"The Urantia Atmosphere"

A Science-Related Source Study

by Matthew Block

THE URANTIA BOOK asserts that revelation proves itself by its spiritual power and philosophic excellence, by the masterful way it "synthesizes the apparently divergent sciences of nature and the theology of religion into a consistent and logical universe philosophy . . . thus creating a harmony of mind and satisfaction of spirit" in the God-knowing people who grasp it (101:2.1). Nevertheless, its science content is one of the few areas in which the book's revelatory claims have any chance of being objectively tested and verified. In "The Limitations of Revelation" (101:4), the writer dampens hopes for spectacular proofs by stating that the UB's cosmology is "limited by our [the revelators'] permission for the co-ordinating and sorting of present-day knowledge." But three paragraphs later, in an apparent reversal, he points to revelatory cosmology's more momentous benefits: "[t]he co-ordination of known or *about-to-be-known* facts and observations [italics added]" and "[t]he supplying of information which will fill in vital missing gaps in otherwise earned knowledge." Seizing on these latter claims, many readers have hoped that these about-to-be-known facts, once identified

and confirmed, would strongly boost the UB's credibility and elevate its stature in the world.

Considering the stakes—as well as the advisability of being as informed as possible about what one believes—it would have been helpful if early Urantians had commissioned astronomers, geologists, physicists, biologists and other science professionals to examine and report on the Urantia Book's science content item by item. A team of scientists could have gone far in tracing the book's reference points, identifying its original material, and pinpointing possible errors and prophecies. But, as far as I know, no such stocktaking was done, and a systematic critical reading and reporting of the book's science has been slow in coming.

This essay introduces a new method of examining the Urantia Book's science in the light of its recently discovered source texts. Since sources were used heavily in composing many of the book's science sections, this method opens the way to a more insightful grasp of the book's entire science content. Before proceeding with its demonstration, I wish to briefly review the history of Urantia Book science study before the method became possible.

THE FIRST RECORDED look at the book's science appears in Dr. William S. Sadler's January 1959 essay, "Consideration of Some Criticisms of the Urantia Book."[1] (This essay was one of several pieces of literature routinely sent out by the Urantia headquarters to inquiring readers.) Here Sadler responds to eighteen criticisms made by three or four unnamed ministers, two of whom, he writes cryptically, "belong to that high echelon of theology that might be comparable to the professors in our theological seminaries." Criticism no. 14 is from a minister who wrote: "I asked a friend of mine, a professor of physics in a near-by university, for an opinion on the scientific aspects of the Urantia Book. After going over the book, he said: 'As regards science, this book is dated. It presents a very good picture of the way we looked at the cosmos ten years ago.'" Sadler replies to this sweeping critique with equal generality: "On the whole, I think this is a valid criticism of the Urantia Book." He then quotes the first two paragraphs of "The Limitations of Revelation," which admit and explain the reasons for the soon-to-be-obsolete material, and concludes: "The science of the Urantia Papers bears the closing date of A.D. 1934 [*sic*]. Even if it is now regarded as ten years out of date, it was 15 or 20 years ahead of the times when first presented to us. But even now, the fact of the ultimaton has not yet been discovered, even though there have been several hints along this line in the scientific papers of the last few years."

> Only facts and truth court the full light of comprehension and rejoice in the illumination and enlightenment of scientific research (90:4.9).

This exchange is frustrating for its complete lack of details. One wonders, Who was the professor? How closely did he "go over" the book? What exactly did he find dated? By "dated," did he mean wrong or simply incomplete? As for Sadler, why did he readily agree? Were he and the professor thinking of the same dated material? Did Sadler have in mind any items in the UB's science that were fifteen or twenty years ahead of their time, or was he simply using the professor's remarks as a convenient lever to tout the book's prophetic nature? In which scientific papers of the last few years did he think the ultimaton had been hinted at?

