
THE LEGEND OF THE SHRINKING SUN

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IN JUNE 1979 A PAPER ENTITLED "SECULAR DECREASE in the Solar Diameter, 1836-1953" was presented at a meeting of the American Astronomical Society.¹ In this report John Eddy, a respected solar astronomer, and his colleague Aram Boornazian presented an analysis of solar meridian transit records from the Royal Greenwich Observatory—records from which they computed the time required for the sun to cross the celestial meridian at noon. Their analysis of this data suggested that during the specified time period the sun's angular diameter had been contracting at a rate of more than two arc seconds per century, equivalent to a linear shrinkage rate of five feet per hour.

Figure 1 shows how the Greenwich data encourage such a conclusion. Furthermore, the case for solar shrinkage over an extended time

period appeared to be strengthened by an appeal to a 1567 report of a solar eclipse which suggested that the eclipse was annular rather than total.² If the sun had been the same size then as now, a total eclipse should have been observed.

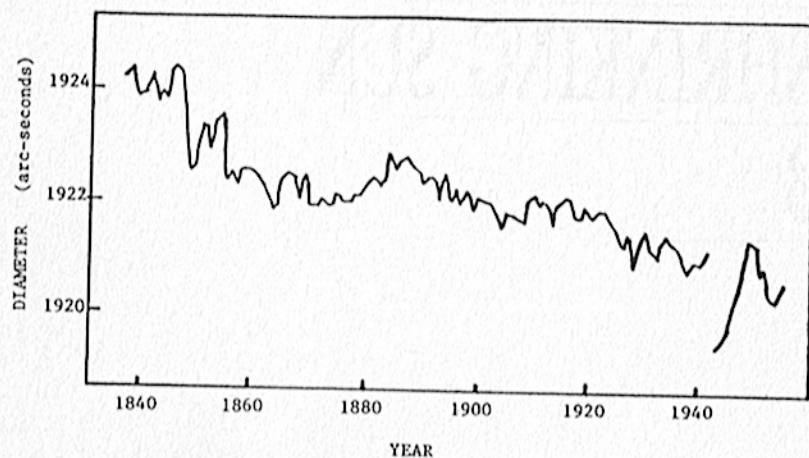


Figure 1. The horizontal (east-west) diameter of the sun from 1836 to 1953 as determined by Eddy and Boornazian from the Royal Greenwich Observatory data. (This figure is adapted from the diagram published in *Physics Today*, ref. 2.)

Eddy and Boornazian's report generated considerable interest because it presented the astronomical community with a puzzle: If the sun has behaved in the manner suggested by that report, then the sun has been far more variable than paleoclimatic evidence and conventional solar models have led us to believe. The combination of extended duration and high rate of variation in the sun's diameter was especially puzzling.

Rapid changes of short duration can be understood in terms of numerous transient and oscillatory phenomena. Relatively slow change, either contraction or expansion, extending over a period of hundreds or even thousands of years could also be the consequence

of oscillatory or temporary changes in the behavior of the solar interior.³ But a truly secular shrinkage—that is, a steady decrease in size over an indefinitely long period of time—would be at odds with contemporary models of solar behavior and inconsistent with geological evidence.

Prior to the discovery of the process of thermonuclear fusion, gradual gravitational contraction (commonly called "Helmholtz contraction") appeared to be the most likely candidate for the energy generating process in stars, including the sun. Since the 1930s, however, astrophysicists have become convinced that the thermonuclear-fusion process is responsible for maintaining stellar luminosity. According to contemporary stellar models, the physical conditions that prevail within the core of a star make the fusion process inevitable. As a consequence of changes brought about by thermonuclear fusion, a slow secular increase in stellar size is predicted—far too slow to observe with present instrumentation, but a secular *increase* nonetheless.

In the context of this prediction, Eddy and Boornazian's suggestion of a rapid secular *decrease* in solar diameter was especially intriguing. Even the *rate* of decrease was difficult to understand. Because a shrinkage rate of five feet per hour is hundreds of times greater than Helmholtz contraction could sustain, Eddy proposed that only the outermost, low-density portion of the sun was involved in contraction. In this way the rate of gravitational energy conversion into heat could still be lower than the sun's luminosity value. Even with this interpretation, however, Eddy and Boornazian's report was provocative, and it stimulated a heightened interest in both the rate and duration of variations in the sun's size.

