Williams, E. L. 1981. A creation model for natural processes in Williams, E. L., editor, Thermodynamics and the development of order, Creation Research Society Books. Norcross, GA, pp. 114-19.

Contributed by Emmett L. Williams

WATER FOR PLANTS

No one disputes the need for and uniqueness of water. This simple substance is so widespread and so common that we are not always aware of how dependent we are on it. The availability of water is a limiting factor not only for plants but also for animals and man. Animals and man are able to move and protect themselves from some of the problems induced by a lack of water, but plants cannot live in places where the water supply is limited. And of course animals and man are ultimately dependent on plants for only plants can provide energy from the sun.

Not only is the quantity of water a limiting factor but its distribution limits plant life as well. Two areas may have the same amount of total precipitation in the year, but in one the rain will be seasonal which requires plants equipped to stand long periods of drought.

Water has a very high heat-holding capacity which enables it to moderate temperatures. It requires a large quantity of heat to change water from a solid to a liquid and from a liquid to a gaseous state; this makes water an effective cooling agent. Water reaches its greatest density at 39°F. This is unusual since all other liquids reach their greatest density at the freezing point. This property of water tends to prevent freezing from the bottom of the lake which would be catastrophic to living things. Water in the form of vapor serves in the same way that glass serves in a greenhouse; it serves as a blanket to maintain the heat on earth. Since water is a unique substance it is hard to believe that its properties came only by chance. It is much easier to believe that they were planned by an all-wise Creator. (Klotz, John W., 1985. *Studies in Creation*, St. Louis, Concordia, pp. 194-197)

Water is available to plants in the form of dew, fog, and precipitation. Dew is probably more important to maintaining plant life than we recognize. It is especially important in desert areas which have little or no summer rain. Here, nightly cooling of the surface soil may result in heavy dew formation that is significant for plant life. In Israel there are many areas where the annual dew fall exceeds 100 mm per year and some where it exceeds 150 mm. The annual total of dew formation on plants is at least as great as the annual rainfall in the western Negev. Since humidity is high on dewy nights, evaporation is at a minimum and this combination certainly contributes to the survival of plants under extreme moisture conditions. (Oosting, Henry J., 1956. *The Studies of Plant Communities*, San Francisco, Freeman, pp. 124 f). Dew also plays a very important part in supporting vegetation on the Galapagos Islands. At sea level there is nothing but desert vegetation. However at altitudes of 3500 feet or higher there is lush tropical vegetation. Almost all the precipitation which supports this lush vegetation comes from dew.

Summer rains are usually convectional in origin resulting from local vertically ascending air currents of high velocity and thus are frequently short and heavy. When moist air is forced upward mechanically as it rises over a mountain, the effect is the same; this is known as orographic precipitation. The typical late afternoon tropical rains which are usually short and very heavy are ordinarily convectional or orographic (Oosting, p. 128).

More important to plants than the total amount of rainfall is the relative humidity of the surrounding air. This of course is related in some degree to the time and amount of precipitation. Generally there is a daily rhythm in humidity, high at night, low during the day. There are also vertical and horizontal differences. From 97 to 99 percent of the water which enters plants from the soil is lost by evaporation from the leaves (referred to as transpiration). Transpiration is greatest at times of low humidity and least at times of high humidity. (Odum, Eugene P., 1959, *Fundamentals of Ecology*, Philadelphia, Saunders, pp. 112-114).

Now what does all this mean? The pattern of late afternoon and evening showers makes possible maximum growth at this time. Photosynthesis is limited by the amount of carbon dioxide which can be taken in through the stomata. However, opening the stomata to admit carbon dioxide means also that they must also be open to release water in transpiration. The amount of water lost through transpiration is highest when the relative humidity is lowest. With afternoon and evening showers, the late afternoon and early evening humidity increases markedly which enables the plant to open more stomata and carry on more photosynthesis. These are the most efficient times for the manufacture of carbohydrates. The high humidity which the late afternoon and early evening showers provide increases the effectiveness of food manufacturing process of the plants. It is hard to believe that just by chance this mechanism exists. It is far easier to believe that it was created by an all-wise and all-knowing God.

Contributed by John W. Klotz

SOME NOTES ON THE TIMING OF PRECIPITATION AND THE THERMODYNAMICS OF AFTERNOON SHOWERS

During the decade of 1974 to 1983 a major research project was conducted by the U.S. Bureau of Reclamation to investigate summer showers and thunderstorms in southeastern Montana. The project, known as HIPLEX, studied the conditions related to the life cycles of these clouds, experimented with modifying them through cloud seeding, and investigated how the timing and amounts of precipitation affected various agricultural ecosystems. A review of the project can be examined in Dennis, et al. (1984), which contains a list of most of the reports and publications related to the project. The notes below draw on this background as a matter of convenience and in order to introduce to this Society a source of research material. They are otherwise independent of the work of the Bureau.

Part of the ecological studies examined the responses of fields of blue gramma grass and western wheatgrass to various amounts of natural and supplemental water during the growing season (Weaver, 1983 a, b). In order to maximize the benefits of supplemental water it was applied by irrigating in the early morning hours. In this way the amounts of water reaching the roots would be greatest. It is then that the least amount of water is lost to evaporative cooling because of minimum surface temperatures, highest relative humidities, most stable surface air, and often minimum winds.

These experiments found that the greatest benefits of supplemental water that was limited to one season occurred when that season was autumn. The plots that received all-season or autumn-season supplements continued to be more productive than control plots for several years after the water supplements were ceased. These and other reports from this series of experiments address the importance of timing and quantity of water supplements from the size of small afternoon showers (little benefit because of evaporative losses, especially during summer) to abundant guaranteed supplies. Similar experiments carried out in differing ecosystems may have other results.

Time of day and seasonal timings of precipitation are thus important to this plant community. It therefore may appear that summer afternoon showers are at the wrong time of day and the wrong season for maximum benefit in terms of water getting to the roots and increasing the production of foliage. Such water is largely recycled almost immediately back into the air by evaporation both as it falls and after hitting the surface. It is therefore suggested that if there is any purpose in such showers occurring in the afternoon and evening rather than the morning, the suggested topic of this mini-symposium, it is that of limiting the temperature of the surface environment of the earth.

The thermodynamics of showers will be briefly reviewed here for those unfamiliar with convective processes. There are many meteorology texts that could be consulted to gain a detailed description. For a popular style and easily obtained text one could read Schaefer and Day (1981) pp. 65-79. The following summary will be of intermediate complexity but will omit explanations of many details.

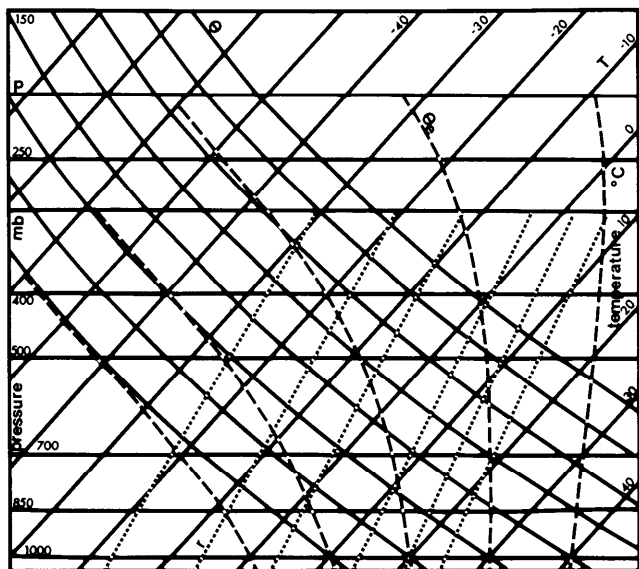


Figure 1. A simplified Skew T Log P diagram on which one can graph atmospheric structure and thermodynamic processes, as in the other figures.

Meteorologists have many styles of graphs on which to indicate the temperature and moisture structure of the atmosphere. One popular diagram, known as "Skew T Log P" is shown in Figure 1. The horizontal axis represents the temperature, T , but lines of equal T slope to the right as one goes to the top of the diagram rather than being vertical. This is done for convenience to keep plots of actual temperatures from going to the left too rapidly with altitude. The vertical axis is the logarithm of pressure, P , decreasing upwards. Altitude is linear with $\log P$ only with constant temperature; the relationship is close to linear for a real atmosphere. Lines of constant moisture (mixing ratio), r , shown by the dotted lines, are more vertical on this diagram than the constant temperature lines. Moisture is usually plotted on these diagrams in terms of dewpoint, D , the temperature at which chilled air becomes saturated.

Vertical motion in the atmosphere without the addition or loss of heat or moisture follows the adiabatic laws of thermodynamics. Dewpoints follow lines of constant mixing ratio, r , during vertical changes. In ascending air that has become saturated D is limited by T and excess water vapor is condensed to form cloud droplets or ice particles. Dry air temperatures of air with vertical motion follow lines of equal potential temperature, θ , sloping towards the left and concave upwards. Saturated air ascending pseudo-adiabatically ("pseudo-" because of heat release from condensation and the removal of the condensate by precipitation) follows the remaining, dashed lines of equal equivalent potential temperature, θ_e , concave to the left and nearly paralleling the θ lines at cold temperatures.

The thermodynamics of showers can be illustrated by actual measurements taken on July 10, 1979, a day which eventually produced vigorous thunderstorms. A temperature and dewpoint profile of the lower atmosphere in early morning is shown in Figure 2a. Surface air below an inversion, where temperatures increase with altitude, was cooled by nocturnal in-

frared radiation. Solar heating and vertical mixing during the day caused T and D in the lower layers to follow the θ and r lines, shown by the dotted lines in Figures 2b and 3. Figure 2b shows partially heated air temperature profiles. Clouds could not yet form in the atmosphere because air had not yet risen to the level where T equals D .

Figure 3 illustrates an air and cloud temperature profile typical of vigorous convection. Cloud temperatures warmer than surrounding air temperatures gave the cloud buoyancy. Cloud growth decelerated when it penetrated air warmer than itself, as above the tropopause. Convective clouds often fall back to a lower level of neutral buoyancy at such locations, forming flat-topped clouds or anvils.

Precipitation falling from the cloud into unsaturated air cools that air by evaporating into it, much like the functioning of swamp coolers used for simple air conditioning in drier climates. Such cooling makes dry air containing precipitation less buoyant than surrounding air and causes a downdraft. In extreme cases these downdrafts can cause the "microbursts" and surface wind shear that have caused airplane crashes during takeoff and landing. Downdraft temperatures can be anywhere between the light dotted line below cloud base in Figure 3 and the air temperatures away from the downdraft.

It usually takes solar heating to initiate the convection that brings showers and thunderstorms. This heating is not instantaneous but takes several hours to restructure the temperature profile to be able to support convection. This delay after sunrise necessarily puts the timing of typical showers into the afternoon and evening.

Once the lower atmosphere warms sufficiently to initiate deep convection there is little more rise in surface air temperatures. Excess heat is quickly convected upwards. Once clouds form they begin shading the surface and scattering solar energy back into space, thus inhibiting further heating of the surface. Once precipitation starts falling into unsaturated air, surface air temperatures are usually cooled by precipitation-driven downdrafts. The precipitation itself also cools hot surfaces by using their heat to evaporate the precipitation back into the air. Land

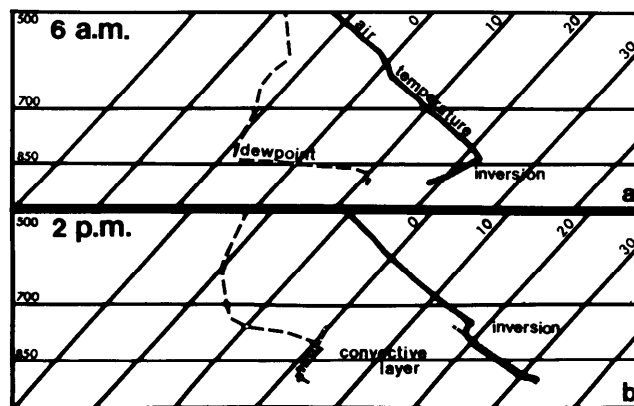


Figure 2. (a) Morning and (b) early afternoon temperature (T) and dewpoint (D) structure of the lower atmosphere before thunderstorms occurred. The dotted lines indicate T and D in convecting air.

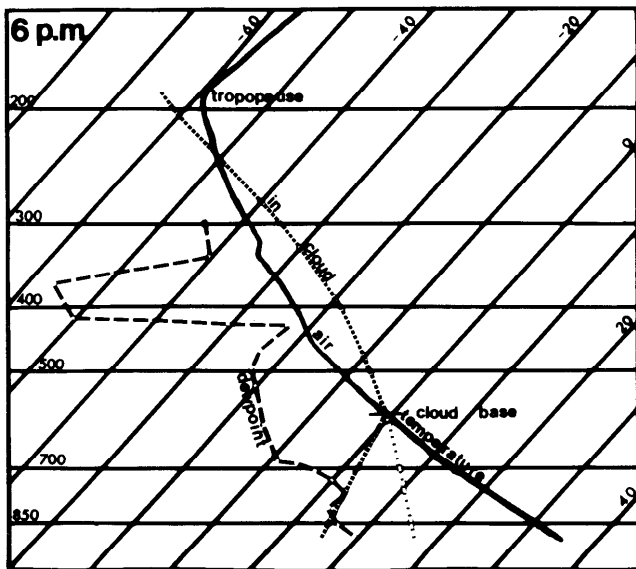


Figure 3. Early evening temperature (T) and dewpoint (D) structure of the atmosphere when vigorous thunderstorms were being produced. The heavier dotted lines graph the T and D of rising air below and in the clouds. The light dotted line is the lower limit of possible downdraft temperatures.

sufficiently soaked by one day's rain will thereby be prevented from rising to as high a temperature the next day as will adjacent dry land until that water has been evaporated.

It is seen by these final effects that the processes of convection, cloud formation and precipitation production have an important function in the regulation of the temperature of the surface environment. Daytime temperatures are thereby prevented from reaching extremes that would be harmful to life. Afternoon and evening convection and showers therefore provide a thermodynamic "safety valve" to limit possibly harmful effects of solar heating. The greater rate of condensation and precipitation production by convective (rather than stratiform) processes in order to water the earth may only be a secondary purpose in the creation of a thermodynamic system that results in more afternoon and evening rather than morning showers. This system usually requires solar heating as the energy source for showers, but then the showers limit that energy input, sometimes causing the cessation of shower activity by sunset.

References

1. Dennis, A. S., E. W. Holroyd III, W. E. Howell, D. A. Matthews, B. A. Silverman, and A. B. Super, 1984: HIPLEX: A cooperative program on rain augmentation in the High Plains, Division of Atmospheric Resources Research, Bureau of Reclamation, Engineering and Research Center, Denver, Colorado 80225.
2. Schaefer, Vincent J., and John A. Day, 1981: A field guide to the atmosphere. Volume 26 of the Peterson Field Guide Series. Houghton Mifflin Co., Boston.
3. Weaver, Theodore, 1983 a: The yield response of High Plains grasslands to water enrichment, three phases. State of Montana Activities in the High Plains Cooperative Program: 1981-83. Montana Department of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59620.
4. Weaver, Theodore, 1983 b: Response of differentially enriched grasslands to cessation of irrigation—dry years following wet. State of Montana Activities in the High Plains Cooperative Program: 1981-83. Montana Department of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59620.

Contributed by Edmond W. Holroyd, III

WATERING THE LAND

The hydrologic cycle is sustained by the Lord to water the earth and demonstrate His love (Job 37:13). From the beginning, man was commanded to manage the earth's precious water supply (Gen. 2:15). In our day, large-scale water control has had mixed results, with both notable successes and also great failures. Deserts have been turned green, but surface/ground reservoirs have been depleted and polluted. What is the correct approach to environmental management? Surely it is the Lord's established plan in every case. We are *stewards* of His land, and should care for it in light of His ownership.

This symposium concerns the most beneficial time of day for irrigating fields. When water is rationed by the clock, as in the Southwest, there may be no choice of watering time. In addition, there is a surprising lack of information on optimum diurnal watering times. Great emphasis is placed on soil moisture measurements, and this is usually the only guideline for watering. Regardless, one may learn valuable lessons from the Lord's watering schedule. Even in a cursed world the local precipitation pattern is obvious, varying from region to region. The Midwest is one important area of great agricultural productivity. Its temperate climate is one of well-defined seasons. During the growing season, what time of day does rain occur? Very often it is during the early morning, late afternoon, or evening hours. There are meteorological reasons for this schedule, involving the vertical development of cumulus clouds and availability of precipitation nuclei. The following paragraphs, however, concentrate on the advantages of this ordained watering schedule.

The Midwestern precipitation schedule largely avoids the midday hours. Broadly, the reasons may be grouped around the concept of efficiency. Midday is not an efficient time to water crops. *First*, air temperature is lower in the early AM and late PM. Evaporation loss is greatly reduced at these times, since cool air holds less moisture than warm air. The effect is measured by the absolute humidity, the amount of water that saturated air can hold. Between 0°C and 30°C, the amount increases six-fold, from 5 gm/m³ to 30 gm/m³. *Second*, air is more likely to be calm during the early AM and late PM. Midday wind greatly accelerates evaporation losses. Unpublished measurements have been made at Grace College of wind speed versus water evaporation. It is a difficult experiment because of the multiple variables: temperature, light, turbulence, humidity, air pressure, and duration. The results show a linear doubling of evaporation as air speed is doubled. *Third*, vegetation takes in *more* water after it has experienced a warm midday. Dry soil and a slight plant moisture deficiency result in optimum intake when water finally is provided! In technical terms, the greater the pressure gradient between a plant's moisture and the available moisture, the greater will be the water absorption by the plant to eliminate the pressure difference. Summary statements may be helpful, even though they appear only as afterthoughts in the literature:

Irrigate at night or in the very early morning, when humidity is high and air temperature may be low. Very likely evaporation losses from the

sprinkler spray and wet foliage can be reduced by doing so.¹

During irrigation, the rate of evaporation can also be high and may amount to over 10% of the applied water. Thus loss is less when irrigating in late evening and during the night.²

One hears many opinions regarding the best time to water lawns, gardens, and crops. Very often the early AM and late PM times are advised to be avoided because of various fungus diseases. Such advice can be readily countered with daytime watering problems like scalding. A more general and credible guideline is the ultimate efficiency of the irrigation process. The Creator's timetable reveals designed efficiency. Many other aspects of irrigation could be explored. For example, water drop size is critical. If too large, damage will be done to the plants and soil. If too small, water drops will be rapidly retarded, deflected, and evaporated. The optimum size is about 2.5 mm in diameter, just the size of rain drops! What other science lessons remain to be learned by looking at the Lord's handiwork?

Reference

1. Hagan, Robert M. 1955. Watering lawns and turf and otherwise caring for them. The yearbook of agriculture U.S. Government Printing Office, Washington, D.C., p. 468.
2. Vitosh, Maurice L. 1980. Irrigating scheduling. Irrigation guide IFS/2-80, Michigan State University, p. 6.

Contributed by Don B. DeYoung

ARIZONA RAIN

The area of Arizona where the Grand Canyon Experiment Station (GCES) is located and areas southward into the desert itself have two rainfall seasons each year. There is a winter wet season in the desert which leads to the growth of one certain set of ephemeral plants that germinate, flower and set seed in a very short time corresponding to the period of moisture. Then in the late summer—late July into August—there is a wet period as well. In the Arizona deserts (south of GCES) there is another summer set

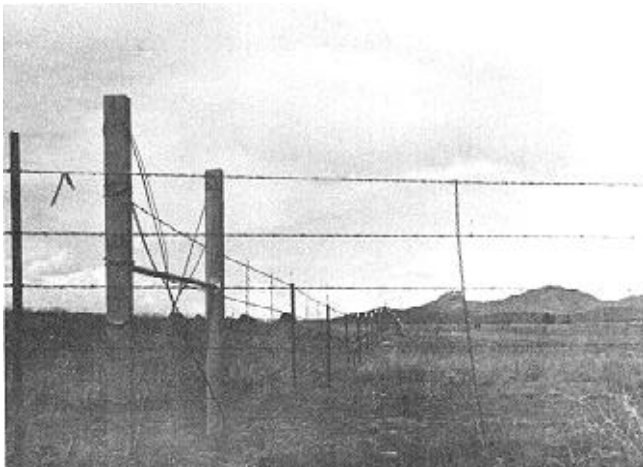


Figure 1. NW corner post (GCES) as an afternoon shower approaches (August 1984).

of ephemeral plants that germinate, flower and set seed in a very short time. This is an entirely different group of plants than the winter annuals!

At GCES there is a late summer "monsoon season" (late July-early August) when storms come characteristically in the afternoon. These cause the grass to get green as seen in Figures 1 and 2. Figure 1 is the NW corner of GCES just before a shower and Figure 2 shows the southern rabbit enclosure fence on our CRS land, looking south, just before a storm. Thus in August, 1984 we found the GCES green and moist but in early July, 1985 it was much drier. Afternoon thundershowers help produce Arizona's monsoon season and supply much-needed moisture for grassland.



Figure 2. Southern rabbit enclosure (GCES) prior to one of the monsoon afternoon storms (August 1984).

Concerning the north rim Kaibab pine forests near where John Meyer and I are doing our Shiva Temple research, Merkle writes: "The average annual precipitation of about 27 in. falls in two seasons, the greater amount occurring during July, August and September as local afternoon showers"¹ Thus afternoon showers supply *most* of the rain the Kaibab Plateau ever receives.

Reference

1. Merkle, John 1972. Plant communities of the Grand Canyon area, *Arizona Ecology* 43:700.

Contributed by George F. Howe

QUOTE

If, in the novels which he reads, in the plays and films which he sees, and in the philosophical and ethical treatises which are presented for his edification, Western man is continually and exclusively subjected to a vision of himself as a being—violent, animalistic, alienated, mannerless, and uncivilized, then is he not being encouraged to identify with such an image and to mold his own outlook and behavior to conform with such an image?

Williams, Duncan. 1985. Negate the negation! Rescuing Man from nihilist art and materialist science. *Imprimis* 14(6):1 Hillsdale College, Hillsdale MI

YUCCAS OF THE SOUTHWESTERN UNITED STATES: A STUDY IN NUMERICAL TAXONOMY AND IN ORIGINS AT THE SPECIES LEVEL

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Abstract

The lily family in general and the *Yucca* genus in particular are discussed in the context of origins. Eleven criteria are presented by which species in the genus *Yucca* may be compared. Nine *Yucca* species are contrasted using these same criteria. The results are then subjected to numerical taxonomy by which three subgroups or "sections" are established in the genus *Yucca* rather than the usual four sections proposed by other workers. Furthermore, it is asserted that the origin of these sections and species in the genus *Yucca* is not easily explained by evolutionary descent within the genus. The data of paleobotany and pollination also fail to support the origin of *Yucca* species by evolution. It is a credible alternative to evolution to suggest that the Creator endowed each particular group in this genus with its own assemblage of morphological characteristics.

Introduction to the Yuccas

Having clusters of bright cream-colored flowers and sword-shaped leaves yuccas are fascinating plants that show similarities to the agaves (century plants) and the nolinias (beargrasses). Sargent (1949, p. 110) reported that the generic name *Yucca* derives from the Carib name for the root of the Cassava. The characteristic shape of a yucca plant jutting out against the skyline is a scene familiar to all who have traveled the American deserts or the sandy, Southeastern beaches.

Yuccas have proved suitable for lawn planting and even for flower garden use. Many different varieties have been employed for such ornamental purposes, being propagated by seeds, cuttings, and offsets—see Bailey (1939, pp. 3529-31) and Clark (1979, pp. 503-5). Sargent (p. 110) has also reported that in countries where rainfall is scanty, yuccas are cultivated for hedge to protect gardens from cattle. Two of the horticultural forms most widely planted in Southern California are *Yucca gloriosa* and *Y. aloifolia* — both species native to the sand dunes of North Carolina and southward to Florida.

All members of the genus *Yucca* were natives of temperate North America from Bermuda and the Eastern Antilles westward across the South Atlantic and Gulf states on to California, as Sargent has written (p. 110). They range from 49° N latitude in southern Alberta down to 15° N latitude in southern Mexico, as indicated by Powell (1984, p. 3). They have been planted widely and have sometimes escaped from cultivation to grow wild so that their present distribution is widespread on many continents.

There are a number of economic uses to which these bizarre plants have been successfully applied. Native Americans used yuccas for making soap, rope, food, baskets, and mats—see Sargent (pp. 22 and 55). More recently these plants have been used industrially to produce stock food, heavy paper, flashing, weather stripping, burlap, and cordage as Cruse (1949, pp. 111, 114, and 129) related. He also reported that yuccas have been harvested and sometimes even cultivated as a source of saponin for soap and hair products (p. 129). In years ahead it is hoped that some further

studies on useful features of yuccas will be carried out at the CRS Grand Canyon Experiment Station, Paulden, Arizona. Readers interested in learning more about this Experiment Station should consult Howe (1984).

The Lily Family

Yuccas are all members of the lily family (Liliaceae), the classification of which has been a conundrum for botanists as will be seen in this short quotation from two leading plant taxonomists:

The Liliaceae are a complex family, however they are classified. As in other cases in which knowledge is scant, opinions have been intense. The Liliaceae include many anastomosing lines of evolution. . . . The proposed segregations emphasizing one character, then another, indicate a complex family not capable of reasonable subdivision. In short, the differentiating characters put forward so far do not yield a natural segregation. Benson and Darrow (1981, p. 46).

When these evolutionary authorities say that there is no "natural segregation" of the lily family, they mean that there is no systematic or coherent way to outline its genera by use of key characteristics—as one might expect if in fact the lily family had arisen by a branching scheme of evolutionary descent. Some other workers like Cronquist *et al.* (1977, pp. 526-27) have sought recourse from the lily family problem by isolating the yucca, agave, and nolina forms into a small separate family of their own called the Agavaceae. A similar revision has been undertaken by Wootton and Standley (1972, p. 135) who have placed the genus *Yucca* into a family called the Dracaenaceae with *Nolina* and *Dasyllirion*. Members of this truncated Agavaceae group are found in the warm, dry areas of the world and entail 20 genera divided into 450 species, as Cronquist *et al.* (p. 527) have reported. But Benson and Darrow have asserted that the erection of a small family for *Yucca* and those two other genera does not really solve the taxonomic problems or the Liliaceae as they indicated:

There have been various proposals for solving the problem by atomization of the family, but any attempt to lop off individual branches as families is based upon too little knowledge of the group as a whole to be meaningful. Accepting the entire group as a single family does not solve the problem,

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either, but the group as a whole is at least natural, and some of the fragments proposed as families are not necessarily so. Benson and Darrow (p. 46).

When they write, as above, that the entire lily family is a "natural" group, taxonomists mean that its members have a broadbased affinity for each other. Evolutionists further hold that all such members of a "natural" group have been closely related through evolutionary descent from common ancestry. Numerical taxonomists use this same phrase "natural group," however, to designate any set of organisms that resemble each other on the basis of many distinct criteria. Creationists enjoy the numerical taxonomist's usage of the word "natural" and creationists also assert that a "natural" group (like the lily family, in this case) contains organisms into which the Creator put many of the same design features. Creationists likewise affirm that such design parallelism extends to the level of chromosomes where it has been shown, for example, that the chromosome complement of all yuccas and agaves consists of a set of 25 small and five large chromosomes—a pattern which is rare in other lily family members as Cronquist (1968, p. 323) has noted.

These same chromosomal characteristics are problematic for evolutionists, however, because the 25 small + five large pattern in chromosomes is not present in some of the genera like *Dracena* and *Nolina* that were originally included in the Agavaceae because of their close similarity to *Agave* and *Yucca* otherwise! To make the problem even more critical, some plants (like the plantain lily of China — *Hosta* — or the desert lily of the United States and Mexico — *Hesperocallis* which otherwise were very different from the Agavaceae) do have chromosome complements essentially like those of *Yucca* and *Agave*, as Cronquist has written (p. 323). In summary—although yuccas and agaves have a 25 + 5 chromosomal arrangement, some yucca-like plants lack this pattern while some very distant non-yucca type lily members possess it. Such a phenomenon is most confusing from an evolutionary standpoint.

Criteria for Classifying Yuccas

It is not my purpose here, however, to dwell further on these challenging problems concerning the origin of the whole lily family but to turn instead to one lily genus—the yuccas. Although there are some Mexican species and several eastern species in this genus (ranging from Texas and Oklahoma eastward to North Carolina and New Jersey), by far the greatest number of yucca species has been classified in the American Southwest. It is these southwestern American species I shall analyze.

Many excellent descriptions and keys of the southwestern yucca species have been produced. Interested readers should consult Benson and Darrow (1981), Cronquist *et al.* (1977), Kearney and Peebles (1951), Howell and McClintock (1960), McKelvey (1938), and Webber (1953) for example. Upon analysis of such treatises, it becomes apparent that the workers have designated the southwestern yuccas into groups most consistently on the basis of the following 10 criteria:

(1) leaf margins having either minute sawtoothed edges (serrations), long separating fibers, or neither.

(2) leaves either relatively broad (2 cm or more in width) or narrow (< 2 cm in width). In Table I representative means and standard deviations are given for two "broad" and two "narrow" leaved species. The narrow vs. broad leaf nature of particular yuccas is not obvious in the photographs because all yucca leaves (whether 5 mm or 25 mm broad) look like narrow ribbons at a distance.

(3) leaf color either blue-green or yellow-green.

(4) leaf either concavo-convex  or plano-convex  in cross section.

(5) trunk upright, on the ground (procumbent), or absent.

(6) flower stalk either unbranched (a raceme) or branched (a panicle).

(7) flower stem (inflorescence) either short and somewhat enclosed by the leaves or relatively long and visible clearly beyond the terminal cluster of leaves.

(8) fruit either erect or non-erect on the inflorescence.

(9) fruit either splitting open at maturity (dehiscent) or not (indehiscent).

(10) fruit either falling after becoming ripe (deciduous) or not falling (persistent).

Other criteria involving the size and color of flower parts and the length of leaves were not employed in the present study as they were less consistently used by the aforementioned authorities. In addition to these 10 characters, I have noted that some southwestern yucca species consistently thrive in relatively low altitude habitats, growing along with Lower Sonoran or desert forms such as creosote bush and coach-whip "cacti" while others inhabit the more moist Upper Sonoran regions frequently mingling with higher altitude plants like pinyon pines, junipers, and scrub oaks. Therefore I have established the following additional criterion:

(11) limited to relatively low altitudes (usually below 4,000 feet) in association with desert plants as opposed to those that thrive well above 4,000 feet altitude and mix with such plants as Utah juniper and pinyon pine.

The Species of Southwestern Yuccas that Result by Use of Such Criteria

By studying these traits, one can readily divide the southwestern yuccas into nine species as follows: *Yucca angustissima*, *Y. arizonica*, *Y. baccata*, *Y. brevifolia*, *Y. elata*, *Y. glauca*, *Y. schidigera*, *Y. schottii*, and *Y. whipplei*. The reader is introduced to some of these yuccas in a photographic essay involving the Cover Photograph and Figures 1-8.

Earlier authorities like Webber (1953) and McKelvey (1938) recognized many other southwestern species of yucca besides these nine. In more recent revisions of the genus, however, some older "species" were lumped together as merely being varieties of or hybrids between other species. For example, Howell and McClintock (p. 1043) in their recent supplement to the Arizona flora judged that *Y. newberryi* is synonymous with *Y. whipplei* while *Y. mohavensis* is also merely a synonym of *Y. schidigera*. In 1981, Benson and Darrow (p. 55) expressed their opinion that *Y. thorneberi* and *Y. confinis* of earlier literature were both probably hybrids between *Y. baccata* and *Y. arizonica*.

Table I. Comparisons between nine southwestern species of yucca according to eleven contrasting traits.

SPECIES:	<i>angustissima</i>	<i>arizonica</i>	<i>baccata</i>	<i>brevifolia</i>	<i>elata</i>	<i>glauca</i>	<i>schidigera</i>	<i>schottii</i>	<i>whipplei</i>
Characteristics:									
1. leaf margin	fibers	a few fibers	fibers	serrations	fibers	fibers	fibers	no fibers no serrations	serrations
2. leaf width* in mm $\pm$ S.D. n = 10	narrow 4.2 $\pm$ 1.80 n = 10	narrow	broad 22.3 $\pm$ 3.25 n = 22	narrow 9.7 $\pm$ 1.17 n = 20	narrow	narrow	broad 29.2 $\pm$ 3.74 n = 10	broad	narrow
3. leaf color	blue-green	-----**	blue-green	blue-green	yellow-green	-----	yellow-green	yellow-green	blue-green
4. leaf cross section plano or concavo-convex	plano	concavo	concavo	plano	plano	plano	concavo	concavo	plano
5. trunk	absent	erect but obscurely so	procumbent	erect	erect	absent	erect	erect	absent (under-ground)
6. inflorescence character	raceme	panicle	panicle	panicle	panicle	raceme	panicle	panicle	panicle
7. inflorescence length	long	long	short	short	long	long	intermediate	intermediate	long
8. fruit stance	erect	not erect	not erect	not erect	erect	erect	not erect	not erect	erect
9. fruit splitting?	dehiscent	indehiscent	indehiscent	indehiscent	dehiscent	dehiscent	indehiscent	indehiscent	dehiscent
10. fruit fall?	deciduous	-----	deciduous	deciduous	persistent	persistent	deciduous	deciduous	persistent
11. altitude and ecological associations	high with pinyon pine and juniper	low 2000 - 4000 feet	high with pinyon pine and juniper	low with creosote bushes	low with creosote bushes	high with pinyon pine & sagebrush	low with creosote bushes	high with oak woodland	low with chaparral

*A mean followed by the standard deviation (in millimeters) is given for each of two typically "narrow leaved" species and two "broad leaved" species. n is the number of leaf width measurements taken.

**A blank line indicates that field and/or library data were not available.

Y. veridensis, *Y. utahensis*, and *Y. kanabensis* have likewise been viewed as hybrids between *Y. elata* and some other yucca species or perhaps as mere variants of *Y. elata* — Howell and McClintock (p. 1043). *Y. navajoa* is now seen as variant of *Y. bailevi* while *Y. bailevi*, *Y. standleyi*, and *Y. harrimanae* are currently thought to be transitional forms between *Y. elata* and *Y. glauca* — see Howell and McClintock (p. 1943) as well as Benson and Darrow (p. 49). Finally, *Y. torreyi* may be just a variety of the species *Y. baccata* as Benson and Darrow (p. 56) also suggested.

Yuccas and Taxonomic Splitting

This collapses the southwestern yuccas to nine species instead of dozens, thus making our study easier. It also points to the practice of taxonomic splitting which is of importance in the field of origins research. Early biologists regularly practiced "splitting" whereby they erected species groups upon the basis of only slight morphological differences. Before origins discussions can center intelligently on any botanical group, it is necessary to scale down the number of taxa as has been done here. But while most authorities would propose a smaller number of species groups than were originally recognized for yuccas, not all of those authorities would agree on the number nine or on the exact identity of the nine listed here. This is not surprising, however, as there is regular disagreement



Figure 1. *Yucca brevifolia*, "Joshua tree" is seen as one leaves the chaparral and descends slopes leading down into the Mohave Desert (near Pearblossom and Palmdale, California). While this yucca has serrated leaf margins like Spanish bayonette, its tall trunk more closely resembles the upright stem of certain other yuccas like the mohave yucca. Legend has it that as the Mormons of San Bernardino made their pilgrimage to Utah, they fancied this tree, with branches akimbo, to be a botanical Joshua directing their path through the desert to the promised land! Although it is difficult to tell the narrow-leaved yuccas from the broad leaved species on photographs like these there is a significant difference between the two. Thus the mean width for *Y. brevifolia* (a typical narrow-leaved species) is 9.7 $\pm$ 1.17 mm (n = 20) while the mean width of leaves for *Y. schidigera* (a broad-leaved yucca) is 29.2 $\pm$ 3.74 mm (n = 10) as seen in Table I.

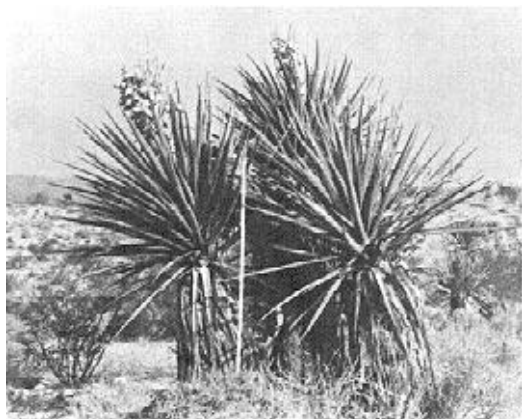


Figure 2. *Yucca schidigera*, "Mohave yucca" first meets the east-bound traveler along Interstate 15 between Victorville and Barstow, California where it is seen growing among the creosote bushes. Like several other broad leaved yuccas, this yucca has long whitish fibers separating from the margins of its leaves. But it is like the Joshua tree of a different yucca "section" or "group" as regards its upright stem seen here. The tape measure seen in this and subsequent photographs is extended 100 cm.

among taxonomists on many issues. A study of revisions in the genus *yucca* shows a small number of Southwestern species, something like the nine species given here (see Benson and Darrow, and Cronquist *et al.*).

Joneen Cockman, a taxonomist who has been identifying grasses from the CRS Grand Canyon Experiment Station, writes that "taxonomic splitting" needs closer attention from the ecological vantage as well because:

With 'rare and endangered' plants having power to hold up timber sales and thwart grazing practices on our public domain, we need to discover whether or not all the nominated plants are indeed 'rare.' Many may be the same species with some slight morphological trait adapting them to their immediate environments. (1985)

Contrasting Traits Evident Among the Nine Southwestern Yucca Species

Table I is a summary of information gathered in the field and from published reviews concerning the nine southwestern yucca species in relation to the 11 aforementioned criteria. Using such a table it is possible to erect "keys" by which any individual plant can be correctly classified into its species. A key contains a series of paired choices which eventually lead to the correct identity of a particular plant. In *Yucca* keys the criteria of Table I are regularly used.