The rate of solar shrinkage suggested by Eddy and Boornazian was disputed from the outset. In the same month that Eddy and Boornazian's preliminary report was presented, S. Sofia, J. O'Keefe, J. R. Lesh and A. S. Endal published an article in *Science* that expressed the judgment that, on the basis of available data (mostly from meridian transit observations), the sun's angular diameter did not diminish by

more than 0.5 arc second between 1850 and 1937.⁴ This value was less than one-fourth the rate proposed by Eddy and Boornazian.

In addition to the timing of solar meridian transits, other observations can be employed to determine the sun's diameter. In 1980 Irwin Shapiro published his analysis of the transits of Mercury in front of the sun from 1736 to 1973.⁵ Shapiro concluded that no significant change in the sun's diameter could be detected and that the maximum shrinkage rate allowed by the data was 0.3 arc second per century, about one-seventh of the Eddy and Boornazian value. Figure 2 illustrates how the Mercury transit data contradict the Eddy and Boornazian proposal. Similarly, D. W. Dunham and others analyzed solar eclipse data and concluded that between 1715 and 1979 the sun's diameter may have decreased, but only by 0.7 arc second, equivalent to a rate of about 0.25 arc second per century.⁶

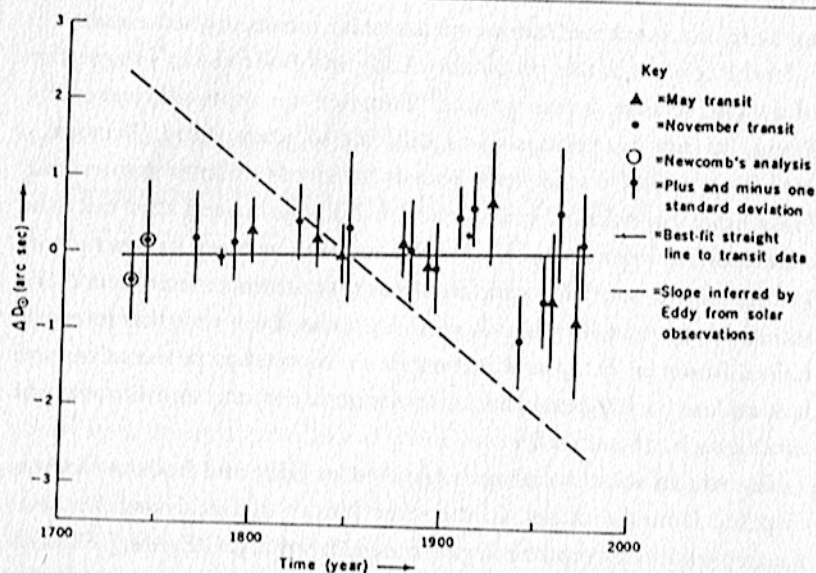


Figure 2. The diameter of the sun from 1723 to 1973 as computed by Irwin Shapiro from Mercury transit data. The dashed line represents the Eddy and Boornazian rapid shrinkage rate. (Diagram taken from ref. 5.)

The discrepancy between these results and the report by Eddy and Boornazian called for a second look at the solar meridian transit data. John H. Parkinson, Leslie V. Morrison and F. Richard Stephenson performed such a re-evaluation and concluded that the trends in the Greenwich data reported by Eddy and Boornazian "are the result of instrumental and observational defects rather than real changes."⁷ In their judgment, based on the combined data sets of the Mercury transit and total solar eclipse observations, no secular change over the past 250 years was detectable, but a cyclic change with an 80-year periodicity was indicated. In an extensive article published in the *Astrophysical Journal*, R. L. Gilliland confirmed the presence of a 76-year periodic variation in the sun's diameter, but suggested that the data do allow for a very slow, long-term shrinkage at the rate of 0.1 arc second per century during the past 265 years.⁸

During the past few years, additional papers have been published which reinforce the conclusion that secular changes in solar diameter cannot be confirmed by available data, but numerous oscillatory phenomena have been verified. Parkinson, for example, in a 1983 paper, states that solar eclipse and Mercury transit measurements "confirm that there is no evidence for any secular changes in the solar diameter, with a reduced upper limit. However, there is increased support for an (approximately) 80-year cyclic variation."⁹ And according to Sofia and others, "Solar radius changes are not secular (monotonic and uniform)."¹⁰

In 1984, Claus Frohlich and John Eddy reported the results of recent measurements of solar diameter.¹¹ Particularly relevant is their finding that, during the period from 1967-80, the sun exhibited an *increase* in diameter at the mean rate of 0.03 arc second per year, equivalent to a linear rate of eight feet per hour. Since 1980 the solar diameter has remained nearly constant, with a weak suggestion of decreasing. This behavior is remarkably consistent with the 76-year periodic behavior found by Parkinson and Gilliland, for which a broad maximum would be expected in the mid-1980s.