Mathematical Taxonomy

In addition to being useful for making keys, Table I can be analyzed to show clusters of resemblance between various species. As early as the 18th century Michel Adanson applied a method of classification that he called "la méthode naturelle" to molluscs and plants. Believing that organisms should be grouped by means of mathematical comparisons between the taxa upon the basis of many characters, he originated what has since come to be called "numerical taxonomy." By such a scheme, groups or "taxa" are ultimately erected by correlating many features that organisms hold in common.

In Adansonian or numerical taxonomy, many features are put together on an equal basis and a simple arithmetic computation is used to decide which organisms should be segregated into subtaxa (species, for example of a particular taxon or group (*e.g.* genus).

In addition to providing a comprehensive footing for taxonomy, such broad-based computations helped separate taxonomy from phylogenetic evolutionary speculations. After 1859 evolution models became a millstone around the neck of taxonomy. Supposed evolutionary connections were employed to determine which criteria were most significant in classification. Other criteria were ignored or minimized in importance. Thus taxonomists after Darwin tried to produce classifications of even the worst known groups—based on supposed evolutionary affinities. Often they foisted preconceived philosophical notions on the data of science and taxonomy. As a result, taxonomy became a field where evolutionary guesswork was rampant. To some workers it seemed that taxonomy had become a stepchild of evolution rather than scientific discipline in its own right after the tradition of the creationist Linnaeus.

Thus some taxonomists magnify a few traits unjustifiably, as a bacterial taxonomist, Cowan, has so cleverly asserted:

A hitherto undetected similarity exists between Lewis Carroll's Alice and bacterial taxonomists in particular. Alice lived (or dreamed) in a world of fantasy in which the eating or drinking of various delicacies gave her the ability to magnify or minimize characters, and she not only upset preconceived ideas of relationships in size, but also disturbed the significance or importance attached to hereditary factors (such as monarchy) and the normal (as distinct from the decapitate) state of the whole organism. Taxonomists also seem to do these things, though they do not need to bite mushrooms or drink magical concoctions in the laboratory. (1969, pp. 145-51.)

In Adanson's method such overemphasis on one or only a few traits cannot take place because one tallies up the composite results by using many traits without any *a priori* decisions as to which traits are most



Figure 3. *Yucca baccata*. "banana yucca" or "datil" is first found growing at higher altitudes east of Kingman, Arizona along Interstate 40. This yucca is easily distinguished from the Mohave yucca because of its leaves that have a distinctly blue-green color (Mohave yuccas are yellow-green) and its stem which usually lies upon the ground; a condition that botanists call "procumbent."



Figure 4. *Yucca baccata* “banana yucca” again seen here bears large, pulpy, banana-like fruit seen here hanging downward. Used as a staple food source by certain Native Americans, these pods are said to have a very fragrant and appetizing smell as they are roasted. While they are like the other broad-leaved yuccas of group two in many ways, banana yuccas differ from each member of that group so that it is difficult to affirm that these yucca groups arose by an evolutionary scheme of descent.

meaningful or of greatest “phylogenetic” significance. The results of such numerical taxonomy can then be employed by either creationists or evolutionists depending on the origins model and philosophy involved. Readers seeking a more comprehensive introduction to numerical taxonomy may consult Sokal and Sneath (1963) as well as Ainsworth and Sneath (1962).

Mathematical Taxonomy and the Southwestern Yuccas

To apply numerical taxonomy to the nine southwestern yucca species using the 11 characteristics listed, one simply compares a particular species like *Y. angustissima* with another such as *Y. arizonica*. The number of characteristics which is possessed in common by both of those species (three in this case) is tallied and divided by the total number of characters (only nine in the comparison between *angustissima* and *arizonica* because data on traits three and 10 were not available for *arizonica*) to produce a “similarity coefficient” which in this case $3/9$, 0.33, or simply 33. Thus a numerical taxonomist would say, based on these data, that the “similarity coefficient” for *angustissima* compared to *arizonica* is 33. In another example, the similarity coefficient for *Y. angustissima* as compared to *Y. baccata* is 4 out of 11, $4/11$, 0.37, or simply 37.

This aforementioned process was repeated for every pair of species to calculate their corresponding similarity coefficients. Then, following the methods of Sokal and Sneath, one produces a “similarity matrix” in which the taxa have not been grouped—see Table II. They suggest next that by skillful rearrangement a sequence of taxa should be established in which clusters of similarity can be more easily seen:

One can then visualize the search for group structure as a rearranging of the rows or columns of this matrix in such a way as to obtain the optimum structure in the system. Sokal and Sneath p. 178).

An example of such a “cleaned up” diagram or matrix is shown in Table III. The same information becomes more graphic when shading is used for different degrees of similarity—Table IV.

Three general outlines of similarity become obvious if one puts into the same group all species that have similarity coefficients of 60 or higher with each other. This choice of 60 or above is arbitrary as is always the case in interpreting numerical taxonomic data.

Group One — *Y. angustissima*, *Y. glauca*, *Y. whipplei*, and *Y. elata*. The inclusion of *Y. elata* in this group is questionable because it has a similarity coefficient of only 55 for *Y. angustissima*. It is put here, however, because it has a high similarity coefficient for both *Y. glauca* (70) and *Y. whipplei* (73).

Group Two — dissimilar to these first four species but having a high degree of similarity among themselves are *Y. baccata*, *Y. arizonica*, *Y. schidigera*, and *Y. schottii*. As with **one** all is not completely well with **two** because the similarity coefficient for *Y. arizonica* is lower for *Y. schottii* (44) than it is for *Y. brevifolia* (56) of **three**! *Y. arizonica* is placed here tentatively, however, because of its close resemblance to *Y. schidigera* (67) and *Y. baccata* (67).

Group Three — the Joshua tree (*Y. brevifolia*) composed a group by itself because its level of similarity to any of the other species is not 60 or above. It resembles *Y. whipplei* and *Y. arizonica* most closely (56 for each) and *Y. elata* next (45). But whereas *whipplei* falls somewhat in a cluster of other species (**group one**) and *Y. arizonica* fits in with **two**, *Y. brevifolia* stands alone.

This system of three groups emerging from the numerical taxonomic use of 11 characteristics is very similar to the work of Benson and Darrow (p. 48) and of Webber (p. 16) who each proposed four major sections in the genus *Yucca* as follows:

Chaenocarpa — includes *Y. elata* and *Y. glauca*. This section corresponds closely to **group one** as Benson and Darrow felt that *angustissima* is merely a transitional form between *Y. elata* and *Y. glauca*—



Figure 5. *Yucca angustissima*, “narrow leaved yucca” thrives at altitudes above 4000 feet and thus shares territory with the banana yucca. It is readily distinguished from another narrow leaved species (*Yucca elata*) in that it has no trunk and it bears flowers in an unbranched series called a “raceme” by botanists. Note how it, like Spanish bayonette, bears its fruit standing erect. It is seen here growing on the land adjacent to the north border of the CRS Grand Canyon Experiment Station, Paulden, Arizona. Our station will most likely be an excellent location for growing several species of yuccas and the well which has been shown to produce 20 gallons per minute should be adequate for irrigating such study plots in years ahead.

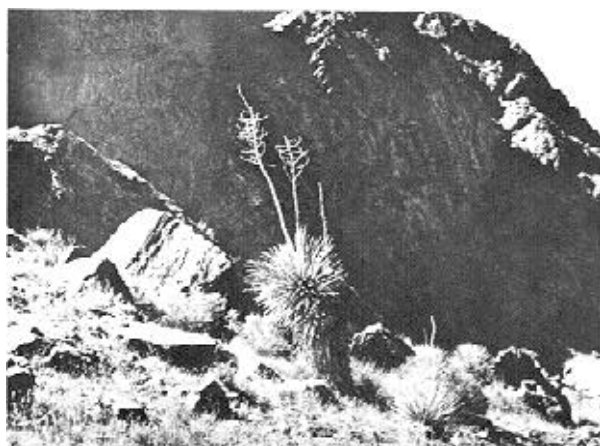


Figure 6. *Yucca elata*, "soaptree yucca" has saponins (natural detergents) in its roots which have been ground up and used as soap by Native Americans who have found that it produces a thick, cleansing lather. It has been harvested and used commercially in the manufacture of shampoo. Although similar to the narrow leaved Yucca (Figure 5) in many ways, soaptree yucca has an erect stem and produces its flowers on a branching stalk known to botanists as a "panicle." Soaptree yucca is generally not listed as a Grand Canyon plant but I have found it growing near the Colorado River, along the eastern portions of "River Trail," which connects the Bright Angel and South Kaibab Trails at the bottom of the South rim hike as seen here. Some writers consider the little narrow leaved yucca (Figure 5) to be nothing more than a transitional form between *Y. glauca* of the great plains and *Yucca elata* seen here. Yet even though the narrow leaved yucca thrives near the South Rim itself at Tusayan, Arizona (altitude about 7000 feet) and the soaptree yucca, as stated, thrives along the Colorado River (altitude about 2500 feet) there is no evidence of transitional forms between them at intermediate altitudes along the South Kaibab or Bright Angel Trails. More work is needed to assess the degree of reproductive isolation between *angustissima*, *elata*, and *glauca*. For an expanded treatment of plants along Grand Canyon trails, consult Howe (1981).

a view with which I disagree. *Y. elata*, as noted above, has only an uneasy fit in this group.

Hesperoyucca — containing *Y. whipplei* alone. Note that a unique and originally unforeseen feature of this present numerical taxonomic study is the step of lumping *Y. whipplei* together with *elata*, *angustissima*, and *glauca* to which it bears fairly high degrees of resemblance—(73), (64), and (60) respectively.

Cleistocarpa — containing *Y. brevifolia* alone and hence the same as my group three.

Sarcocarpa — includes *Y. schottii*, *Y. baccata*, *Y. schidigera*, and *Y. torreyi*. This section is like my group two because Benson and Darrow did not mention *Y. arizonica* and they included *Y. torreyi*—which some would lump as a mere variety of *Y. baccata*.

The Origin of Yucca Groups

It is thus possible by means of numerical taxonomy to divide nine species of Southwestern yuccas into three groups according to their similarities and differences relative to 11 characteristics. While this has been an interesting exercise in taxonomy, one wonders what the origins significance of these three groups might be, especially since there are some serious problems with the placement of *Y. elata*, *Y. brevifolia*, and *Y. arizonica* when all is said and done. Thus the members of the present three yucca groups (or the

Table II. A similarity matrix giving similarity coefficients for pairs of Southwestern yucca species listed in simple alphabetical order. Note that *Y. elata* and *Y. baccata* (each from different groups of sections of the genus) have a very low level of similarity to each other—18. See text for method of calculating these similarity coefficients.

	<i>angustissima</i>	<i>arizonica</i>	<i>baccata</i>	<i>brevifolia</i>	<i>elata</i>	<i>glauca</i>	<i>schidigera</i>	<i>schottii</i>	<i>whipplei</i>
<i>Y. angustissima</i>	100								
<i>Y. arizonica</i>	33	100							
<i>Y. baccata</i>	37	67	100						
<i>Y. brevifolia</i>	37	56	55	100					
<i>Y. elata</i>	55	56	18	45	100				
<i>Y. glauca</i>	90	22	18	37	70	100			
<i>Y. schidigera</i>	18	67	64	55	45	20	100		
<i>Y. schottii</i>	18	44	60	45	27	20	82	100	
<i>Y. whipplei</i>	64	44	27	55	73	60	18	9	100

four groups of Benson and Darrow) do not submit easily to an evolutionary scheme of development. There is not, as one might expect from evolution, a coherent and phylogenetic distribution of traits in these three groups but instead a series of embarrassing parallelisms between members of different groups.

It might seem at first that one is a rather coherent, closely-knit group because it contains the narrow-leaved, dehiscent fruited yuccas which share several other traits such as long flower stalks, erect fruit, and (for the most part) plano-convex leaves. But note that while most of the members of one have fibrous leaf



Figure 7. The fruit of *Yucca elata* is a capsule which splits open when ripe, as seen here. For most species of Yucca, including this one, fertilization and seed development are dependent on the amazing pollinating activities of the pronuba moth, *Tegeticula yuccasella*. This is a "mutualistic" symbiotic relationship in that the moth larvae hatch and grow inside the chambers of this capsule where they move down a row, eating generous quantities of seeds. A centimeter scale is visible.

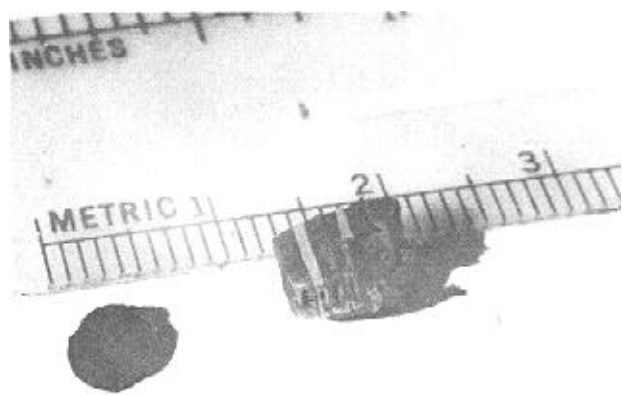


Figure 8. One seed of *Yucca elata* is seen at the left while several seeds still attached to each other as they were taken from the capsule are visible near the center of this figure.

margins, *Y. whipplei* has serrated leaf margins more like *Y. brevifolia* which by itself belongs in **three**. Two of the members of **group one** thrive naturally in low regions of desert or chaparral (*whipplei* and *elata*) while the other **two** (*angustissima* and *glauca*) can occur in higher altitude associations like some members of **group two**. Three members of **one** have persistent fruits but *Y. angustissima* fruits are deciduous like those of **two**. Two members of **group one** have flowers in racemes (*Y. angustissima* and *Y. glauca*) while the other two (*Y. elata* and *Y. whipplei*) have panicles—more like the yuccas of **group two**. Three members of **group one** have no trunk (*angustissima*, *glauca*, and *whipplei*) but *elata* has a tall, sturdy trunk and is thereby very much like certain yuccas of **two** and, of course, like *brevifolia* of **three**.

Group two, on the other hand, contains the relatively broadleaved, indehiscent fruited yuccas which generally also have fibers along their leaf margins and a

Table III. A rearranged similarity matrix has been ordered to place similar species close to each other, as is the case with the first four or the last four.

	<i>angustissima</i>	<i>glauca</i>	<i>whipplei</i>	<i>elata</i>	<i>brevifolia</i>	<i>baccata</i>	<i>arizonica</i>	<i>schidigera</i>	<i>schottii</i>
<i>Y. angustissima</i>	100								
<i>Y. glauca</i>	90	100							
<i>Y. whipplei</i>	64	60	100						
<i>Y. elata</i>	55	70	73	100					
<i>Y. brevifolia</i>	37	37	55	45	100				
<i>Y. baccata</i>	37	18	27	18	55	100			
<i>Y. arizonica</i>	33	22	44	56	56	67	100		
<i>Y. schidigera</i>	18	20	18	45	55	64	67	100	
<i>Y. schottii</i>	18	20	9	27	45	60	44	82	100

Table IV. In this rearranged similarity matrix or “cluster diagram” degrees of similarity have been given graphic representation to make patches of resemblance more visible. On the basis of these data (and those of Table I from which the whole figure was derived) three groups can be established among the southwestern yuccas—the first four species make group one, the last four make group two and Joshua tree (*Y. brevifolia*) stands pretty much alone in group three.

KEY	<i>angustissima</i>	<i>glauca</i>	<i>whipplei</i>	<i>elata</i>	<i>brevifolia</i>	<i>baccata</i>	<i>arizonica</i>	<i>schidigera</i>	<i>schottii</i>
100									
80-99									
60-79									
40-59									
0-39									
<i>Y. angustissima</i>									
<i>Y. glauca</i>									
<i>Y. whipplei</i>									
<i>Y. elata</i>									
<i>Y. brevifolia</i>									
<i>Y. baccata</i>									
<i>Y. arizonica</i>									
<i>Y. schidigera</i>									
<i>Y. schottii</i>									

concavo-convex leaf cross section. But as was seen with members of **one** above, the species in **two** vary among themselves regarding such traits as presence or absence of trunk, color of leaves, length of flower stalk, and altitude of growth—see Table I. Although *Y. schidigera* is like *Y. baccata* in many ways, *schidigera* is more like *elata* of **one** when it comes to the nature of its trunk and color of foliage. Although *Y. schottii* resembles other **group two** yuccas in many ways, it has neither fibers nor serrations along its leaf margins and hence is distinct from other yuccas of all three groups!

Thus it is not easy nor is it “scientific” to construct a tree of evolution for these nine species or three sections of southwestern yuccas. They present a hopeless (to the evolutionist) array of internal parallel features. One might wisely paraphrase Benson and Darrow’s prudent statements about the lily family (quoted earlier) as follows: The yuccas are a complex genus, however they are classified. As in other cases in which knowledge is scant, opinions have been intense. The yuccas include many anastomosing lines of evolution. . . . The proposed segregations emphasizing one character, then another, indicate a complex genus not capable of evolutionary subdivision. The differentiating characters put forward do not yield a natural segregation. While Benson and Darrow did not and perhaps would not make such a statement about the yuccas, it is entirely in keeping with the facts. Cronquist *et al.* (p. 527) put it this way: “Taxonomically, the genus is one of the most difficult in our area.”

Do The Fossils Help?

One might suppose that a study of the fossil record might clear up a few details or even supply direct answers about the origin of the genus *Yucca* as well as its sections and species but such is not the case. While Axelrod (1944, p. 118) surmised that yucca was probably part of an early Pliocene flora he has called the "Madro-Tertiary Flora," he lists no fossil yuccas in this or in his other publications as far as I could find—Axelrod (1939, and 1944).

Although Seward (1959, p. 323) and Daugherty (1941, pp. 70, 71, and plate 13) deal with a yucca-like leaf fossil called Yuccites from the upper Triassic strata, they present no evidence that these leaves are from yuccas or their progenitors. The only mention of yucca fossils I found after looking through many books was by Darrah (1959, p. 242) concerning a "... supposed *Yucca*" noted in the Citronella Flora of southern Alabama. Thus the fossil record of these plants is sketchy to say the least, and not much help in delineating origins. This comes in spite of the fact that the genus *Yucca* is thought to have originated quite recently and might therefore be expected to show a better than average fossil record.

Yucca Pollination and Origins

The yucca flower is usually pollinated by moths of the genus *Tegeticula*. The fascinating relationship between this moth and the flower is a well-known story aptly summarized here by Webber:

It is reported that the moth collects pollen from several flowers, carries it to another flower, and forces it down the stigmatic tube. While forcing the pollen down the stigmatic tube, the moth thrusts its ovipositor through the ovary wall and lays eggs. Thus the flower is sure of being pollinated and of producing seed, upon which the larvae from the eggs feed. (p. 65)

It should also be mentioned that the mouthparts of these same insects are specially suited for holding the pollen masses of yucca.

One might have imagined, as early workers did, that each species of yucca would have its own species of *Tegeticula* moth:

It was predicted that many of the unusual yuccas of the southwestern United States and Mexico would be found to harbor additional species of these moths, but in general this has not proven to be the case. (Powell p. 1)

Instead, one species of moth, *Tegeticula yuccasella*, (as noted by Powell, and Powell and Mackie, 1966) is responsible for the pollination of nearly all the species (except *Y. whipplei* which is pollinated by *T. maculata* and *Y. brevifolia* which has another distinct *Tegeticula* species as pollinator). Thus it is by no means clear from an evolutionary standpoint how the species of *Yucca* could have undergone independent speciation as they are for the most part pollinated by one species of pronuba moth — *Tegeticula yuccasella*. Readers who turn to the excellent studies by Powell and Powell and Mackie will learn as well that there is another moth resembling *Tegeticula yuccasella* very closely that *does not* pollinate the yucca flower but *does* lay its eggs variously in the flower stalk or even in the fruit of yuccas. The genus name for these bogus pollinators

is *Prodoxus*. Furthermore they have noted that a third genus of moths (*Parategeticula pollenifera*) has been found to actually pollinate *Yucca schottii* but it does *not* use the *Y. schottii* ovules for oviposition. This whole study of fascinating insect-plant interactions in the genus *Yucca* could be profitably reviewed from the creationist viewpoint.

Summary

Rather than proposing evolutionary schemes as part of yucca taxonomy, taxonomists as scientists would do well to simply state that nine southwestern species of *Yucca* can be placed into three helpful groups. The evolutionary origin of these section groups or of the nine species themselves is not apparent because attempts to display lineages lead to numerous puzzling parallelisms that defy the manufacture of diagrams for evolutionary descent.

The paucity of support for macroevolution quite obviously does not in itself prove creationism. Such evolutionary chaos in trying to explain the origin of species in just one plant genus, however, ought to give sincere evolution-minded scientists much reason to consider the only viable alternative—special creationism. Perhaps the Creator endowed each of these nine species of *Yucca* with various morphological components for reasons of design and physiology not yet understood by botanists.

The actual creation of these nine species (or three groups as the case may be) might have occurred either at the time of the original creation or as a result of directed hybridization of genotypes after the global Flood catastrophe, as proposed by Lammerts and Howe (1974, pp. 227-28). When man thus hybridizes seed corn for increased production or produces by polyploidy a new strain of strawberries, he is (on a very limited scale) following in the footsteps of One who rapidly produced groups of plants and animals equipped for survival in their own environmental niches.

Acknowledgments

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References

- Ainsworth, G. C. and P. H. A. Sneath, editors. 1962. Microbial classification, twelfth symposium of The Society of General Microbiology, Cambridge University Press. Cambridge, England.
- Axelrod, D. I. 1939. A Miocene flora from the western border of the Mohave Desert. Carnegie Institution of Washington Publication 516, Washington, D.C., see especially pp. 87 & 88.
- . 1944. Pliocene floras of California and Oregon. Edited by

- R. W. Chaney, Carnegie Institution of Washington Publication 553, Washington, D.C., p. 118.
- Bailey, L. H. 1939. The standard encyclopedia of horticulture, Vol. 3. The MacMillan Co., New York.
- Benson, L. and R. A. Darrow. 1981. Trees and shrubs of the southwestern desert, third edition. The University of Arizona Press, Tucson.
- Clark, D. E. (editor). 1979. New western garden book. Lane Book Co., Palo Alto CA, pp. 503-05.
- Cockman, J. 1985. Personal correspondence to E. L. Williams (September 3).
- Cowan, S. T. 1989. Heretical taxonomy for bacteriologists. *Journal of General Microbiology* 61:145-51. Based on a seminar entitled "Alice in taxonomyland." University of Maryland. May 5, 1969.
- Cronquist, A. 1968. The evolution and classification of flowering plants. Houghton Mifflin Co., Boston MA.
- . A. H. Holmgren, N. H. Holmgren, J. L. Reveal, and P. K. Holmgren. 1977. Intermountain flora: vascular plants of the intermountain west, U.S.A. Columbia University Press, New York.
- Cruse, R. R. 1949. A chemurgic survey of the desert flora in the American southwest. *Economic Botany* 3:111-31.
- Darrah, W. C. 1960. Principles of Paleobotany, second edition. The Ronald Press Co., New York.
- Daugherty, L. H. 1941. The Upper Triassic flora of Arizona. Carnegie Institution of Washington Publication 526, Washington, D.C.
- Howe, G. F. 1981. Which woody plants grow where at the Grand Canyon. *Creation Research Society Quarterly* 17:219-26.
- . 1984. A trip to the Grand Canyon Experiment Station. *Creation Research Society Quarterly* 21:9-17 and cover.
- Howell, J. T. and E. McClintock. 1960. Supplement to Arizona flora. University of California Press, Berkeley, CA.
- Kearney, T. H. and R. H. Peebles. 1951. Arizona flora. University of California Press, Berkeley, CA.
- Lammers, W. E. and G. F. Howe. 1974. Plant succession studies in relation to microevolution. *Creation Research Society Quarterly* 10:208-28.
- McKelvey, S. D. 1938. Yuccas of the southwestern United States. The Arnold Arboretum of Harvard University, Jamaica Plain, MA.
- Powell, J. A. and R. A. Mackie. 1966. Biological interrelationships of moths and *Yucca whipplei*. University of California Publications in Entomology (Vol. 42). University of California Press, Berkeley, CA.
- Powell, J. A. 1984. Biological interrelationships of moths and *Yucca schottii*. University of California Press, Berkeley, CA.
- Sargent, C. S. 1949. Manual of the trees of North America (Vol. 1). Dover Publications Inc., New York.
- Seward, A. C. 1959. Plant life through the ages. Hafner Publishing Co., New York.
- Sokal, R. R. and P. H. A. Sneath. 1963. Principles of numerical taxonomy. W. H. Freeman Co., San Francisco, CA, see especially pp. 177-99.
- Webber, J. M. 1953. Yuccas of the Southwest. Agricultural Monograph No. 17, United States Department of Agriculture, Washington, D.C.
- Wootton, E. O. and P. C. Standley. 1972. Flora of New Mexico. (Vol. 7). United States Government Printing Office, Washington, D.C.

STEREOCHEMICAL DESIGN IN LIPIDS

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Abstract

Creationists have successfully challenged evolutionists with the evidence of clever engineering design in optically active isomers such as the L-amino acids and D-sugars found exclusively in life forms. That these resolved isomers cannot be synthesized or maintained in significant quantities outside of living organisms has been recognized as strong evidence against any spontaneous generation of biopolymers from some primeval broth.

Nevertheless, the evidence found in geometric isomers is largely unknown in spite of the critical role played by this sort of stereoisomerism in living cells. Some biolipids found in cell membranes (phospholipids) are always in the cis—same side— configuration. While this geometry is essential for the proper functioning of cell membranes, it turns out that this cis configuration is not what we would expect to find in nature because it is the higher energy form. The trans—opposite side— configuration is the lower energy form and thus would be expected to be found.

A creationist teleological (planning and purpose apparent in design) explanation seems to be demanded by these facts. It is true that certain low probability molecules can be synthesized in the laboratory, such as certain substituted benzene ring isomers or even cis -polyethylene. However, these only serve to buttress the teleological argument since they require intelligence in planning the synthesis, fabricating and arranging the complex apparatus, environmental control, and in carrying out the stepwise chemical reactions in the presence of highly specific reagents, using controlled (not random) energy sources.

Further, the phyletic distribution of many biolipids may very well follow a mosaic pattern previously alluded to by some creationists.

Introduction

Biochemical synthetic pathways are complex, requiring pre-existing biomolecules such as enzymes, vitamins, high-energy phosphates, and nucleic acids, all of which are at least as highly ordered as the biopolymers whose origin we seek to explain. It is also recognized that intact cellular machinery is required to produce and integrate all cell functions—chromosomes, mitochondria, ribosomes, membrane networks and others.

Organized components do not fall happily together in test tubes (or soups) except in fairy tales and science fiction, Prigogine's dissipative structures notwithstanding.¹

(Ilya Prigogine, winner of a Nobel Prize in 1977, recently coauthored a book in which he claims to show theoretically how order can be generated in far from equilibrium chaotic conditions.) This holds not only for proteins and amino acids, but also for lipids. This paper will emphasize that the kind of geometric isomerism found in certain lipids is important both functionally (as in cell membrane permeability) and energetically (since the less stable form is preferred).

Geometric isomerism is seldom addressed by creationists. S. E. Aw expressed surprise that evolutionary biochemists have also more or less ignored the lipids in abiotic experiments since lipids are a widespread class of biomolecules comprising up to 70 percent dryweight of some cells. He adds that where abiotic syntheses were attempted, the results have almost

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invariably been failures because only minute quantities of lipid-like materials were detected, and even those were too highly branched,^{1, 2} to be considered similar to natural lipids. Perhaps evolutionists have had enough on their hands trying to explain the origin of other classes of compounds for the popular press. I will first describe lipids, review the concepts of isomerism, and finally summarize and discuss geometric isomerism in certain straight-chained biolipids.

Lipids

Lipids may be described as one class of organic molecules which are insoluble in water and extractable from cells by organic solvents of low polarity such as ether or chloroform. They include substances commonly known as waxes, fats and oils, as well as more complex and less well known substances—steroid hormones and phospholipids.

Not only are lipids widely distributed throughout animal, plant, and other kingdoms, but they are also widely distributed within the various tissues such as bone, nerve, blood, liver and adipose tissue of animals. Common waxes include beeswax and the wax coating found on the outside of leaves. Fats, the most abundant lipids, are the main constituents of storage fat cells in plants and animals and are important food reserves as well as biochemical precursors from which more complicated chemicals are built. Being chemically similar, most oils and fats are mixtures of different molecules which share common structural features. Oils can be thought of as fats with relatively low melting points.

Figure 1 represents the formation reaction of a simple lipid. The R group might be a long hydrocarbon chain-like a string of carbon beads with hydrogens off to the side. The R' group is simply another hydrocarbon chain which may or may not be identical to the first R group. The kind of reaction shown is called a condensation reaction in which an ester is formed on the right, by combination of an alcohol (R'OH) and a carboxylic acid (R'COOH) with the elimination of water (H₂O). In Figure 1, the segments destined to form water are reduced for ease of recognition only.

Interestingly enough, significant yield of products from condensation reactions are highly unlikely in the presence of excess water (i.e.; in a primeval soup) because water drives the reaction to the left favoring reactant formation, rather than to the right in favor of products.

Structure of Biolipids

Waxes generally follow the reaction pattern shown in Figure 1 where the R and R' groups are usually long even-numbered carbon chains. Fats and oils including lard, butter, olive oil, peanut oil, soybean oil, etc., are generally more complex. They are called triglycerides because they are formed from glycerol which has not one, but three hydroxyl groups (OH), and from long

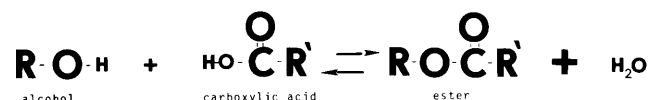


Figure 1. Formation of a simple lipid. Lipids are esters resulting from a reaction between an alcohol and a carboxylic acid.

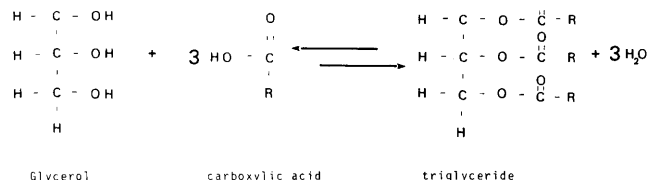


Figure 2a. Formation of triglycerides—typical constituents of fats and oils.

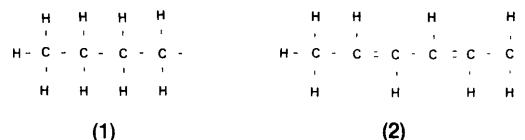


Figure 2b. (1) Configuration of the R group when the fatty acid is saturated. (2) Configuration of the R group when the fatty acid is unsaturated.

chain, fatty, carboxylic acids (COOH). Figure 2a portrays the general case. Figure 2b shows the configurations that the R groups might take depending on which fatty acid is involved.

A saturated fatty acid will have no double-bonded carbons, while an unsaturated fatty acid will contain carbon-carbon double bonds (C=C). Most fats and oils have molecules with various degrees of saturation, that is, they contain mixtures of both saturated and unsaturated fatty acids. As we shall see, only unsaturated fatty acids exhibit geometric or *cis-trans* isomerism since only they contain the carbon-carbon double bond which is necessary for stereoisomerism and for certain reactions (hydrogenation, halogenation, etc.)

As a rule bio-fatty acids are unbranched chains, unlike the products of laboratory abiotic experiments. A typical molecule of cottonseed oil is shown in Figure 3. This kind of mixed fatty acid structure is typical of fats and oils. Cottonseed oil contains many fatty acids. A partial list might be: palmitic, stearic, oleic (see Figure 4) and linoleic. Milk contains such fatty acids as butyric and stearic.

As a result of this mixture of saturated and unsaturated fatty acids in various degrees and proportions, fats and oils can be characterized by their iodine number. The iodine number is a measure of their degree of unsaturation (number of double bonds available to bind iodine), and refers to the number of grams of iodine which add to the double bonds present in 100 grams of lipid. Saturated acids have an iodine number of 0. Vegetable oils tend to have higher iodine numbers than animal fats.

Brain Lipids

Sphingolipids including both sphingomyelin (see Figure 5) and the cerebroside are interesting groups of more complex lipids. In addition to the lipid portion, cerebroside contains a sugar linkage. Both sphingomyelin and the cerebroside are the principal lipids found in the brain and in the myelin sheath of nerve tissue. They are also important constituents of cell membranes.

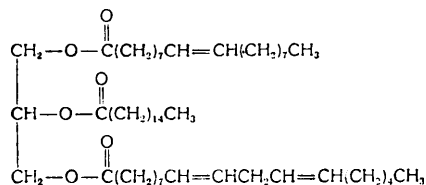


Figure 3. A representation of Cottonseed oil.

Lipid-Based Hormones

Other fascinating lipid groups are cholesterol (another important cyclical membrane lipid) and a host of derivatives of cholesterol such as some of the steroid hormones which are vital in regulating physiology. These lipids are all based on the same four-ring structure shown in Figure 6. Cholesterol is drawn in Figure 7.

Important steroids, which include testosterone (male hormone) and progesterone (female hormone), can be seen in Figure 8. Another crucial cholesterol-type hormone known to laymen and endocrinologists alike is cortisone.

Hormone Distribution—Accepted Theory

The phyletic distribution of steroid hormones based on the same basic four-ring structure is worth noting because it supports the concept of special creation. Steroid distribution seems to demonstrate both economy and fixity of design, and a mosaic pattern throughout the animal kingdom. Turner and Bagnara state:

There is much evidence to support the view that a pituitary-adrenal axis operates in all vertebrates, and that the steroidogenic tissue of the adrenal secretes similar hormones from fishes to mammals. . . . In searching for generalizations about the biochemistry of the adrenal cortex, it is striking to find such a uniformity of pattern. The existence of the same or similar corticosteroid hormones in groups which are unrelated from the point of view of taxonomy or physiology suggests that the evolution of adrenal steroids met with early success.⁴

Early is right! Being committed to evolution and the mutation/selection framework, these authors suggest that the reason why steroids have such an unpredictable distribution by evolutionary theory is that, unlike peptide hormones which they claim would be directly affected by mutations via transcription-translation and protein synthesis, steroids could only be indirectly affected by mutation because they are not directly in the transcription-protein synthesis loop (not being proteins). Rather, they propose that since the enzymes responsible for steroid synthesis are protein in nature, mutations could directly affect the enzymes which in turn would alter the function, rather than the structure of the steroids.

This reasoning is reminiscent of the strained special pleading that pervaded most of Darwin's *Origin of Species*. In the absence of the assumption that one phyletic group evolved from another, there is no need or logic to such speculation.



Figure 4. This fatty acid is found in many oils, including Cottonseed Oil.

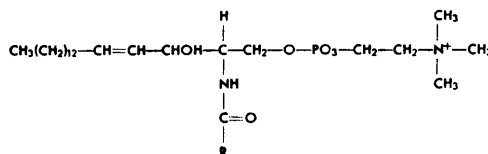


Figure 5. One of the brain lipids.

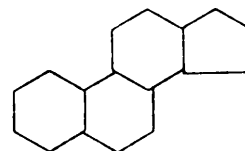


Figure 6. Typical four-ring base structure found in the cholesterol-based lipids such as steroids.

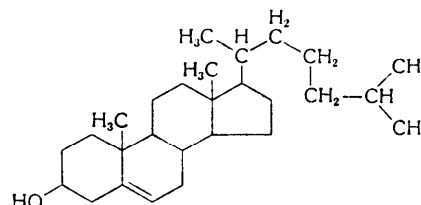
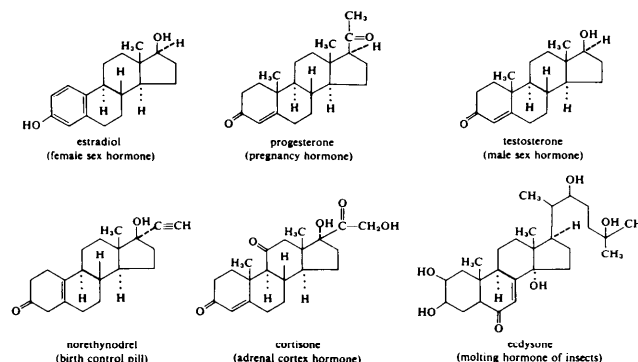


Figure 7. Cholesterol—the principal group common among steroid hormones.

Figure 8. Common Steroid Hormones (based on C. N. Wu, 1979, *Modern Organic Chemistry* Vol. 2, p. 587).

Hormone Distribution—The Facts

When we look at which groups of vertebrates (fish, amphibians, reptiles, mammals, birds) utilize which type of steroid hormone, we find no hierarchy. There is no indication of evolution from "simplest" forms, early fishes, to the "more complex" forms, mammals and man. Instead a uniform, perhaps mosaic distribution is found throughout the vertebrata.

Creationists have every right, as scientists, to reiterate the famous question posed by Morris and Gish to thousands of people for over a decade: "Which model fits the data best?" Even if one were a committed Darwinist, the explanation offered above should be recognized as being weak. It is difficult to believe, for example, that random mutations for a basic enzyme would not disrupt the complex biosynthetic pathway maybe to the point of aborting or halting the process. Surely many medicines are nothing more than chemicals which mimic the natural enzyme of an infecting microorganism, but which are different enough to kill it by disrupting metabolic pathways.

Even harder to accept is the idea that changing the function of hormones as cosmopolitan as steroids, without simultaneously changing receptor sites in target tissues, would result in anything but disaster, because steroids act in concert with other hormones and body chemicals. They regulate form, function and physiology as vital links in a variety of feedback loops. Functional deviations, especially at critical times in the life cycle, would cause havoc.

Not one, but many concurrent genetic changes would be required, all of which would have to be beneficial simultaneously. The probability of this event occurring is so remote as to be beyond credibility. Further, there is no experimental evidence that either hormones or receptors can be generated spontaneously, or even that reasonable precursors for them could be formed under the evolutionary set of primitive abiotic conditions.

Gower reminds us that steroids are hormones found not only in vertebrates but also among invertebrates. For instance, starfish have corticosterone, cortisol (hormones regulating glucose and protein metabolism), testosterone (which usually regulates male secondary sexual characters and male organs), and estradiol-17B (the most potent among estrogen hormones regulating female sexual development). The electric ray fish contains all of these hormones and more, as do other invertebrates, fish, reptiles, amphibians, mammals and man.