Where did Eddy and Boornazian go wrong? It appears that the Greenwich data contain some systematic errors which limit their reliability. As noted by Parkinson and others (see ref. 7) there were significant changes in both the method and the instrumentation employed in obtaining the Greenwich data. A number of discontinuities in the data can be correlated with these changes. Such phenomena, along with significant variations in both the skill of observers and the quality of observing conditions, place severe limitations on the reliability of some of the Greenwich data and on the credibility of the Eddy and Boornazian proposal concerning rapid solar shrinkage. The data on which Eddy and Boornazian based their conclusions are plagued with subtle flaws.

Reflections on the Professional Approach

This brief sketch of approximately six years of investigation regarding solar-size variations has concentrated on observational matters; we have not dealt extensively with theories concerning the physical processes which might generate these variations. Furthermore, we have been most concerned with secular (that is, long-term) variations, and have chosen not to discuss a number of short-term oscillations and fluctuations. In spite of these limitations, however, what we have considered here does provide us with an illustrative case study of the way in which professional natural science is performed. Let us highlight some of the characteristic features of this episode.

The question of solar-size variations is interesting mostly for its relevance to other phenomena. The temporal development of the sun's radius is an integral part of any theoretical model for solar behavior. Episodes of gravitational contraction, for instance, might be relevant to the resolution of the neutrino puzzle (to be discussed later in this chapter). And scientists who are interested in the history of the terrestrial climate are concerned to investigate the relationship of variations in solar radius to variations in the rate at which earth receives solar energy.

Eddy and Boornazian chose to look for variations in solar diameter by investigating historical records of solar meridian transits (that is, the rate at which the sun crosses a meridian). Their preliminary results suggested a long-term contraction at a surprisingly high rate. Though they did not consider their results ready for formal publication Eddy and Boornazian decided to present their puzzle in a brief talk at a meeting of the American Astronomical Society. In this way the professional scientific community could join them in a critical evaluation of the data and their interpretation.

The response of the scientific community was precisely as one should expect. Various investigators began to consider other relevant phenomena which might shed light on the puzzle. Data from solar eclipse observations and transits of Mercury, for example, were employed to generate independent computations of variations in solar diameter. The reliability of the meridian transit data was carefully scrutinized. And the results of these several investigations were published for further community evaluation.

By now the puzzle has largely been solved. The possibility of long-term, rapid shrinkage is *not* supported by the data. On the question of secular contraction or expansion at a very slow rate, the data are inconclusive. The limited precision of the data and the limited duration of the historical record preclude the employment of these data as the basis for any conjecture concerning the sun's size before about 1700. Any extrapolation of transit or eclipse data beyond three or four centuries is entirely unwarranted. Geological evidence for terrestrial climate variation provides a far more reliable indicator of solar dimensions prior to 1700.

All of the variation in solar diameter that is revealed by the transit and eclipse data can be identified with oscillatory and transient effects. The 80-year oscillation confirmed by this data had been anticipated on the basis of clues drawn from sunspot cycles. Although the investigations discussed in this chapter have not resolved the neutrino puzzle, neither do they offer any substantial encouragement for

doubting that thermonuclear fusion is responsible for energy production in the sun. In fact, paleoclimatic evidence clearly discourages such a conjecture. And because of the strong influence of solar history on terrestrial history, conjectures concerning the history of solar behavior should never be made in isolation from a consideration of the physical record of terrestrial history.

From Puzzle to Proof: The Creation of a Legend

The puzzling report that there was evidence to suggest a rapid shrinkage of the sun over several centuries was quickly adapted by the creation-science community for use as a "scientific evidence," or "proof," for a very young earth. Without the extended duration of cosmic history, the concept of cosmic evolution would appear to be untenable. And, according to the proponents of creation-science, if evolution over a multibillion-year period did not take place, then creation (restricted to acts of inception) must have occurred during a very busy week about 10,000 years ago. Let us explore how the shrinking sun report has been employed as evidence in support of the young-earth hypothesis.