Having carefully examined the distribution of steroids throughout the various animal forms, Gower concludes:

Contrary to the expectation of general evolutionary theory, molecular structures and associated types of biosynthetic modification of steroid hormones do not display significant patterns of development in the animal kingdom. Rather the impression obtained from recent study is that steroid hormones are universal biomolecules present at all phylogenetic levels.⁵

The Teleological Approach

Economy of design typical of chemical engineering is a better explanation of the distribution of steroids. We should not recoil from the teleological explanation when it is so obvious and apropos. Today there are marvelous examples of this sort of chemical designing.

Consider all the different man-made polymers based on monomers like styrene, isoprene, or propylene. Polymers with desired characteristics are carefully synthesized from these basic monomers under rigorously controlled conditions—temperature, pressure, concentration, reagents and catalysts.

Samples are examined and tested during the polymerization process and adjustments in any or all of the above may be required to obtain the desired product. Formula sheets (similar to recipes) are followed meticulously.

If all this teleonomy (thoughtful, planned know-how) and effort are required to produce relatively simple molecules, how much more teleonomy was required to design and produce the first biomolecules which are far more complex, longer-chained and stereospecific in many cases? How much more teleonomy was required to develop and maintain the requisite

biomachinery to regulate, synthesize, store, and utilize such chemicals, and to distribute them across wide varieties of animals?

Consider the complex neuro-endocrine, humoral, and metabolic regulations associated with most biomolecules like lipids. Materialism simply cannot explain the origin of all this harmony and complexity. Rather than becoming antiquated by the details of modern biochemistry, the first chapter of Romans is repeatedly validated.

Biosynthesis of Lipids

Long-chained biolipids are found almost exclusively in the *cis* geometry. However, this is not to say that all biolipids are so configured. For instance, some cyclical biolipids are not, but then their function is not the same as linear lipid molecules. Natural chemical reactions (left to themselves) would not form *cis*-lipids in linear chains. But they are not left to themselves.

There is evidence of deliberate manipulation of these processes using catalysts, enzymes and reactions which take place in a controlled specified order. Chemists do the same thing today. What is astounding is that the very machinery which is designed to form *cis*-biolipids is itself dependent on *cis*-biolipids in the first place! It is only operational under the controlled environmental milieu afforded it by the living cell, surrounded by a lipo-protein membrane network.

Neither is biosynthesis a simple process. On the contrary, lipid biosynthesis is a complex series of reactions involving highly specific enzymes, vitamins and carrier proteins. (The interested reader should refer to any recent textbook of biochemistry for a thorough treatment.) More incredible is that the formation is not simply the reverse of lipid breakdown following digestion. Lipid catabolism is not the reverse of lipid anabolism.

The biosynthesis of long-chain fatty acids in animal tissues, plants and microorganisms is not a direct reversal of fatty acid oxidation, although acetyl Co A is the starting material. Instead, acetyl Co A is carboxylated to form malonyl Co A in the presence of the enzyme coenzyme A carboxylase in a reaction dependent on the presence of ATP and the vitamin biotin.⁶

Acetyl Co A refers to acetyl coenzyme A carboxylase, another molecule that finds extensive use in living cells. I might add that another biomolecule, well known to students of cell biochemistry, NADPH, is also required and that there is more than one route that biosynthesis of lipids can take depending on where it is taking place. The point is that we see requirements for an extremely complex biosynthetic apparatus without which the whole synthesis is not possible.

That mammals have biosynthetic pathways for most fatty acids except perhaps linolenic and linoleic, may prove to be the result of universal degradation (which may be traceable to the fall of man and the curse). On the other hand, it could also point to ecological interdependence in nature since we can obtain these essential fatty acids from a variety of natural food sources.

Isomers in General

By definition, isomers are compounds having identical molecular formulas but different structural ar-

rangements. Therefore isomers are different forms of the same molecules. (Isomers are not to be confused with isotopes which are different forms of the same atom having the same number of protons but a different number of neutrons.) Isomers differ not in the number nor in the kinds of atoms present, but in the spatial orientation (arrangement in three-dimensional space) of these atoms.

Stereoisomers

Working with solutions of tartaric acid crystals in 1815, the creationist Louis Pasteur laid the foundations of biological stereoisomerism. Giulio Natta received the Nobel Prize for work in the area of atactic, isotactic, and syndiotactic stereochemistry in 1964.

In most organic compounds, isomerism arises out of the fact that the carbon atom is tetravalent. That is, it can bond to four other groups or atoms. If the groups are identical as in methane, CH_4 which has four bonded hydrogens, or carbon tetrachloride CCl_4 with four chlorines, there is complete symmetry in the compound. On the other hand, if one of the groups is different then molecular symmetry is destroyed although the general tetrahedral geometry of the molecule is maintained. The various isomers which are possible in the presence of unsymmetrical groups are called stereoisomers.

Non-Biological Stereoisomerism

Typically, in relatively simple polymers with only one unsymmetrical group [such as a methyl (CH_3) group] instead of a hydrogen on a polyethylene chain, there are three possible descriptions:

atactic—where the unsymmetrical group is randomly arranged.

isotactic—where the unsymmetrical groups are all lined up on the same side of the main chain, and

syndiotactic—where the unsymmetrical groups are placed on both sides of the main carbon chain in an alternating pattern.

These types of stereoisomers are generally associated with laboratory polymerizations of relatively simple non-biological polymers, nevertheless the different forms have radically different properties which are very important to the plastics and related technologies. For instance, the atactic forms may be gummy while the syndiotactic forms tend to be more rigid.

Other isomers of more interest biologically are the structural isomers such as the various forms of propanol. Rubbing alcohol (2-propanol) has slightly different physical properties than 1-propanol just because the alcohol group (OH) is attached onto the middle carbon in 2-propanol rather than onto one of the end carbons as in 1-propanol.

Biological Stereoisomerism

In contrast to the structural isomers of propanol and to the non-biological stereoisomers, there are two basic kinds of stereoisomers of biochemical import,—optical isomers, and geometric isomers.

Optical Isomers

Optical isomers as the name suggests are identified with reference to optics and light. Normally light

beams propagate in all directions and in all planes—x, y, and z. However, when special polarizing filters intercept light beams they can be redirected so that only the rays from one plane can pass, the rest being either absorbed or reflected. Polarized sunglasses perform this filtering function to a degree.

Optical isomers are identified by the fact that they rotate plane polarized light. Being identical in all other properties, optical isomers of the same compound rotate plane polarized light equally in magnitude but in opposite directions.

If two optical isomers can be superimposed one upon the other, as is the case with L- and D-amino acids then we call them enantiomers. They can be thought of as being analogous to right and left gloves because each isomer is a mirror image of the other. Enantiomers arise because of chirality (handedness). A carbon with four different substituents has chirality. Such a carbon known as a chiral carbon is shown in schematic form in Figure 9a.

L-Amino Acid Isomers—Impact on Origins

While it is true that optical isomers have been found in many families of chemicals, the amino acids have drawn most attention because of their role as building blocks for proteins of which our bodies are composed. However the biosynthesis of amino acids yields exclusively L forms—the D configuration being biologically inactive or perhaps even lethal. On the other hand, laboratory syntheses in the absence of special optically active reagents yield a mixture of both the L and D forms, called a racemic modification.

In light of these facts, scientists of the creationist school ask: “How could proteins with 100 percent L-amino acid building blocks evolve from chance molecular reactions when the chemical and thermodynamic laws which govern such reactions all preclude stereospecific amino acid formation?”⁷⁻¹²

Evolutionists have attempted all kinds of exotic experiments to ‘explain’ this puzzle, most admitting that it is an unsolved problem.^{13,14} They, of course, refuse to consider the teleological implications regardless of the apparent purpose of the design. Such conditions as polarized light, bentonite clays and metallic cobalt complexes have been postulated by materialists as causal agents, but none of them provide adequate explanations regarding the origin, propagation, or maintenance of optical specificity.

Helmick states that the teleonomic approach to biochemical origins leads to the most satisfactory model because only pre-existing stereospecific precursors are known to produce exclusively stereospecific products,

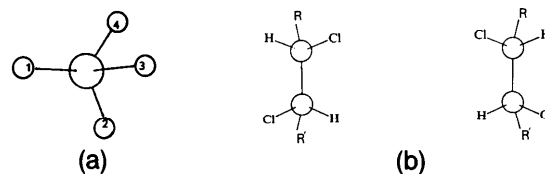


Figure 9. (a) Schematic model showing four groups attached to the tetravalent central carbon atom. When all four groups are identical, as in methane (CH_4) and carbon tetrachloride (CCl_4), symmetry is maintained. When one or more groups are different as in some amino acids, the symmetry is destroyed. When all four groups are different the central carbon is described as being chiral. (b) Molecules containing two chiral carbons.

and furthermore resolved amino acids (L form only) represent the highest degree of order possible in a universe subject to spontaneous decreases in order.¹⁵

It appears that we have experimental evidence which contradicts the notion that optically active biological molecules (L-amino acids) could have somehow been spontaneously separated following abiotic synthesis. These enantiomers cannot be separated by ordinary chemical means in the laboratory. Special optically active reagents are required. If spontaneous separation (resolution) cannot happen now, why postulate that it must have happened in the unknowable past? Rather, accept at face value the evidence of sophisticated and purposeful chemical engineering performed by a competent chemist. This is the teleological view based on apparent purpose in design and based on intelligent know-how (teleonomy).

Whenever one pure enantiomer is purposely prepared using a preexisting optically active reagent, it slowly but inevitably spontaneously isomerizes to form a mixture containing equal concentrations of both enantiomers (racemic modifications). An identical phenomenon takes place in living tissues after the death of an organism when the systems of the cells are no longer functioning to maintain amino acids in the L form only. Hence as proteins age, their building blocks, the amino acids, spontaneously tend towards equilibrium. This is the basis of one of the lesser known dating methods for estimating the age of fossilized proteins, amino acid racemization dating. (Like most methods of dating substances from the past, it suffers from extrapolated assumptions which may not stand up to reasonable scrutiny namely, temperature and pH constancy.)¹⁶

Diastereomers

Stereoisomers which do not have a mirror image relationship are called diastereomers. An example is shown in Figure 9b. Both of the carbon atoms may rotate freely about the carbon-carbon single bond at room temperature. The energy barrier to this rotation is only about 3 kcal/mole which is considered to be relatively low.

However, if the carbon-carbon bond were double instead of single like the one shown in Figure 10, then we are dealing with the second form of biologically important stereoisomerism known as geometric or *cis-trans* isomerism. (*Cis* and *trans* isomers are also important to nonbiological polymers, especially dienes such as 1,4-polyisoprene where natural rubber is the long irregular *cis* form and the *trans* form is a hard tough polymer.)

Geometric Isomerism

Geometric isomerism is contingent upon the existence of different groups bonded to the carbons, and to the presence of carbon-carbon double bonds. Geometric isomers exist as a result of hindered rotation about carbon-carbon double bonds. For free rotation to take place, a 70 kcal/mole energy barrier must be overcome and this generally does not happen at ambient conditions. In order to distinguish between the *cis* and *trans* forms like those in Figure 10, we define the *cis*- isomer as the molecule with like substituent groups (for instance Cl and Cl or H and H) on the same side of the double bonded carbons, whereas *trans* denotes that the groups are on opposite sides of the double bond.

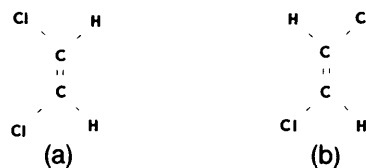


Figure 10. Geometric isomers— diastereomers including double-bonded carbons.

Geometric isomers contain the same functional groups, but they may react with the same reagents at different rates and possess slightly dissimilar melting points, boiling points, and solubilities thus making isomer separation possible. It is this geometric isomerism that is found in membrane biolipids.

Energetically, the *trans* form is the most stable. It contains fewer kcal/mole energy (as determined by heats of hydrogenation). One reason for this is steric. That is, the functional groups are farther apart in the *trans* geometry and therefore subject to lower molecular forces (van der Waals strain). It is the *trans* form then, that we would expect to be most likely to form under natural conditions. Nevertheless, the *cis* form predominates.

Geometric Isomers in Lipids

Many lipids of biological interest are composed of long chains of three to twenty-one carbon units (like beads on a necklace) built up of *cis*- fatty acids. Morrison and Boyd state: "The configuration about these double bonds is almost invariably *cis*, rather than the more stable *trans*."¹⁷

Texts dealing with biochemistry concur. Yet if biolipids evolved as a result of natural chemical laws, the laws which characterize observable chemical interactions today, we would expect to see the *trans*- isomer almost invariably.

From Where Did the *Cis* Form Come?

The question which must be answered relative to origins is; "How did the all *cis* form of biolipids arise in the first place?" And secondly "How do we account for the a-teleonomic guidance of this arrangement so that the more probable *trans* form was prevented from participating in biolipid formation?" (I am not discussing some of the cyclic, cholesterol based lipids, just the relatively long chained variety.) Did early biomonomers, alleged to exist by pure materialists, use first the predominant *trans* geometry and then progress to both *cis* and *trans*, and finally to the exclusive incorporation of *cis*? If so, where is the record? Where do we see this kind of unearthly chemistry taking place spontaneously now?

Cis from the Beginning

As we shall see, biological membranes which are vital to all life forms, except perhaps the virus, seem to have always been dependent on *cis*- lipids from the very beginning. The fact that there is a perfectly logical reason (purpose) for using *cis*- isomers now, stands as an argument in favor of teleonomy rather than against it. One cannot deduce the end purpose of *cis*- lipids in membranes by purely materialistic chemical reasoning for the simple reason that such reasoning leads us in the opposite direction, towards an original *trans*- lipid geometry which would not confer biological fitness because it will not work. This is an excellent opportunity to invoke teleonomy in order to make sense out of the facts and propose a reasonable explanation.

An Attempt at Materialistic Speculation

I am not saying that evolutionists cannot possibly imagine or invent a scenario wherein *trans*- isomers and trace quantities of *cis*- isomers competed for integration into a protomembrane(?) and further in our chemical fairy-tale, the *cis* begin to statistically out-compete the *trans* by increasing the fitness of little almost-cells(?) as a function of more efficient membrane selective permeability, etc., etc. But just because we can imagine all this does not make it any more plausible, and certainly does not mean that it actually happened.

One may be tempted to postulate that the *cis* configuration is found in these lipids because only *cis*-fatty acids were available on the primitive earth at that time. The question then becomes; "Why were *trans*- fatty acids (the easiest to form) not formed in the first place? An alternative which should be popular with Darwinists might involve the struggle for survival. *Trans*- isomers would form rigid, crystalline lipids with high melting points. Therefore cells incorporating these isomers would be selected against. In this scenario, only cells using the *cis*- isomers would survive. Again we are embarking on wild speculation and there is no evidence to support any of this.

Teleology— More Sensible

A teleological explanation is superior because the facts and the laws of chemistry are taken at face value and we deduce that biolipids could not have naturally assumed this critical geometry on their own. More likely, they were supernaturally designed to be synthesized by cells in the *cis* configuration because the *cis* arrangement exactly meets the need. In much the same way modern chemists incorporate the *cis* configuration into laboratory syntheses of linear polyethylene. They use catalytic chemicals and substrates which took years to develop in order to obtain desired properties for the polymer.¹⁸

Teleology— More Useful

In an excellent review of the reality and validity of teleology in modern science, Gordon E. Barnes demonstrated that:

1. Despite public disdain of it, biologists continue to privately chat in blatantly teleological terms.
2. When on their best behavior, scientists formally masquerade adaptive and selective terminology which amount to teleology anyway.
3. Legitimate, even objective uses of teleological explanations can be found in nature where correlations exist between the apparent process and the suspected goal, (homeostasis and morphogenic adjustments).
4. Both causal (descriptive cause and effect), and teleological explanations (acknowledging apparent purpose as real information), apply in cases where the functioning of parts is related to the functioning of a whole, (coordination of the beat of the heart with the timing of the opening and closing of heart valves).
5. Many cases exist where causal (materialistic) explanations are empty and significant progress in understanding will come only when teleology is invoked, (migration of baby seals into the sea after being born on land).
6. Teleological questions both guide and stimulate research with inquiries such as: "What is the function of this tissue or this gland— i.e.: the pineal?"¹⁹

I would add that *cis*- isomers in biolipids are candidates for teleological as well as causal (descriptive) explanation. The burden of proof that *cis*- lipids were ever any other way, than we observe them to be at present, is upon the evolutionists, and they have been unusually silent on this issue.

Significance of Cis- biolipids

Given what we find in terms of biolipid geometry, we might try only to causally describe how *cis*-biolipids are formed using this pathway and that enzyme and how the molecules align themselves etcetera, but teleologically we are stimulated to probe with research type questions such as: "What is the purpose and function of the *cis* configuration." The materialist will ask the same question in disguise saying: "What is the adaptive significance of this arrangement?"

Causal Explanations— Mere Descriptions

Causal reasoning is attempted by Morrison and Boyd in their textbook discussion of the observed preference for *cis* isomers in straight chained biolipids:

Unsaturation with this particular stereochemistry has an effect that is seemingly trivial but is actually of vital biological significance: it lowers the melting point. In the solid phase, the molecules of a fat fit together as best they can; the closer the fit, the stronger the intermolecular forces, and the higher the melting point. Saturated acid chains are extended in a linear fashion— with, of course the zig-zag due to the tetrahedral bond angles— and fit together rather well. *Trans*- unsaturated acid chains can be similarly extended to linear conformations that match saturated chains rather well. But *cis*- unsaturated acid chains have a bend at the double bond and fit each other and saturated chains- badly. The net result is that *cis*-unsaturation lowers the melting point of fat.²⁰

Again their causal explanation of the lowered melting point is driven home a few pages later where they explain how ionic regulation and semipermeability are necessary properties of cell membranes. Protein transport molecules must carry critical ions across the phospholipid bilayer of the membrane and into the cell.

Now, if the transport protein is to do its job, it must be free to move within the membrane. The molecules of the bilayer, while necessarily aligned, must not be locked into a rigid crystalline lattice— as they would be if all the fatty acid chains were saturated. Actually, some of the chains in the membrane phospholipids are unsaturated and these, with their *cis*-stereochemistry and the accompanying bend disrupt the alignment enough to make the membrane semiliquid at physiological temperatures.²¹

As much as the authors tried to stick to causality, the teleological message came through, because the most satisfactory explanation seems to be that *cis* isomers are deliberately chosen for the purpose of making membranes semipermeable so that chemicals which are critical to life can be transported through the membrane barrier into the protoplasm of the cell and others can be transported outward.

Materialism's Paradox— No Problem for Creation

We arrive at another chicken-egg paradox. Which came first, the cell which must have the phospholipid

membrane to survive, or the phospholipid which is only synthesized by the machinery found in intact cells already possessing fully functional membranes?

Inside my thermostat in the living room, is a piece of metal. It is not just any old piece of metal and it is not in any old configuration. It is coiled in such a way that as it cools it unwinds and, depending on how I set the level, it causes a contact switch to turn on the gas and electric fan to my furnace which in turn heats the house. If we take it apart, find the coiled metal, and ask the heating engineer why it is in this form, he is likely to reply that it has a purpose—to make or break a contact connection in response to fluctuations in ambient temperature. Membrane lipid geometry clearly has an analogous, intelligently planned, purpose.

References

1. Prigogine, I., and I. Stengers. 1984. Order out of chaos. Bantam Books, pp. 127-209.
2. Aw, S. E. 1982. Chemical evolution. Master Books, San Diego, pp. 98-103.
3. Dwinell, M. H. 1984. Chemical evolution. (book review). *Origins Research* 7:5.
4. Turner, C. D. and J. T. Bagnara. 1971. General endocrinology. W. B. Saunders, Philadelphia, pp. 355-56.
5. Gower, D. B. 1984. Steroid hormones and evolution. *Biblical Creation* 6:149-59.
6. Harrow, B. and A. Mazur. 1966. Textbook of biochemistry. W. B. Saunders, Philadelphia. p. 305.
7. Aw. *Op. cit.*, pp. 19-33.
8. Wilder-Smith, A. E. 1981. The natural sciences know nothing of evolution. Master Books, San Diego. pp. 9-31.
9. Wysong, R. L. 1976. The creation-evolution controversy. Inquiry Press, Midland, pp. 69-85.
10. Coppedge, J. T. 1973. Evolution: possible or impossible? Zondervan, Grand Rapids, pp. 55-79.
11. Denner, D. 1982. Design in chemistry. *Ex Nihilo* 4:11-18.
12. Zimmerman, P. A. 1976. The spontaneous generation of life. in Lammerts, W. E., editor, Scientific studies in special creation. Presbyterian and Reformed, Phillipsburg, NJ, pp. 317-27.
13. Dickerson, R. E. 1978. Chemical evolution and the origin of life. *Scientific American* 239:70-86.
14. Youatt, J. B. and R. D. Brown. 1981. Origins of chirality in nature: a reassessment of the postulated role of bentonite. *Science* 212:1145-46.
15. Helmick, L. S. 1975. Origin and maintenance of optical activity. *Creation Research Society Quarterly* 12:156-66.
16. Gish, D. T. 1975. The amino acid racemization dating method. *I.C.R. Impact Article* No. 23. Institute for Creation Research El Cajon.
17. Morrison, R. T. and R. N. Boyd. 1973. Organic chemistry. Allyn and Bacon. Boston. p. 1058.
18. Rosen, S. L. 1971. Fundamental principles of polymeric materials. Barnes and Noble, New York, pp. 119-21.
19. Barnes, G. E. 1986. Teleology in modern biology. *Faith and Thought* 107:114-22.
20. Morrison and Boyd. *Op. cit.*
21. *Ibid.*, p. 1067.

PANORAMA OF SCIENCE

Panorama of Science Editor Conducts Research



Dr. E. Norbert Smith, editor Panorama Science section, inspects a green sea turtle.

One of our board members and Director of the Grasslands Experiment Station, E. Norbert Smith, Ph.D., recently had the opportunity to study thermoregulation of green sea turtles, *Chelonia Mydas*, at the Cayman Island Turtle Farm, Ltd., on Grand Cayman Island, British West Indies. His findings have been accepted for publication in the *Journal of Herpetology*, an international, peer reviewed scientific journal. Dr. Smith has published numerous scientific papers dealing with behavioral and physiological thermoregulation of reptiles and sees strong evidence of design. Indeed, the alleged evolution of endothermic (or "warm-blooded") animals from ectothermic ("cold-

blooded") animals is a serious problem for the evolutionist because anatomical physiological requirements for endothermy are often opposite those for ectothermy. For example ectothermic animals must not have an insulating layer of fat under the skin yet this is essential for endothermic animals (see *CRSQ* 12:54-58 for additional information).

Dr. Smith found green sea turtles to be excellent physiological thermoregulators. They are able to warm faster and cool slower than any other similar sized reptile in the world. In support of this it has the largest difference in warming and cooling heart rate of any other reptile. (The heart beats fast during warming in order to supply an abundant supply of blood to the animal's periphery to hasten warming.) In fact cooling heart rate was virtually independent from body temperature—something not previously described for any vertebrate.

Work such as this, by creationists, does much to discredit the claims made by many vocal evolutionists that all reputable scientists embrace evolution. Such oft repeated remarks simply are not supported by the evidence.

A Reevaluation of the English Peppered Moth's Use as an Example of Evolution in Progress (Osborne)

Introduction

An excellent review of the literature on the English peppered moth, *Biston betularia* L. is presented in this thesis. Also suggestions for possible creationist research projects are listed. The conclusions of the study are quoted directly.

***B. betularia*'s Contribution to the Origins Issue**

It is staggering to realize that this famous textbook case for evolution does not clearly demonstrate one single aspect of microevolution. Even if it did, one would not be any closer to solving the creation/evolution question, for both views include horizontal speciation processes (Coffin and Brown, pp. 384-95; Morris and Parker, pp. 44-8). Furthermore, both incorporate the phenomenon of natural selection. Indeed, it was Blythe, the creationist, not Darwin, who first proposed this concept (Eisley). However, Blythe appears to have seen natural selection as a mechanism for inducing the radiation of Genesis kinds into specialized new environments left by the great Noachian Deluge. Apparently, Blythe saw natural selection as a means of optimally distributing the vast phenotypic potential of each surviving Genesis kind. Clearly, the popular impression that evidence for natural selection is evidence for biological origin by way of evolution, is utter nonsense.

Therefore, a genetic case for the theory of evolution must include the demonstrated capacity of organisms to mutate so as to yield varieties with quantitatively and qualitatively increased genetic potential which, in turn, provide fundamentally new and beneficial characteristics. In other words, it must be demonstrated that mutations have the capacity of introducing beneficial genetic innovation which add to a living system's order and complexity. Demonstrations short of this do not differentiate between creation and evolution expectations.

As for the peppered moth, as far as human history permits one to say, it started as the peppered moth and it continues as the peppered moth. If melanism occurred by means of spontaneous mutation, which appears doubtful, then only the quantity of melanin deposition has been altered; nothing truly innovative has resulted. In addition, extrapolation leads only to phylogenetic cul-de-sacs—all white and all black moth variants. True, such changes may set the stage for truly important transformations, but so might any other stage; wishful thinking of this sort does not bring one any closer to demonstrating macroevolution. The issue is not how much existing genetic potential can be shuffled, but can this potential be effectively increased? Certainly, the English peppered moth does not provide reasonable grounds to think so (Osborne, pp. 132-33).

Summary

Published literature was used to reassess the popular assertion that the English peppered moth (*Biston betularia* L.) is a demonstration of evolution in action. Answers were sought to four principal questions:

1. Assuming this moth's melanic forms came about by recent spontaneous mutation(s), what is the nature of the responsible mutation(s)?
2. How do alternative hypotheses compare in their ability to account for the data?
3. To what degree does this species display the attributes of a good evolutionary model?
4. What are the implications of this case with respect to the origin issue?

Little could be confidently ascertained regarding the presumed responsible mutation(s). In fact, there is substantial evidence suggesting that melanism in the English peppered moth is an ancient phenomenon. However, two major points were deduced. If melanism in *B. betularia* resulted from a recent spontaneous mutation, then it probably occurred by means of a single mutation within each melanic form. Second, all conceived plausible mechanisms involve a partial or complete loss of a genetic character, the typical pattern. Thus, the mutation was probably degenerative. Although such mechanisms can be readily interpreted from an evolutionary perspective, they do not serve to illustrate or suggest the capacity for deriving taxa of greater order and complexity from simpler ones.

Three alternative explanations were considered for the origin of melanism in *B. betularia*: the relic, recombination, and induction hypotheses. None of these were found inferior to the mutation hypothesis. Indeed, the relic and recombination hypotheses were found to be clearly superior in clarity, plausibility, and ability to harmonize the data. Specifically, both explanations readily account for similarities among Eastern and Western Hemisphere variants, the success of *insularia* forms in non-industrial regions, the phenomenon of background choice behavior in melanic forms, the apparent similar fitnesses of type and early melanic forms, and the persistence of polymorphism at industrialized localities. In addition, the recombination hypothesis accounts for previously unexplained breeding results.

In contrast, the mutation hypothesis was not found to adequately account for any of the above phenomena. Furthermore, all of its successes were equally shared by all three alternative hypotheses. The mutation hypothesis suffers an additional deficiency not encountered by the first two alternatives: it lacks a definitive mechanism. Since the mutation hypothesis is a necessary component of the evolutionary explanation, its many weaknesses greatly undermine the validity of this famous case for evolution.

Utilizing the five components of evolution outlined by Stebbins (p. 2), five corresponding requirements for a good evolutionary model were outlined. The English peppered moth example was not found to satisfactorily fulfill any of these requirements. Thus, *B. betularia* proved to be a poor illustration of subspecific evolution and, therefore, a disastrous demonstration of supraspecific evolution. Consequently, the peppered moth utterly failed the test as a substantiating model for supraspecific (i.e., transpecific) evolution (Osborne pp. 137-39).

References

- Coffin, H. G. and R. H. Brown. 1983. Origin by design. Review and Herald Publishing Association, Washington, D.C.
- Eisley, L. 1972. Darwin and the mysterious Mr. X. Dutton Publishing Company, New York.
- Morris, H. M. and G. E. Parker. 1982. What is creation science? Creation Life Publishers, San Diego, CA.
- Osborne, C. D. 1985. A reevaluation of the English peppered moth's use as an example of evolution in progress. Master of Science Thesis. Institute for Creation Research, El Cajon, CA.
- Stebbins, G. L. 1971. Processes of organic evolution. Second edition, Prentice-Hall, Englewood Cliffs, NJ.

Contributed by Emmett L. Williams

Thermodynamics and the Christian

Thermodynamics is a branch of science primarily concerned with the relationship between heat and work. There are four laws of thermodynamics and in their narrowest, technical formulation we would expect them to have more to do with the engines of our automobiles than with us and our relationship with the Creator. But the laws of thermodynamics not only represent some of the most concrete and certain science that we possess but they also allow us to gain insight into the fundamental nature of the universe and the God that created it. The Christian should approach the study of science with the same attitude with which he approaches the study of Scripture, that is to learn more about God. These scientific laws as they appear in textbooks of physical chemistry are but special cases of universal laws legislated by God to govern His creation. Perhaps it is surprising that modern man has rejected absolute spiritual laws while maintaining a belief in absolute physical laws.

The Zeroth Law of Thermodynamics was actually the last of the four laws to be formulated. Simply illustrated, this law tells us that if we have two baked potatoes in the oven and they are both at the same temperature as the oven, no heat can flow from one potato to the other. Using scientific language we would say that both potatoes are in thermal equilibrium with each other and with the oven. Imagine a universe in which this law could be broken and we opened the oven to find one potato frozen and the other burnt!

The First Law of Thermodynamics is also known as the Law of Conservation of Energy. This law states that energy cannot be created or destroyed. It reveals God in His role as Creator and Sustainer of the universe. Energy is not being created, energy is not eternal, therefore God must be eternal since He is the source of all the energy in the universe. He also must be greater in power than all the energy He has created!

We know that energy is not eternal because of the Second Law of Thermodynamics which states that there is a particular direction for all spontaneous processes. Water flows down hill, new cars grow old and rusty and eventually even the sun itself would burn out and turn into a cold cinder, its energy dispersed evenly throughout the whole universe. The downward direction is the key. All of us find it much easier to burn a gallon of gasoline than to manufacture another one with the energy that we used.

The Third Law of Thermodynamics informs us that complete and perfect order (such as we might expect to find in a perfect crystal at the lowest possible temperature) cannot be attained. There is a specialized word that scientists use to describe the amount of disorder in any system and that word is entropy. Therefore, another way of stating the Third Law is to say that we can never reach a state where the entropy equals zero. Entropy is always with us in this life. But as we look around us we clearly see that any order in the universe comes as a result of design and intelligence. The evolutionist says that order can arise spontaneously but we can find no evidence of this taking place in the natural world. The order and symmetry of the flower is the result of the mechanism of photosynthesis and the genetic code both designed by God to usefully harness the energy of the sun. Consider the fact that even the ice crystal derives its order and symmetry from the instructions that God has built into the water molecule in terms of bond lengths, angles and forces. Order requires energy and applied intelligence.

For a more detailed discussion of creationist applications of the laws of thermodynamics consult Williams, E. L. (editor). 1981 *Thermodynamics and the Development of Order*, Creation Research Society Books, Norcross, GA.

Contributed by George Matzko

Definition of Secularism, Humanism and Indifferentism

Secularism—the prevailing values and norms of the age, of the *saeculum*, alone count; centering only on the temporal, the worldly, the *saecularis*, and disregarding anything eternal or religious. Humanism—the absolute self-sufficiency of man, the deification and worship of man and his powers. Indifferentism—science, learning, discovery, research, truth are indifferent to the existence or non-existence of God.

Malik, Charles H. 1984. Faith and reason in the university. *Modern Age* 28:315

Definition of Rationalism, Evolutionism, Materialism and Change

Rationalism—truth is only what the canons of critical reason admit. Naturalistic monism, nature, or “the universe,” is all in all. Evolutionism—everything, including truth, culture, spirit, freedom, beauty, values, has somehow “evolved” from more primitive conditions. Materialism—the primacy of the material whereby the superstructure (truth, beauty, freedom, the spirit) “emerges” automatically from the infrastructure (economic, social, and political conditions). Change—this is the god of today—everything changes and nothing whatsoever abides except change itself.

Malik, Charles H. 1984. Faith and reason in the university. 28:314-15

Definition of Relativism, Freudianism, Technologism and Voluntarism

Relativism—no absolute moral standards. Freudianism—a certain mythology whereby man is principally his dreams, fantasies and sexual urges. Technologism—everything—the humanities, beauty, values, spirit, life itself—is to be technicized, mathematicized, computerized. Voluntarism—the will determines everything including reason, whose function is only to rationalize the dictates of the will. The will to power—the will itself is chiefly determined by the urge to dominate and control and to secure and extend power.

Malik, Charles H. 1984. Faith and reason in the university. *Modern Age* 28:315

INVITED PAPER

EARTH'S YOUNG MAGNETIC AGE CONFIRMED

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Abstract

The depletion of the earth's magnetic field is documented in scientific literature. This field shields the earth from some of the cosmic rays. The depletion of this shield has two side effects: 1) harmful biological effects, and 2) lowering of carbon-14 dates. The decay process is explained in terms of an equivalent circuit, providing simple solutions for the decay process. The theory and data are employed to set a limit on the age of the earth's magnet and, by inference, the age of the earth. Three independent checks provide confirmation of the theory.

Irreversible Worldwide Decay

There is some awareness now that our energy resources are being depleted and that conservation measures are needed. However, there are some natural energy-depleting processes that are beyond the scope of conservation measures. At least two of those processes are worldwide in scope: 1) The energy in the earth's rotation is being depleted, and 2) the energy in the earth's magnetic field is being depleted.

Each day there is some extremely small loss in the earth's rotational kinetic energy. The earth's rotational rate is decaying and the days are getting slightly longer. The standard unit of time, the second, is no longer based on the rate of rotation of the earth. It is based on an atomic vibrational frequency that does not decay. The instrument for measuring the standard second is the atomic clock.

The decay in the rotational rate of the earth is an inexorable process. There is no way to keep the earth's rotation from slowing down. There is neither a motor to keep the earth rotating, nor a suitable energy source to replace this continual loss of rotational energy.

Of more immediate importance, however, is the decay of the magnetic energy and its associated magnetic field. This is a much more rapid decay and there are unwanted environmental consequences. Harmful cosmic rays are coming in from all directions, headed toward the earth. Cosmic rays are extremely energetic charged particles. When they strike the atmosphere, they set up showers of secondary cosmic rays. Cosmic rays are very penetrative and have been detected at the bottom of deep lakes. The most desirable protection from cosmic rays is to have them deflected away from the earth before they reach our atmosphere.

The earth's magnetic field extends into space beyond the earth's atmosphere. A magnetic field will deflect the path of charged particles moving across the magnetic field. So the earth's magnetic field deflects cosmic rays, causing many of them to miss the earth's atmosphere. This magnetic shield is a great blessing, but time is running out for this magnetic shield.

The depletion of the earth's magnetic field is an inexorable process. There is no way to keep the earth's magnetic field from decaying. There is no power plant in the earth to sustain the earth's magnet or to regenerate it after it is gone. Nor is there any suitable energy source there to run the power plant if there were one.

Documentation of the Magnetic Decay

In his 1951 book, *The Earth's Magnetism*, the famous

geophysicist Sidney Chapman declared that the great scale of the decay of the earth's magnetic field is: "not paralleled for any other worldwide geophysical phenomenon."¹ In the 1965 ESSA Technical Report, *An Analysis of the Earth's Magnetic Field from 1835 to 1965*, it stated that: "if this decay rate persists, the earth's dipole magnet will vanish in A.D. 3991."²

In the August 1976 issue of *Industrial Research and Development*, Frederick Jueneman's article, "Magnetic Depletion," states:

All the recent commotion about the exponential depletion of our natural resources has singularly failed to mention that we are also running out of a rather vital, apparently nonrenewable resource, the Earth's magnetic field, quite rapidly.³

These conclusions are based on the evaluations of the earth's magnetic moment, the one quantity that specifies the state of the earth's magnet, its strength and direction. These are the only meaningful evaluations of the state of the earth's magnet.

Each evaluation was based on a huge number of measurements from an extensive portion of the globe. Each real-time measurement contained not just the "signal" desired but magnetic "noise." It was a monumental task to reduce these data to obtain the magnetic moment.

Description of the Earth's Magnet

The earth's magnet is vastly larger and stronger than any man-made magnet. It is located in the core of the earth. Its diameter is about seven million meters. The material in this magnet is some molten metal, perhaps it is predominantly iron and is a much better conductor than the rest of the earth, outside the core.

The material is too hot for it to be a permanent magnet. This magnet depends upon the flow of electric current. Any time an electric current flows there is a magnetic field associated with it. An electric current can produce a magnet no matter how high the temperature is.

The electric current flows in a circular path around the axis of the magnet. The magnetic axis is tilted 11.5 degrees away from the earth's spin axis. That is one reason why it is known that the earth's spin does not generate this magnet. The earth's spin energy and its magnetic energy are both decaying, but from different causes.

The present value of the electric current in the earth's magnet is six billion amperes. That is a huge current. The average total current in a home is, perhaps, not more than 30 amps. If that be correct, the electric current flowing in the earth's magnet is equivalent to the electric current flowing in 200,000,000 homes.

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The Decay Process

The equation for a natural decay in physics is well known. However, it is worthwhile to consider the physical processes involved. The earth's magnet had an initial amount of energy (the energy in its original magnetic field). It has been continually losing this energy ever since.

The lost magnetic energy has gone into heat energy, as might be expected from the second law of thermodynamics. As illustrated in Figure 1, the transition from magnetic energy to heat energy takes place in two stages. The magnetic energy is transformed into electric energy. Then the electric energy is transformed into heat energy.

Since there is no power plant to generate the electric current, the current attempts to dissipate immediately. The self inductance of the core of the magnet prevents that from happening. As the magnetic field tends to collapse, that very action induces a current in the core which tends to sustain the electric current. It is a delaying action on the decay process.

That induction process can be expressed as Lenz's law. Any time there is a rate of change of the magnetic field, in this case a diminishing of the magnetic field, it induces a "back" electromotive force that tends to oppose the process. This electromotive force causes a forward current to flow in the metal core. That induced current replenishes the current, keeping it from dying out rapidly.