The basic framework was set in place by Russell Akridge. The Institute for Creation Research publishes a monthly series of brief, popular-level "vital articles on science/creation" under the heading of *Impact*. The April 1980 issue, entitled "The Sun Is Shrinking," was written by Akridge, a physicist at Oral Roberts University. Two elements characterize his approach: (1) an unquestioning acceptance of the solar shrinkage rate proposed by Eddy and Boornazian in 1979; and (2) an unrestrained extrapolation of that behavior into the indefinite past. Employing this approach, Akridge calculated that 100,000 years ago the sun would have been twice its present size, and that 20 million years ago it would have been as large as the earth's orbit, thereby precluding a multibillion-year duration for cosmic history and discrediting all concepts of evolution.

According to Akridge, not only did the shrinking sun phenomenon

cast doubt on the standard chronology for terrestrial history, but it also had the potential for destroying the credibility of conventional astrophysical models for stellar behavior, ultimately dismantling the very concept of stellar evolution. By assuming that gravitational contraction had been amply demonstrated, Akridge concluded that the identification of thermonuclear fusion as the solar energy source was seriously threatened. In his words:

The discovery that the sun is shrinking may prove to be the downfall of the accepted theory of solar evolution. . . . The entire theoretical description of the evolution of the universe may be at stake. . . . The changes detected in the sun call into question the accepted thermonuclear fusion energy source for the sun. This, in turn, questions the entire theoretical structure upon which the evolutionary theory of astrophysics is built.¹²

These were bold claims, asserting the imminent collapse of a major portion of the contemporary paradigm of astrophysics. The credibility of a scientific claim, however, is established not by its boldness, but by its adequacy to account for physical phenomena in an accurate, coherent and fruitful manner. How well did Akridge's claims hold up under the ordinary tests for scientific adequacy?

In order to support his assertions, Akridge needed to establish at least these two points: (1) that solar contraction over a period of a century or more was convincingly demonstrated by the empirical evidence; (2) that a contraction in the sun's diameter, if observed during a period of a few centuries, may be extrapolated indefinitely into the past. On the first point, Akridge was already on shaky ground. Recall that the 1979 paper published by Sofia and others placed a much lower limit on the rate of any possible shrinkage. Furthermore, the results of investigation concerning related phenomena, such as Mercury transits or solar eclipse observations, had not yet been published. Thus to speak of the Eddy and Boornazian result (published only as an abstract) as if it had convincingly established the occurrence of long-term solar shrinkage constituted a failure to exercise appropriate

restraint in employing the results of a single investigation.

Though it may not have been apparent to his untrained readers, Akridge's uncritical acceptance of a single report—a report greeted with skepticism by the relevant professional community, a preliminary report not yet tested by comparison with other relevant studies—represented a serious failure to perform with integrity the critical evaluation expected of professional scientists.

The second failure is considerably more obvious. Not only did Akridge unquestioningly accept the Eddy and Boornazian preliminary result as if it had firmly established solar shrinkage, he extrapolated that behavior indefinitely into the remote past. Assuming, without sufficient warrant, a constant shrinkage rate, Akridge led the reader to believe that, had the sun existed 20 million years ago, it would necessarily have been as large as the earth's orbit. In performing such an extended extrapolation, Akridge chose to ignore the possibility of numerous transient and oscillatory phenomena with characteristic time periods as long as thousands of years.

As we indicated earlier in this discussion, any extrapolation of solar diameter variations beyond a few centuries would be entirely unwarranted, thereby representing unacceptable scientific practice. To base, as did Akridge, a bold and substantial claim on such an unwarranted extrapolation represents a serious failure to follow the fundamental principles for competent scientific investigation. And not only did Akridge presume the validity of this extrapolation, he even argued that to assume a constant shrinkage rate over extended time periods was a *conservative* assumption.

In spite of these and other shortcomings, however, the shrinking sun report, presented in the manner established by Akridge, continues to be employed as a "scientific evidence" for a young earth. In a 1982 article in *Christianity Today*, Thomas Barnes, then Dean of the Graduate School at the Institute for Creation Research, presented a list of six "evidences" for a recent creation.¹³ Barnes concluded his list with an appeal to the shrinking sun report.