The self inductance is a function of the dimensions of the core. The larger the core of the magnet and smaller the resistance of the core, the longer it takes for the magnet to decay. The reason the earth's magnetic field takes a few thousand years to decay is that the core is very large and its electrical resistance is quite small.

The diameter of this magnet is approximately half the diameter of the earth. So its decay time is vastly longer than the decay time of a laboratory electromagnet. However, laboratory magnets obey the same laws of physics and their decay times are computed from the same fundamental electromagnetic equations.

Hence the decay process in the earth's magnet has been analyzed by the same type of reliable equations as those employed in applied physics and electrical engineering. The depletion in the magnetic field of the earth is predictable and it has been confirmed by the historical evaluations of the state of the earth's magnet.

The Half-Life of the Earth's Magnet

The equation for natural decay processes is an exponential equation. A simple way to describe the decay is in terms of the half-life. A half-life is the time it takes to decay to half of the value it was in the beginning.

The half-life of the earth's magnetic energy is 700 years. The magnetic energy is reduced by a factor of two every 700 years. Today there is only half as much energy in the earth's magnet as there was 700 years ago. There is only one-fourth as much as there was 1400 years ago, and only one-eighth as much as there was 2100 years ago. The half-life of carbon-14 is approximately 5,700 years. The earth's magnetic energy is decaying about eight times as fast as the rate of decay of carbon-14.

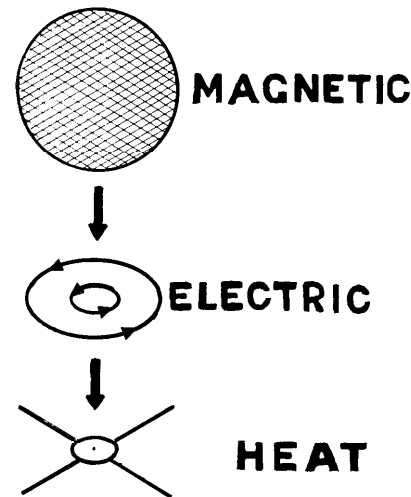


Figure 1. Schematic Energy Flow in Earth's Magnetic Field.

The magnetic field acts as a magnetic shield. The variation in the strength of this shield can alter the radiocarbon dates. A weaker shield lets in a greater number of cosmic rays. That increases the rate of production of carbon-14 in the atmosphere. This factor tends to yield a younger carbon-14 date, particularly on the older dates. However, this is such a complex problem that this information has not been employed to yield accurate corrections.

Age Limit on the Earth's Magnetic Field

When comparing half-lives of the earth's magnet with the half-life of radioactive decay one should employ the half-life of the energy in the earth's magnet. In radioactive decay, the loss is in mass and that is equated to energy.

If one is concerned with the field strength, or with magnetic shielding, a half-life of 1400 years should be employed. The factor of two between the half-life of the magnetic field and the magnetic energy is due to the fact that the energy is proportional to the square of the field strength. Going backward in time the magnetic field strength was twice as strong 1400 years ago, four times as strong 2800 years ago, eight times as strong 4200 years ago, etc.

These stronger magnetic fields in the past can be employed to set a limit on the age of the earth's magnetic field. Ten thousand years ago the earth's magnetic field would have been 141 times as strong as it is today. That value is about as strong as the magnetic field of some of the magnetic stars.⁴

If one makes the reasonable postulate that the earth's magnetic field was never as great as that of a magnetic star, this puts a limit on the age of the earth's magnet of less than 10,000 years. That seems to be a reasonable postulate because the star is said to have a nuclear source of energy and there is no reason to think that the earth has ever been a star.

Circuit Theory Solution

There are two basic methods of solving problems in electricity and magnetism: 1) circuit theory and 2) field theory. The simplest of these is circuit theory.

When the electric current is confined to a wire, one may use circuit theory. When the current is spread out

over a broad expanse of conductive material, as it is in the earth's core, field theory is required in most cases. Field theory has been employed in all of the solutions referred to thus far. However, it may be helpful to those who know circuit theory and are not familiar with field theory, to use circuit theory solutions to this decay phenomenon. One may employ an "equivalent circuit" to solve for some of the overall effects.

In this simplified approach to the decay problem, the earth's spherical core model is replaced by a circular loop of wire model. The loop has a diameter almost as large as the diameter of the earth's core. It has the same current and power dissipation as the earth's core. It is, for the limited conditions under which it is employed here, an equivalent electromagnet. There is no generator in this circuit. The electric current is decaying, in accordance with the real-time measurements of the earth's magnetic moment. The electric current it has now is what is left of the original current (the current it had when the magnet was created).

The well known solutions for the decay of the current in this type of circuit can now be employed to evaluate the resistance and inductance of the earth's core. To begin with one can use the following values that have been obtained from evaluations of the earth's magnetic moment and from the solutions in the author's original paper:⁵

Time constant	$T = 6.2 \times 10^{10}$ seconds
Magnetic moment	$M = 8 \times 10^{22}$ amp meter ²
Current	$I = 6 \times 10^9$ amp
Power	$P = 8 \times 10^8$ watt

One may use the following circuit theory equations to solve for the resistance (R), the self inductance (L), and the radius (r) of the wire loop:

$$P = I^2 R \quad (1)$$

$$T = L/R \quad (2)$$

$$M = \pi r^2 I \quad (3)$$

The answers are:

Resistance	$R = 2.2 \times 10^{-11}$ ohm
Inductance	$L = 1.4$ henry
Loop radius	$r = 2.1 \times 10^6$ meter

Circuit theory tells one that if a current were induced in that wire loop, the current would continue to flow, without a battery or generator, for a few thousand years. Its half-life would be 1,400 years.

Reasonableness of the Solutions

The reasonableness of these solutions, which depend upon the decay of the earth's electromagnet, can be seen by noting how well they check with independent solutions that do not depend upon any decay. Three examples will be given:

1) The value of the self inductance (L) of the earth's core does not depend on the current, or on the decay. The self inductance was evaluated in the preceding section by the use of circuit theory and the time constant of decay. The answer for that solution is $L = 1.4$ henry. The original definition of the unit of inductance, the henry, can be used to give an independent evaluation on the inductance of the core of the earth. In the original definition the henry is the inductance of a wire of length 10^7 meters. (The length of a quadrant of the earth.) In the equivalent circuit the length of the wire is the circumference of the loop. In view of

the known radius, the circumference of the loop is 1.32×10^7 meters. Applying the definition of the henry, the inductance $L = 1.32$ henry for the loop and hence for the earth's core. That is confirmation of the exponential decay theory which was used to evaluate the core's inductance.

2) Employing the field theory solution to the exponential decay of the earth's electromagnet, the author obtained this equation for the decay time constant (T):

$$T = \sigma \mu r^2 / \pi^2 \quad (4)$$

where σ and μ are, respectively, the conductivity and permeability of the core. The time constant was computed from the magnetic moment data. The radius of the core is known. Using those values in this equation yields the value of conductivity of the earth's core of 4×10^4 mho/meter.⁶ The value of 3×10^4 mho/meter is the value of the conductivity of the core of the earth obtained by F. D. Stacey from metallurgical considerations.⁷

3) The conservation of energy principle illustrated in Figure 1 has been used to evaluate the magnetic energy in the earth's magnetic field. If the decay theory is correct, that field energy is the only energy source this magnet has. It follows that the magnetic field energy equals the energy that will be lost in heat. That heat energy was computed by integrating the exponential power equation from time zero to infinity. The calculation yields the heat energy and it is equal to the present magnetic field energy.

The answer is:

$$\text{Earth's magnetic energy} = 2.5 \times 10^{19} \text{ joule.}^8$$

This value of the magnetic energy in the earth's dipole magnet is very important. If it is the correct value, it confirms the exponential decay theory of the earth's magnet. That value of the earth's magnetic energy has been verified by another evaluation of the earth's magnetic energy that is unrelated to the decay. The author has computed the magnetic energy in a uniformly magnetized sphere of the same dimensions as the earth's core and having the same value of magnetic moment as the earth's magnet. Its magnetic energy is 1.5×10^{19} joule. This is a fairly good check, even without the needed correction for the different current distributions in the two different types of magnets.

The earth's magnet has its real current distributed through all of the core. That was evaluated in the author's field theory solution. The permanent magnet has a known amperian current that is all located at the surface of the magnet. When the correction for this difference in the two magnets was made, there was a perfect check.⁹ This confirms not only the present value of energy in the earth's magnet, but also the exponential decay theory upon which that evaluation was based.

Summary

The irreversible worldwide decay of the earth's magnetic field is documented by the only kind of data from which one can evaluate the state of the earth's magnet, its magnetic moment. The depletion of the magnetic field is a relatively rapid phenomenon, not paralleled by any other worldwide geophysical phenomenon. The diminishing magnetic field strength allows more cosmic rays to impinge on the earth. This

has detrimental biological effects. It also alters the carbon-14 dating, tending to reduce those age dates.

The earth's magnet is an electromagnet that has a current of six billion amperes now. There is no power generating plant down in the earth to maintain that current. This magnet is consuming energy and there is no source of energy to sustain it other than the magnetic energy that is presently in its field. In accordance with the law of conservation of energy, the magnetic energy decays into heat energy. This energy transfer takes place in two stages. The magnetic energy goes into electric energy through the process of electromagnetic induction as it tends to die out. This induced electric energy goes into heat energy in the core.

This induction process of generating a forward current as the magnetic field decays, replenishes to some extent the current that is dying. This process prevents the magnet from dying immediately. That is why it requires a few thousand years for the earth's magnet to be depleted. The larger the core of the magnet and the lower its resistance, the longer it takes to decay. The evaluations of the earth's magnetic moment show that the half-life of the magnetic field is 1400 years.

If one computes the magnetic field strength back in time 10 thousand years, the earth's magnetic field would have been as strong as that of some magnetic stars. The reasonable assumption has been made that the earth never had a magnetic field as strong as a star's magnetic field. On the basis of an original magnetic field strength of the earth that is less than that of a magnetic star, the origin of the earth's magnet is less

than 10 thousand years ago.

Since there is no power generating plant in the earth its origin must have been at the time of creation. This means that the young magnetic age of the earth's magnet also means a young age for the earth itself. These conclusions are based upon the decay theory of the earth's magnet. That is supported by:

- 1) The real-time evaluations of the earth's magnetic moment.
- 2) The only rigorous theoretical explanation of the present processes in this electromagnet.
- 3) Three types of independent confirmational checks on that theory.

References

1. Chapman, Sidney. 1951. The earth's magnetism, Methuen and Co., Ltd. London: John Wiley and Sons, Inc., New York, p. 23.
2. McDonald, Keith L. and Robert H. Gunst. 1967. An analysis of the earth's magnetic field from 1835 to 1965, ESSA Technical Report, IER 46-IES 1. U.S. Government Printing Office, Washington, D.C., p. 1.
3. Jueneman, Fredrick B. 1978. Magnetic depletion, *Industrial Research and Development*, 20(8):13.
4. Barnes, Thomas G. 1983. Origin and destiny of the earth's magnetic field, second edition. Institute for Creation Research, El Cajon, CA., p. 36.
5. Barnes, Thomas G. 1973. Electromagnetics of earth's field and evaluation of electric conductivity, current, and joule heating in the earth's core, *Creation Research Society Quarterly*, 10:222-30.
6. Barnes. 1973. *Op. cit.*, p. 228.
7. Stacey, F. D. 1967. Electrical resistivity of the earth's core, *Earth and Planetary Science Letters*, North Holland Pub. Co., Amsterdam, pp. 204-06.
8. Barnes. 1983. *Op. cit.*, p. 108.
9. *Ibid.*, pp. 104-12.

BOOK REVIEWS

Ancient Diamond Time Capsules, Secrets of Life and the World by Charles E. Melton. 1985. Melton-Giardini Book Company, Route 2 Box 18, Hull, Georgia 30646. 166 pages. \$5.95 pb. \$9.95 hb.

Reviewed by Eugene F. Chaffin*

Most of the "big picture" encountered in this book developed by starting with experimental studies of the fluid inclusions found in diamonds collected from all parts of the globe. The author is a well qualified physical chemist at the University of Georgia, and most of the work reported was performed with A. A. Giardini, a professor of geology, also eminently qualified in the fields of crystallography, mineralogy, and related areas. While Drs. Melton and Giardini do not espouse true creationist views, they have nevertheless presented some views of petroleum origins, chemical evolution, and the thermal history of the earth which are sometimes at variance with the views of conventional evolutionary dogma.

The basis for the views presented seems to be a 6.3 carat diamond from near Murfreesboro, Arkansas. This particular diamond was free from biotite and other potassium bearing minerals. It was crushed in an especially constructed diamond crusher (with elements constructed from tungsten carbide), and the fluid inclusions released were analyzed in a high sensitivity mass spectrometer.^{1,2} The ratio Argon-40 to Argon-36 was found to be 189. By assuming that

the earth's mantle contained negligible Ar-40 when it formed, it was deduced that the diamond was 3.1 billion years old. In a separate work it was deduced that the Arkansas diatreme where the diamond was erupted should be dated at 100 million years before the present.³ This particular diamond contained no potassium, hence the figure of 189 for the Ar-40/Ar-36 is assumed to be representative of the earth's mantle at the time the diamond was formed. This information and other information about the fluid inclusions in this diamond is the scientific data used to build the views of petroleum formation and chemical evolution presented in the remainder of the book.

Creationists have previously criticized the assumptions made by evolutionists regarding initial Ar-40 content in rocks. See for example Whitelaw^{4,5} and Clementson.⁶ Also, published studies of Ar-40/Ar-36 ratios have shown them to vary from values above 16,000 to very small values.⁷⁻⁹ Hence we are justified in stating that the 189 ratio of Ar-40/Ar-36 in the diamond inclusions does not indicate the "age" of the diamond or of the earth for that matter. Other items in lists of possible "flaws" in radioactive dating methods would also be relevant. Hence, there is no real basis for the main thrust of the remainder of the book.

Dr. Melton starts from the diamond's supposed age and data on the chemical composition of its fluid inclusions to try to build a theory of the evolution of the atmosphere. In this case, and in some other important discussions in the book he follows the debating tactic of oversimplifying the opponents' posi-

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tion, removing supporting details, and then presenting his own position complete with all its detail. In this discussion of atmospheric evolution he follows Don Quixote's practice in dreaming up an opposing "dragon." The dragon for this episode is the sudden catastrophic degassing theory of evolutionists. The "theory" is not really a theory since it postulates a sudden release of the earth's atmosphere from the interior, soon after the earth's formation, an event which like all models of origins cannot be duplicated in the laboratory due to its supposed occurrence at a singular past moment in time. Dr. Melton then claims to have constructed a more "scientifically" sound theory of continuous atmospheric degassing based on his data on fluid inclusions in diamonds. While the inclusion of the diamond data would seem to make the discussion "scientific," closer inspection reveals unsound speculation, since assumptions are made to derive an age for the diamond, the diamond inclusions are assumed to be representative of the earth's mantle as a whole, etc. On page 44 of the book mention is made of Dr. Henry Morris and the Creation Research Institute. Creationists such as Dr. Morris are dismissed as being "unscientific" since they assume things about the earth's origins which are not subject to testing in scientific laboratories. In so dismissing creationism, the non-testable nature of any model of origins is passed over, ignored, or unfortunately not recognized. In particular, the book's presentation of a continuous degassing model is subject to the same criticism since it is not the slightest bit more "scientific" than the others.

In the concluding chapters of the book, a curious speculation on the chemical evolution of life is presented, only a slight modification of speculations of D. E. Tyler.¹⁰ Instead of the production of amino acids by lightning in an atmosphere of hydrogen, methane, ammonia, carbon dioxide, and water vapor, and subsequent formation of life, Dr. Melton takes the unorthodox viewpoint that life originated in petroleum. This is supported in Chapter 5 by a model for the non-biogenic origin of petroleum. However, Dr. Melton believes that mere formation of the chemical constituents of life is not enough, but some type of "force of creation" is needed to form a living entity. Overlooked are the extreme improbabilities of the formation of DNA or RNA from constituent molecular parts, the simultaneous formation and location of enzyme proteins, and the formation of protective coatings to make these primitive life forms. However, the fact that life is more than just its constituent chemical parts is considered. Thus the book is basically uniformitarian in its beliefs pertaining to origins, but it does present a "force of creation." The book mentions Christ on page 99, where it refers to the "reported resurrection" of Christ, as if the issue of His bodily resurrection were in doubt. Thus, it would seem that this book is to creationism as the cults are to true Christianity.

There are some minor errors in the printing of the book. On pages 54-55 reference is made to equation 3-6, but there is no equation 3-6. Equations 2-4 and 3-3 should be the same but they are not. On the whole the book may be of use to those interested in serious research on the subject of origins, and certainly to those who would like to keep up with the current trends in scientific thought.

References

1. Melton, C. E. and A. A. Giardini. 1986. The isotopic composition of argon included in an Arkansas diamond and its significance. *Geophysical Research Letters* 7:461-64.
2. Melton, C. E. and A. A. Giardini. 1982. The evolution of the earth's atmosphere and oceans. *Geophysical Research Letters* 9:579-82.
3. Gogineni, S. V., C. E. Melton and A. A. Giardini. 1978. Some petrological aspects of the prairie creek diamond-bearing kimberlite diatreme, Arkansas. *Contributions to Mineralogy and Petrology* 66:251-61.
4. Whitelaw, R. L. 1968. Radiocarbon confirms Biblical Creation (and so does potassium-argon). *Creation Research Society Quarterly* 5:78.
5. Whitelaw, R. L. 1969. Radiocarbon and potassium-argon dating in the light of new discoveries in cosmic rays. *Creation Research Society Quarterly* 6:71.
6. Clementson, Sidney P. 1970. A critical examination of radioactive dating of rocks. *Creation Research Society Quarterly* 7:137-41.
7. Brown, J. F., C. T. Harper, and A. L. Odom. 1974. Petrogenic implications of argon isotopic evolution in the upper mantle. *Nature* 250:130-33.
8. Ozima, M. 1975. Ar isotopes and earth-atmosphere evolution models. *Geochimica et Cosmochimica Acta* 39:1127-34.
9. Dymond, J. and L. Hogan. 1978. Factors controlling the noble gas abundance patterns of deep sea basalts. *Earth and Planetary Science Letters* 38:117-28.
10. Tyler, D. E. 1983. *Originations of life from volcanoes and petroleum*. Ryan Gwinnes Press, Portland.

The New Evolutionary Timetable, by Steven M. Stanley, 1981. Basic Books, Inc., New York. 222 pages. \$17.50.

Reviewed by Clifford Lillo*

That evolutionists are divided in their interpretations of science, the fossil record, and Darwinism should come as no surprise to anyone. This book illustrates the magnitude of that division while the author emphasizes repeatedly that he and all true scientists believe in Darwinism, seemingly regardless of where that faith leads.