Though this was written three years after the Eddy and Boornazian report, Barnes gave no evidence of having taken into account the several professional publications which had cast serious doubt on the reality of secular solar shrinkage. Instead, Barnes simply repeated the Akridge analysis. In a handbook written to accompany the *ORIGINS* film series, distributed by Films For Christ, we also find the shrinking sun cited as evidence for a young earth.¹⁴ The brief discussion follows the Akridge approach very closely; it even borrows from the *Impact* article a diagram which shows the earth skimming the surface of a bloated sun, presumably 20 million years ago.

Having lost contact with the results of continuing investigation and evaluation by the professional scientific community, the employment of the shrinking sun as an "evidence" for recent creation ceased to be authentically scientific. Instead, it took on the status of a legendary tale, recited to provide its hearers with the comforting reassurance that their recent-creation scenario was supported by empirical evidence.

Functioning to provide young-earth advocates with reassurance for their particular picture of God's creative activity, lists of "scientific evidences" serve as specimens of a creationist folk science.¹⁵ One of the most lengthy of these lists can be found in the June, July and August 1984 issues of the *Bible-Science Newsletter*. Under the heading of "The Scientific Case for Creation," we find a list of 116 categories of evidence prepared by Dr. Walter T. Brown, Jr., a mechanical engineer. Number 85 on this list is the shrinking sun phenomenon. Brown's analysis is essentially the same as Akridge's. He treated secular contraction as if convincingly established and extrapolated that behavior indefinitely, on which basis he concluded that "had the sun existed a million years ago, it would have been so large that it would have heated the earth so much that life could not have survived."¹⁶

Henry Morris, President of the Institute for Creation Research, did no better than Akridge, Barnes or Brown. In his 1984 treatise on *The Biblical Basis for Modern Science*, Morris presented his vision of biblical

insights into a broad spectrum of natural sciences. In a brief discussion on solar energy generation, Morris sought to argue that gravitational collapse, not thermonuclear fusion, is responsible for solar luminosity. The shrinking sun report was employed to bolster that argument:

As a matter of fact, careful measurements in recent years have supported the collapse theory by showing that the sun's diameter does, indeed, appear to be shrinking. But this in turn would mean that the sun could not possibly be billions of years old!¹⁷

This statement, made five years after Eddy and Boornazian's preliminary report, demonstrated no attempt to incorporate the results of the numerous, relevant investigations performed and reported during that five-year interval. Instead, Henry Morris, clearly the most influential person in the creation-science movement, propagated the same misrepresentation of solar behavior initiated by Akridge's 1980 *Impact* article.

The Shrinking Sun in the *Creation Research Society Quarterly*

Thus far the creation-science literature cited has been popular-level material intended for a general audience. Is it possible that the more technical literature of the recent-creationist community has done a better job of displaying a respect for the professional standards of the scientific community? As a general rule it has not, though there are exceptions.

For example, we should expect the *Creation Research Society Quarterly* to demonstrate a higher level of methodological competence and professional integrity. How have they handled the shrinking sun report? In a series of two articles, published in June and December of 1980, Hilton Hinderliter presented his analysis of this phenomenon.¹⁸ Although these articles are anecdotal in style, very different from professional journal literature, we will assume that they were intended to be read as authentic specimens of creation-science, that is, informative analytical reports written by scientifically trained persons. (Dr.

Hinderliter is an assistant professor of physics at the New Kensington campus of Pennsylvania State University.) The scientific adequacy of the analysis, however, differs little from the popular material reviewed above.

Like Akridge, Hinderliter uncritically accepted the rapid shrinkage rate first reported by Eddy and Boornazian; he even praised the reliability of the historical data used by Eddy and the thoroughness of his data analysis. On the other hand, the judgment expressed by Eddy and many others¹⁹ that the suspected variation was most likely a cyclic phenomenon was summarily dismissed as no more than the product of an unwarranted belief in what Hinderliter called the "billion year myth."

We find in this discussion no evidence of any careful evaluation of the merits of several suggested mechanisms that could introduce periodic variations in solar size.²⁰ Instead, the suggestion of periodic behavior was rejected as merely a product of an evolutionistic bias. Similarly, Hinderliter's ready acceptance of the conclusion drawn from one analysis of meridian transit data alone failed to recognize the relevance of data drawn from other phenomena, such as solar eclipse records, Mercury transit observations and the paleoclimatic record. None of these data were critically evaluated by Hinderliter; they were simply ignored or rejected as unworthy of consideration.

In his discussion of gravitational contraction as a possible source of solar energy, Hinderliter claimed that this mechanism had been rejected by the scientific community "solely on the basis of a supposed age of the earth in billions of years."²¹ Furthermore, "the compelling force for the acceptance of vast ages was merely a faith in evolutionism, which itself has no evidential leg to stand on."²² In summary, "evolutionism demanded a vast age for the sun, which in turn caused gravitational contraction to be ruled out as a major source of the sun's energy."²³

A careful review of the relevant history, however, yields a significantly different conclusion. Because both geological and radiometric

evidence indicated a terrestrial age of billions of years, the gravitational collapse lifetime for the sun—a few tens of millions of years—presented a real puzzle. When the process of thermonuclear fusion first became known, it was indeed greeted as a candidate for solar energy generation. But the transformation from candidate to accepted phenomenon could take place only with the development of a model for the sun which complied with all of the known patterns for material behavior and which would make fusion inevitable. Such has been the case.²⁴

Nonetheless, by assuming that the meridian transit data had convincingly established a secular gravitational contraction of the sun and appealing to the surprisingly low solar neutrino flux as supporting evidence, Hinderliter concluded that the thermonuclear fusion model for solar energy production had been thoroughly discredited. In a manner very much like that of Russell Akridge, Hinderliter asserted that from his analysis of the shrinking sun report, "It is clear that we have witnessed a major scientific defeat for evolutionism."²⁵

Although the papers by Hinderliter may fail to display the appropriate level of critical evaluation of the relevant phenomena, data and theoretical models, another paper, "The Sun's Luminosity and Age," written by James Hanson, suffers from even greater shortcomings. Hanson strongly favored a shrinking sun, such as reported by Eddy and Boornazian. The first reason cited by Hanson for this opinion was that "it is anti-evolutionary and compatible with the creationist view of a recently created, not evolved, sun."²⁶ He cited papers by Shapiro, Sofia and others,²⁷ but failed to deal substantively with their content. Their objections to Eddy and Boornazian's conclusions were categorically dismissed as the product of evolutionistic bias.

But the most bewildering component of Hanson's paper is his proposal of an "incandescence theory" for solar luminosity. He proposed that the sun was created 6000 years ago with a *uniform* temperature, and that it has been *uniformly* cooling off since that time. Solar luminosity, according to Hanson's model, derives simply from the thermal

energy stored in the recently created sun. After performing some calculations which purport to show that the decrease in solar temperature during the past 6000 years would be acceptably small, Hanson says:

Note that by this analysis we may infer that if the sun or a star were created isothermal it would stay nearly that way, which is, also, in direct contradiction to evolutionary astrophysics.²⁸

Within the statement just quoted, we encounter at least three serious problems with Hanson's approach. First, the idea that the sun would, if created isothermal, remain isothermal cannot be *inferred* from Hanson's model; rather, it is no more than the unwarranted *assumption* on which the model is built.

Second, Hanson offered no demonstration that an isothermal solar model which complies with all relevant physical laws (concerning gravity, hydrostatic equilibrium, equation of state, etc.) can be constructed. In fact, the necessity of such a demonstration was not even recognized.

Third, and especially devastating, Hanson's incandescence model with its isothermal sun is in contradiction not only to "evolutionary astrophysics," it also stands in contradiction to a basic thermodynamic principle taught in most first-year general physics courses! Heat does not flow through an ordinary medium unless there is a temperature gradient. Hanson's isothermal sun would demand an infinite thermal conductivity (or some other means of unimpeded heat transfer) in order to remain at a uniform temperature while radiating energy from its surface. Contemporary models for the solar interior, on the other hand, indicate that a central temperature of greater than 10,000,000 degrees Kelvin is required to maintain an adequate heat flow from the core to the solar surface. The incandescence model proposed in Hanson's paper is wholly unrealistic.

Elsewhere in the paper, Hanson expressed a certain fondness for reviving theories from the past. In his closing statements Hanson favorably associated his incandescence model with pre-Copernican

astronomy with these words:

The incandescence theory would probably have been the explanation in pre-Copernican times. This is another example of the frequent superiority of pre-Copernican astronomy over the present Copernican-evolutionary views.²⁹

An article of considerably higher quality, "Solar Neutrinos and a Young Sun," by Paul Steidl, can be found in the June 1980 issue of the *Quarterly*. Compared with the material written by Akridge, Hinderliter or Hanson, Steidl's paper demonstrated a far greater knowledge of astrophysics and a creditable awareness of relevant data and phenomena. The chief topic of the paper is the solar neutrino puzzle. Contemporary solar models predict the types and rates of thermonuclear fusion reactions that would occur in the sun, provided that our understanding of the relevant physical conditions and processes is adequate. During the past several years, measurements have been performed to determine the rate at which neutrinos, a byproduct of these fusion reactions, are being received on earth. The puzzling result is that the measured rate is only one-third of the expected rate.