Dr. Stanley is a firm believer in punctuational evolution, thereby aligning himself with Otto Schindewolf, Ernst Mayr, Niles Eldredge, Stephen Jay Gould, and George Gaylord Simpson. He says:

This book is not designed to build a rigorous case for the punctuational model of evolution—the goal of my more technical volume, *Macroevolution: Pattern and Process*, published in 1979. Rather, in the present book I attempt to give the interested non-specialist access to the punctuational view and its implications—implications that are by no means trivial. (p. xv)

In the ten chapters of the book he introduces the "non-specialist" to Darwinism and shows how Darwin's gradualistic evolutionary views—although rejected at first by most scientists—became accepted but are now giving way to the concept of punctuationalism. In describing the swing away from Darwin's gradualism views, the author says:

Throughout the 1940's . . . the geneticist Richard Goldschmidt argued for the sudden appearance of species by macromutation. Because of his prominence as an experimentalist, Goldschmidt was too conspicuous to be ignored and he . . . was ostracized by the evolutionary community. (p. 71)

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Later in the book the author adds, "Goldschmidt's most controversial construct was the hopeful monster, the single animal supposed to constitute a new genus or family at birth." (p. 135)

In 1950, Schindewolf, a prominent German paleontologist, was widely derided in English-speaking countries because he "published two books that were shockingly anti-Darwinian." (p. 108) Schindewolf was attempting to reconcile the facts of paleontology with the theory of evolution and "he adopted the old idea of macromutation, envisioning such things as the first bird hatching, fully formed, from a reptile egg." (p. 108) Continuing his history, the author says, "... in 1954 Ernst Mayr published his paper suggesting that evolutionary novelties often evolve rapidly in localized speciation events ..." (p. 108). After the early 1950s:

Punctationalism went underground for nearly two decades. It was not until 1971 and 1972, when Niles Eldredge and Stephen Jay Gould reiterated Mayr's arguments on speciation, that biologists finally began to take notice ... The time was ripe for change. (p. 108)

What does Stanley himself believe? He says: "In retrospect, it seems to me that Goldschmidt deserves posthumous accolades for his steps in the right direction, though they may have been steps too far." (p. 135). On another page he adds, "It is virtually inconceivable that the first bird emerged full blown, from a dinosaur egg ..." (p. 166) With his qualifying words "may have been" and "virtually," Stanley apparently is not rejecting the "hopeful monster" theory outright but is leaving the door open just in case later developments prove the Schindewolf/Gould/Simpson "monster" view to be the "correct" one.

Just what is the punctationalism view that Stanley is espousing? The author says:

... I have suggested that we erect unambiguous and nonextreme models: the *gradualistic model*, representing the traditional view, holds that most evolutionary change in the history of life has taken place within fully established species, while the *punctational model* asserts that most change is associated with speciation that involves small populations ... I will attempt to show how most genera, families, and still larger branches of the tree of life have developed mainly by way of one or more steps of rapid evolution associated with branching (speciation). (p. 78)

The technique the author has used is well known to creationists who advocate two models of origins: the creation model and the evolutionary model. As Henry Morris has stated:

There are only these two possibilities. There may be evolutionary submodels (e.g., different evolutionary mechanisms or sequences) and various creationist sub-models (e.g., different dates of creation or events of creation), but there can be only two basic models—evolution or creation.¹

Dr. Stanley does have a few words about creationists:

There is no doubt that the new punctational movement will bring joy to the hearts of creationists—those who claim species to be discrete entities that a divine being brought separately to life and placed upon the earth."

His definition of creationists, although close, does not coincide with definitions usually given by creationists themselves: A creationist is one who believes that "major categories of nature were formed by special creative and cataclysmic, purposive processes in the past which are no longer in operation today ..."² The difference in the two definitions is quite significant. Creationists believe major categories were created and that from those major categories, or "kinds," many species have developed. Creationists believe that God created birds and that birds beget birds and no one has ever provided proof that it did not happen. Birds can change within the limits of their gene pool, but birds are always birds. Stanley continues:

... if creationism had to rise again, it is well that we have punctationalism to counter some of its arguments. Many of the complaints that creationists have leveled at gradualistic evolution (complaints that this model of change does not square with the facts of the fossil record) now appear baseless. With the acceptance of the punctational scheme, the sudden appearance in the fossil record of many distinctive groups of animals and plants need trouble evolutionists no longer. (p. 165)

Dr. Stanley is right in one respect: the evolutionary model does not square with the facts in the fossil record. With the creation model, a book that has been in existence for well over two thousand years was seen by scientists to fit the facts of the fossil record with amazing accuracy. By contrast, with the evolutionary model, a book written in 1859, with no evidence to support its allegations, nevertheless has been accepted by some scientists in the hope that future generations would find it to conform to the fossil record, but it has failed dismally. The fossil record shows all types of animals and plants first appearing as fully formed, without a long evolutionary development. Stanley's technique is to accept the evidence and his "punctational model" fits the fossil record. But, does that render invalid the creationist viewpoint? He believes it does, but the arguments he presents in his book fail to convince the reader.

How does the punctational view account for the existence of life on earth? It falls back on the old evolutionary claim that life formed from non-life and then the first living creatures multiplied. "It can now be shown that trace fossils make their first appearance in the record as simple tubelike structures of very late Precambrian Age ..." (p. 87). What Stanley does not mention is that these "simple tubelike structures" represent highly complex life forms. As Parker has said:

Actually, very few Precambrian fossils have been found, but those that have strongly support the creation concept. Soft-bodied jellyfish and members of the earthworm group (annelids) have been found, for example—separate and complex types like those living today.³

In what way does Stanley provide proof for the punctational method using the fossil record? He says:

Here then we have a test. We can single out for examination narrow branches of phylogeny—small but persistent families or orders—and we can then see how much net change they undergo. In other words, is the original genus of the group eventually

succeeded by others of quite different form (gradualistic model), or are the changes minor, so that even over long stretches of time no new genera, or only slightly different ones, emerge (punctuational model). (p. 83)

Stanley cites two examples:

As a first example, we can consider the bowfin fishes . . . No more than two bowfin species are known to have existed at any one time . . . What has happened to the bowfin fishes during their long history of more than one hundred million years? Next to nothing! . . . The bowfins of seventy or eighty million years ago must have lived very much as their lake dwelling descendants do today. Thus, the punctuational view is favored. (pp. 83, 84)

An obvious truth that Dr. Stanley has not admitted is that the example he has given favors the creationist view even more than either the punctuationalist or the gradualist views. He continues:

The lungfishes represent another example. These animals are well equipped to withstand droughts that occur where they live in South America, Africa, and Australia. Lungfishes breathe air, and the South American and African forms can also burrow into mud in order to sit out dry intervals.

The evolutionary history of the lungfishes differs from that of the bowfins in that it includes an early history of rapid diversification. The lungfishes evolved at a high rate early in their history, when they also speciated rapidly. Then, beginning about 300 million years ago, they declined to a small number of lineages. At this low diversity they persisted to the present day. Meanwhile they evolved only modestly. Again, the punctuational model is favored (p. 84)

Put into fewer words, the author has said that lungfishes (which appeared suddenly in the fossil record) showed some microevolutionary changes (creationists agree that microevolutionary changes do occur— it is the macroevolutionary changes that are not supported by the fossil record) but remained lungfishes and have not changed much to this day. They are *still lungfishes*. And Stanley has erred— it is the creationist model that is favored.

When the author presents his views on human origins in Chapter seven, a small amount of evidence becomes conclusive to him. Stanley says: "As I will outline, we have conclusive evidence that the succeeding group of hominids, the australopithecines, were two-legged ground walkers." (p. 142) In speaking of *australopithecus africanus*, which evolutionists consider to be one of the australopithecines, he says:

Australopithecus africanus has often been regarded as the direct ancestor of the human genus, *Homo*. Its existence spanned the interval from three million years ago . . . to perhaps 1.6 million years ago . . . *Australopithecus africanus*, like our species, was a fully upright creature. This we can see from various skeletal features, but most especially from its basketlike pelvis— a pelvis built along human lines to support the body above the legs. An ape's pelvis is more elongate, extending for some distance along the lower back . . . (pp. 142, 143)

Charles Oxnard, Professor of Anatomy at the University of Southern California, has pointed out that "anatomical relationships can't be simply established by subjective opinion."⁴ In a book review in *Science*, Brian Shea of Northwestern University discussed Oxnard's multivariate statistical analyses in these terms:

Oxnard has concluded that *Australopithecus* could not have been ancestral to *Homo* . . . his conclusions regarding morphology and behavior have been prophetic. His and his collaborators' claims that *Australopithecus* engaged in a form of locomotion quite different from that of modern *Homo* were ignored or ridiculed by many for years, but they have recently gained support . . . different workers using more traditional methods of comparative anatomy (Tuttle and Stern and Susman), as well as other techniques (Prost), have all . . . converged upon the view presented by Oxnard that australopithecines were more proficient in the trees and more different from modern *Homo* . . . than was previously believed.⁵

In commenting on Oxnard's work, Morris says:

These multivariate statistical analyses were computerized and highly detailed, showing almost conclusively that the australopithecines were some form of extinct ape, and that they did not walk erect.⁶

There is more to Stanley's argument, however. He says:

What is known of the pelvic and limb bones of australopithecines has for some time been taken to indicate that these animals were fully erect in posture. This inference has been confirmed by Mary Leakey's spectacular discovery of tracks of fossil footprints more than three million years old. Apparently these were left by slender australopithecines treading across a fresh layer of volcanic ash in what is now Tanzania. The tracks look hauntingly like our own. (p. 145)

Careful analysis of this statement reveals that the only thing that has been confirmed is that some footprints have been found. No proof has been provided by Stanley or anyone else that the tracks were made by any of the australopithecines. Busse and Heikes, writing in *Science* said:

The uneroded footprints show a total morphological pattern like that seen in modern humans . . . Spatial relationships of the footprints are strikingly human in pattern . . . The Laetoli hominid trails at site G do not differ substantially from modern human trails made on a similar substrate.⁷

When one of the foremost spokesmen for the punctuationalist movement illustrates the problems that evolutionists are having, it confirms what creationists have been saying right along. But more than that, his vain attempt to reconcile the fossil record to the punctuational form of evolution will result in more scientists than ever before questioning the whole theory of evolution. That indeed brings joy to the hearts of creationists.

References

1. Morris, H. M. and G. E. Parker. 1984. What is creation science? (public school edition), Master Book Publishers, San Diego, p. 156.

2. Morris, H. M. 1974. The troubled waters of evolution, Creation-Life Publishers, San Diego, p. 82.
3. Morris and Parker. *Op. Cit.*, p. 95.
4. *Ibid.*, p. 122.
5. Shea, B. T. 1984. Primate morphometrics, *Science*, 224:148-49. (Book review of The order of man, by Charles Oxnard, New Haven, CT.
6. Morris, *Op. Cit.*, p. 78.
7. Busse, P. H. and K. E. Heikes. Evolutionary implications of Pliocene hominid footprints, *Science*, 208:175, as quoted by Morris, *Evolution in turmoil*, p. 79, 80.

Before You Were a Baby by Mike J. Fritz. 1985. Victory Videos, San Diego, CA \$39.95 (rental)

Reviewed by David Kaufmann*

This video and booklet show the complete development of a child from conception to birth. The learning method, which is recommended for sixth grade through adults, allows the viewer to see the video once in a relaxed mood. The viewer then watches the video a second time following along with the booklet. The third showing is without the booklet. This is followed by taking a 15 question quiz at the end of the booklet.

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Although there is no medical advisor listed in the credits, the visual and verbal presentation is essentially accurate. The only exceptions were statements that "the ovum is receptive to the sperm for about eight hours." Hole (1981) claims it is 12-24 hours.

"Every single cell of the thousands of millions that make an individual's body is an exact duplicate of the very first cell created by its mother and father." The latter statement incorrectly implies that a mature, developed, differentiated brain, bone, blood or any cell is structurally and functionally an exact duplicate of the zygote. The statement is only true before differentiation occurs.

The booklet and video make no ideological statements in their presentation with reference to birth control, abortion, sexual morals or venereal disease. It is truly a factual and neutral presentation suitable for public schools. It could also be used by Christian Churches or schools allowing them to add their specific theological viewpoint after the presentation.

Reference

- Hole, Jr., J. W. 1981. Human anatomy and physiology, W. C. Brown, Dubuque, IA.

LETTER TO THE EDITOR

Egypt and Carbon-14 Dating

Part II of Vaninger's "Archaeology and the antiquity of ancient civilization: a conflict with Biblical chronology CRSQ 22:64-67) points out very expertly some of the problems with radiocarbon dating— problems acknowledged by many users of the method themselves. Unfortunately, certain information in the article is out of date and needs correcting. Vaninger's statement, "No C-14 tests on New Kingdom material have ever been made," (p. 65) was true as of 1962, but it no longer holds true. According to *Radiocarbon* (1965) 7:196, a piece of wood from King Tutankhamen's tomb was dated to 1030 B.C., which as an uncorrected date is more than three centuries too young. Other examples of New Kingdom radiocarbon dates are found in R. M. Derricourt (1971), "Radiocarbon chronology for Egypt and North Africa," *Journal of Near Eastern Studies* 30:281.

Three major problems exist with the C-14 dating of Egyptian materials:

- 1) CONTAMINATION BY MODERN CARBON. For example, reeds from Theban tombs, all of which were constructed during the reign of Rameses II, can have dates 1500 years too young if derived from mud bricks too close to the surface! See R. Berger and H. E. Suess, ed. (1979). *Radiocarbon dating*, pp. 601-12.
- 2) REUSE OF ANCIENT WOOD FOR FUNERARY ARTIFACTS. A papyrus deposited in the British Museum records the allegations that a piece of wood was stolen from the necropolis of Rameses II (19th Dynasty) in order to be reused in coffins dating to the late 20th dynasty. This document dating from the 20th Dynasty explains a modern discrepancy between

a C-14 date of 905-805 B.C. for a coffin board from a tomb in W. Thebes and a date some 1300 years earlier from the coffin joint of the same coffin! See J. M. Weinstein (1984) *Radiocarbon and some ancient Egyptian thievery*, *American Journal of Archeology* 88:591-92.

3) THE DESTRUCTIVENESS OF THE METHOD ITSELF TO VALUABLE ARTIFACTS. Up until recently few Egyptian objects have been available for C-14 dating because once it is applied to a given object some 10-20 grams or more of organic content is irretrievably lost to archeology just for the sake of one C-14 determination. A new method of dating, the direct counting of C-14 ions, requires a sample size some 1000 times smaller than the old method and thus is considerably less destructive to irreplaceable objects. A good description of this method in R. E. M. Hedges and J. A. J. Gowlett, 1986, "Radiocarbon dating by accelerator mass spectrometry," *Scientific American*, Jan:100-7. Some of the initial reports by the AMS method in Egypt tend to be consistent with results from the old method. For example, a calibrated age of 2450-2900 B.C. was obtained for emmer wheat taken from the tomb of King Zoser of the third Dynasty, according to R. Gillespie, *et al.* (1985) "Radiocarbon dates from the Oxford AMS System," *Archaeometry* 27:237-46. This recent analysis avoids the three major stumbling blocks to a more successful dating of rare objects from Egypt, although it still does not have the accuracy for which archeologists had wished.

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SPECIAL FEATURE

RECORDED INSTANCES OF WRONG-ORDER FORMATIONS: A BIBLIOGRAPHY— PART VI

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References

1. Deiss, C. F. 1941. Structure of central part of Sawtooth Range, Montana. *Bulletin of the Geological Society of America* 52:1896-97.
2. Fix, P. F. 1940. Structure of Gallatin Valley, Montana. *Colorado University Studies* 26(3):42-44.
3. Longwell, C. R. 1940. Belt of thrusting restudied: Muddy Mountain, Nevada. *Bulletin of the Geological Society of America* 52:1920-21.
4. Merriam, C. W. and C. A. Anderson. 1941. Low angle thrusting in the Roberts Mountains, Nevada. *Bulletin of the Geological Society of America* 52:1953.
5. Johnson, H. 1941. Paleozoic lowlands of northwestern Newfoundland. *Transactions of the New York Academy of Sciences* 3:141-45.
6. Stark, J. T. 1941. Structure of the Los Pinos Mountains, New Mexico. *Bulletin of the Geological Society of America* 52:1936.
7. Kay, G. M. 1940. Taconic disturbances and associated events. *Bulletin of the Geological Society of America* 51:1932.
8. Hendricks, T. A. 1941. Structure of the western part of the Onachira Mountains, Oklahoma-Arkansas. *Tulsa Geologic Society Digest* 9:45-46.
9. Stase, G. W. and A. I. J. Stase. 1940. Further evidence Reading Overthrust, Pennsylvania. *Bulletin of the Geological Society of America* 51:2007-08.
10. Smith, Jr., J. F. 1941. Geology of the Eagle Spring area, Eagle Mountain, Hudspeth County, Texas. *Field and Laboratory* 9:70-79.
11. Wilson, C. C. 1940. Los Bajos Fault of South Trinidad, B. W. I. *Bulletin of the American Association of Petroleum Geologists* 24:2102-25.
12. Hawkes, Jr., H. E. 1941. Roots of the taconic fault in west-central Vermont. *Bulletin of the Geological Society of America* 52:649-66.
13. Cooper, B. N. and J. C. Hoff. 1940. Max Meadows Fault, Breccia, Virginia. *Journal of Geology* 48:945-74.
14. Edmundson, R. S. 1941. Structure of a part of Walker Mountain, Virginia. *Bulletin of the Geological Society of America* 52:1899.
15. Beckwith, R. H. 1941. Structure of the Elk Mountain District, Carbon County, Wyoming. *Bulletin of the Geological Society of America* 52:1445-86.
16. Demarest, M. H. 1941. Critical structural features of the Big Horn Mountains, Wyoming. *Bulletin of the Geological Society of America* 52:161-76.
17. Love, J. D. 1940. The fault at the small end of the Big Horn Mountains, Wyoming. *Bulletin of the Geological Society of America* 51:1934.
18. Woodbury, H. O. 1942. The structure of the Boulder Arch, Colorado. *Colorado University Bulletin* 32(17):78.
19. Tollefson, O. W. 1942. The structure of the foothills from Gregory Canyon to the southern Boulder City Line, Colorado. *Colorado University Bulletin* 42(17):70.
20. Nolan, T. B. 1943. The Basin and Range Province in Utah, Nevada, and California. United States Geological Survey Professional Paper 197-D. United States Government Printing Office, Washington, D.C., pp. 141-96.
21. Stase, G. W. 1942. Structural interpretation of the Death Valley Region by Levi Noble. *Journal of the Washington, D.C., Academy of Sciences* 32:279.
22. Stevens, J. B. 1943. McKittrick Area of the McKittrick Oil Field, California. California Department of Natural Resources, Division of Mines Bulletin 118. pp. 510-11.
23. Thorn, W. T. 1942. The major deformational patterns and characteristics of the Earth's crust and their mechanics of origin. *Transactions of the American Geophysical Union*, Twenty-Third Annual Meeting, Part 2:708-10.
24. Ludlum, J. C. 1943. Structure and Stratigraphy of part of the Bannock Range, Idaho. *Bulletin of the Geological Society of America* 54:1973-86.
25. Beckwith, R. H. 1942. Structure of the Upper Laramie River Valley, Colorado-Wyoming. *Bulletin of the Geological Society of America* 52:1491-1532.
26. Giles, A. W. 1942. Structure of the Little North Mountain of the north central Appalachians. *Journal of Geology* 50:916-80.
27. Parsons, W. H. 1942. Origins and structure of Livingston igneous rocks, Montana. *Bulletin of the Geological Society of America* 53:1175-85.

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