Steidl's solution to this puzzle was to propose that no fusion whatsoever is occurring in the sun and that solar luminosity is derived solely from gravitational contraction, thereby discrediting any multi-billion-year chronology for solar system history. In Steidl's words, "Thus the near absence of solar neutrinos alone is enough to indicate that the sun is considerably younger than usually assumed. . . . The sun is surely younger than its accepted (uniformitarian) age."³⁰

In our judgment, however, Steidl paid far too little attention to a vast array of empirical and theoretical considerations which have led the professional scientific community to the well-founded *conclusion* (not assumption) that the solar system formed about 4.6 billion years ago. We suspect that it was Steidl's commitment to a recent-creation scenario, rather than a critical evaluation of the data, which played the decisive role in leading him to his conclusion. Yet Steidl himself accused the entire professional scientific community of a bias in favor

of an ancient, evolved sun. "It [fusion] has become accepted dogma simply because it is the only conceivable process which could provide energy for the billions of years which stars are believed to have existed."³¹

Steidl offered a brief discussion of the solar shrinkage phenomenon as reported by Eddy and Boornazian. For Steidl this report was taken as confirmation that fusion is not occurring in the sun and that solar luminosity is powered by Helmholtz contraction. Regarding Eddy and Boornazian's own judgment that the solar shrinkage they reported was part of a cyclic phenomenon, Steidl said, "Of course they do not allow the possibility that it has been going on for more than a few hundred years, since this would totally dethrone stellar evolution."³² By suppressing arguments based on the coherence of numerous empirical and theoretical considerations which have led scientists to their conclusions concerning an old and fusion-powered sun, claiming instead that these concepts are based *solely* on some form of evolutionistic bias, Steidl joined in the approach followed by Akridge, Hinderliter and Hanson.

But our review of Steidl's work can end on a much more positive note. In a brief letter published in the March 1982 *Quarterly*, Steidl alerted his readers to two significant developments.³³ First, the possibility of a nonzero rest mass for the neutrino would reduce the expected neutrino detection rate by a factor of three, consonant with the observed value. Steidl aptly concluded: "Perhaps the sun is burning hydrogen after all"—that is, converting hydrogen into helium through thermonuclear fusion. Second, Steidl called attention to several recently published papers which contest the reality of secular solar shrinkage. In advising his readers to suspend judgment on his earlier conclusions, Steidl displayed the kind of professional integrity that is expected within the scientific community.

Paul Steidl is to be commended for his attempt to alert the readers of the *Quarterly* to the fact that the credibility of earlier reports regarding solar contraction had been greatly diminished by further inves-

tigation. Unfortunately, his warnings went unheeded. Long after Steidl's letter appeared in the *Quarterly*, and long after the professional journals had published extensive papers discrediting the initial claim, references to the shrinking sun as a "scientific evidence" for a young earth continued to appear in the creationist literature. The *Impact* article by Akridge, in spite of its grievous shortcomings, had far more influence than Steidl's more critical appraisal.

Reflections on the Scientific-Creationist Approach

As this case study has illustrated, what began as a puzzling report within the professional scientific community was transformed by the scientific-creationist community into a "scientific evidence" purporting to substantiate their recent-creation scenario. But this transformation from scientific puzzle to recent-creation evidence carried, we believe, too high a price tag.

In order to make the shrinking sun concept function as a young-earth evidence, numerous principles of good scientific practice had to be breached: one preliminary report—a report soon discredited—had to be granted far greater weight than several substantial reports subsequently published; the principles of meaningful extrapolation had to be violated; and the relevance of several important phenomena and much readily accessible data had to be disregarded. The shrinking sun report, as it propagated through the recent-creationist literature, lost contact with the critical evaluation and continuing investigation performed with competence and integrity by the community of professional scientists. And, having lost this vital connection, the solar shrinkage report became the "legend of the shrinking sun"—the vehicle of misinformation and unwarranted conclusions.

Postscript

The substance of this chapter was published as an article in the September 1986 issue of the *Journal of the American Scientific Affiliation*.³⁴ In the March 1987 issue of the *Creation Research Society Quarterly*,

Thomas G. Barnes published a rebuttal to this material.³⁵ In the rebuttal Barnes clings to the idea of solar shrinkage for the duration of the sun's history. Our references to published criticisms of Eddy and Boornazian's 1979 report were characterized by Barnes as "nit-picking" and as providing "nothing of quantitative value." Eddy's 1984 report of the recent *increase* in solar diameter was ignored entirely. And, very interestingly, our criticism of the unrestrained (and therefore meaningless) extrapolation employed in the creation-science literature to reach a recent-creation conclusion was uncontested, in fact, not even acknowledged. Barnes's conclusion: "*The case for a shrinking sun still holds.*"

Van Till, *The Fourth Day: What the Bible and the Heavens Are Telling Us about the Creation* (Grand Rapids: Eerdmans, 1986), especially chapters six and ten.

Chapter 2: The Path Most Traveled

¹See, for example, the following: Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2d ed. (Chicago: University of Chicago Press, 1970), and *The Essential Tension* (Chicago: University of Chicago Press, 1977), especially chapter thirteen, "Objectivity, Value Judgment, and Theory Choice," pp. 320-39; Larry Laudan, *Science and Values* (Berkeley: University of California Press, 1984); Ernan McMullin, "Values in Science," *PSA 1982* [Proceedings of the 1982 biennial meeting of the Philosophy of Science Association] (E. Lansing, Mich.: Philosophy of Science Association, 1983), Vol. 2; and Jerome R. Ravetz, *Scientific Knowledge and Its Social Problems* (New York: Oxford University Press, 1971).

²Our thanks to Professor Robert E. Snow for suggesting this set of four categories.

³Ernan McMullin, "Values in Science," pp. 1-25. For other discussions of scientific-theory evaluation, see W. H. Newton-Smith, *The Rationality of Science* (Boston: Routledge and Kegan Paul, 1981), pp. 226-32; Thomas S. Kuhn, *The Essential Tension* (Chicago: University of Chicago Press, 1977), pp. 320-39; and Del Ratzsch, *Philosophy of Science: The Natural Sciences in Christian Perspective* (Downers Grove, Ill.: InterVarsity Press, 1986), pp. 75-96.

⁴See Paul Davies, *Superforce* (New York: Simon and Schuster, 1984).

⁵We are using the term *folk science* in a manner similar to that of Jerome R. Ravetz in *Scientific Knowledge and Its Social Problems* (New York: Oxford University Press, 1971), especially pp. 386-97. Ravetz defines *folk science* as that "part of a general world-view, or ideology, which is given special articulation so that it may provide comfort and reassurance in the face of the crucial uncertainties of the world of experience" (p. 386).

⁶For a brief typology of positions on this question, see Ratzsch, *Philosophy of Science*, pp. 141-48.

Chapter 3: The Legend of the Shrinking Sun

J. A. Eddy and A. A. Boornazian, "Secular Decrease in the Solar Diameter, 1836-1953," *Bulletin of the American Astronomical Society* 11 (1979):437. Note: this is only an abstract. The full text was never published.

⁷G. B. Lubkin, "Analyses of Historical Data Suggest Sun Is Shrinking," *Physics Today* 32, No. 9 (1979):17. The reference to the 1567 solar eclipse does not appear in the abstract (ref. 1), but can be found in this news report regarding Eddy and Boornazian's presentation.

⁸See the comments by Martin Schwarzschild reported in ref. 2. For an extensive review article which discusses these matters, see Gordon Newkirk, Jr., "Variations in Solar Luminosity," *Annual Review of Astronomy and Astrophysics*, 21 (1983):429-67.

⁹S. Sofia, J. O'Keefe, J. R. Lesh, and A. S. Endal, "Solar Constant: Constraints on Possible Variations Derived from Solar Diameter Measurements," *Science* 204 (1979):1306.

¹⁰Irwin I. Shapiro, "Is the Sun Shrinking?" *Science* 208 (1980):51.

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²⁰In order to give due recognition to an important symmetry, we should note that just as scientific creationism functions as the folk science of contemporary Christian fundamentalism, so also naturalistic evolutionism functions as the folk science of modern Western naturalism. In each case, selected results of scientific investigation are interpreted in such a way that they may be employed to bolster a creedal tenet of a world view or ideology.

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