Later in 1959, Benjamin N. Adams, a Presbyterian minister from San Francisco, sent Sadler a remarkable letter[2] in which he praised the Urantia Book highly but advised that "the best and highest service which can be rendered this book is a strictly objective and merciless critical analysis thereof." He continues: "As I read what it has to say about cosmology, cosmogeny, geology, chronology, biology, anthropology, astronomy, physics, chemistry, nuclear physics, etc., etc., I find myself wishing that I had considerably more competence in all of these fields." Focusing on his area of expertise, he lists several mistakes or discrepancies he perceives in the Jesus papers. But he does challenge one science-related statement: "There are just 100 distinguishable atomic materializations of space-energy in a dual universe; that is the maximum possible organization of matter in Nebadon" (42:7.4). He comments: "This seems to me to say that only 100 chemical elements are possible. But I can quote several authorities to the effect that at least 103 elements have been identified and named."

Replying to Adams's remarks on the UB's science, Sadler ignores the question about the maximum possible number of atomic elements. Preferring once again to speak in generalities, he writes: "You ask about others who have critically examined the Urantia Book. From a standpoint of general science I think the studies of the late Sir Hubert Wilkins were perhaps the most extended and exhaustive. For more than twenty years he periodically spent time in Chicago going over the Papers. He would work weeks at a time, ten hours a day, and his final conclusion was that the Papers were consistent with the known facts of modern science." One wonders, As an ardent believer in the Urantia Book, did Wilkins subject the book's science to the "strictly objective and merciless critical analysis" that Adams recommended? Did he question the apparently erroneous statement quoted by Adams? Did he find *any* of the book's science questionable? As for Sadler, did he cite Wilkins because of his scientific expertise—Sir Hubert was a famed aviator, polar explorer, and military consultant, not an academic scientist—or because of his celebrity?[3]

Sadler continues: "Since the Book was published, a young physicist in Philadelphia has been a very careful student of the physics of the Urantia Papers. About a year ago he wrote a paper, with many diagrams, for the Gravitational Society, in which he advocated that the cosmology of the Urantia Book was the only one that was possible from the gravitational standpoint." One wonders, Who was this young physicist? How was his paper received by his colleagues?

In the early 1960s, two comb-bound textbooks, *Science in the Urantia Book* (Volumes 1 and 2), were prepared for the Urantia Brotherhood School. These books, compiled by Dr. Sadler and Alvin Kulieke, simply reorganized the UB's science passages by ➤

topic, with no further question or comment, which suggests that the UB's science was presented as "teachings" to be learned but not critically examined.[4]

But some detail-oriented study must have been done, as evidenced by four science-related changes surreptitiously made to the text of the second edition of the Urantia Book in 1967: (1) In 41:4.4, the density estimate of an unnamed, contracting star was tweaked from 'sixty' to 'forty' times as dense as the sun; (2) in 42:5.1, 'Y rays' was changed to 'gamma rays'; (3) in 42:6.7, the masses of electrons and protons in relation to each other and to the hydrogen atom were adjusted; and (4) in 42:7.7, the word 'well-nigh' was inserted before the word 'instantaneous' in "When one hundred and one [electrons] have been artificially introduced into the orbital field, the result has always been the instantaneous disruption of the central proton [*sic*] . . ." Who pointed out the errors, why they weren't noticed in the years before the book was published, and why the changes were kept under wraps until computer analyses by Kristen Maaherra and others exposed them about ten years ago, are still mysteries. (My source research indicates that the first three of the above errors probably resulted from misreadings or miscopyings of the respective source texts.[5] The last change may well have been made as a result of the Adams letter; the letter clearly triggered several changes in the Jesus papers.)

By the late 1970s and 1980s serious study of the Urantia Book's science began to surface, as a few UB enthusiasts delved into details and presented their studies in movement newsletters, journals and the Urantia Brotherhood's Scientific Symposia. Errors and possible errors began to be mooted, on such matters as the rotation of Mercury (57:6.2), the number of chromosomes in humans (36:2.4), the one hundred elements discussed in 42:7.4-7 (the insertion of 'well-nigh,' referred to above, did not remove the error that Adams perceived), the "one hundred octaves of wave energy" (42:5.1), and the distance to Andromeda (15:4.7). Readers wondered: Is the Milky Way the nucleus of Orvonton, as Paper 15 seems to indicate, and if so, how to reconcile the discrepancies in star counts? How does one get to the mansion worlds by seraphic transport in three days, when mansonia is many light years away?

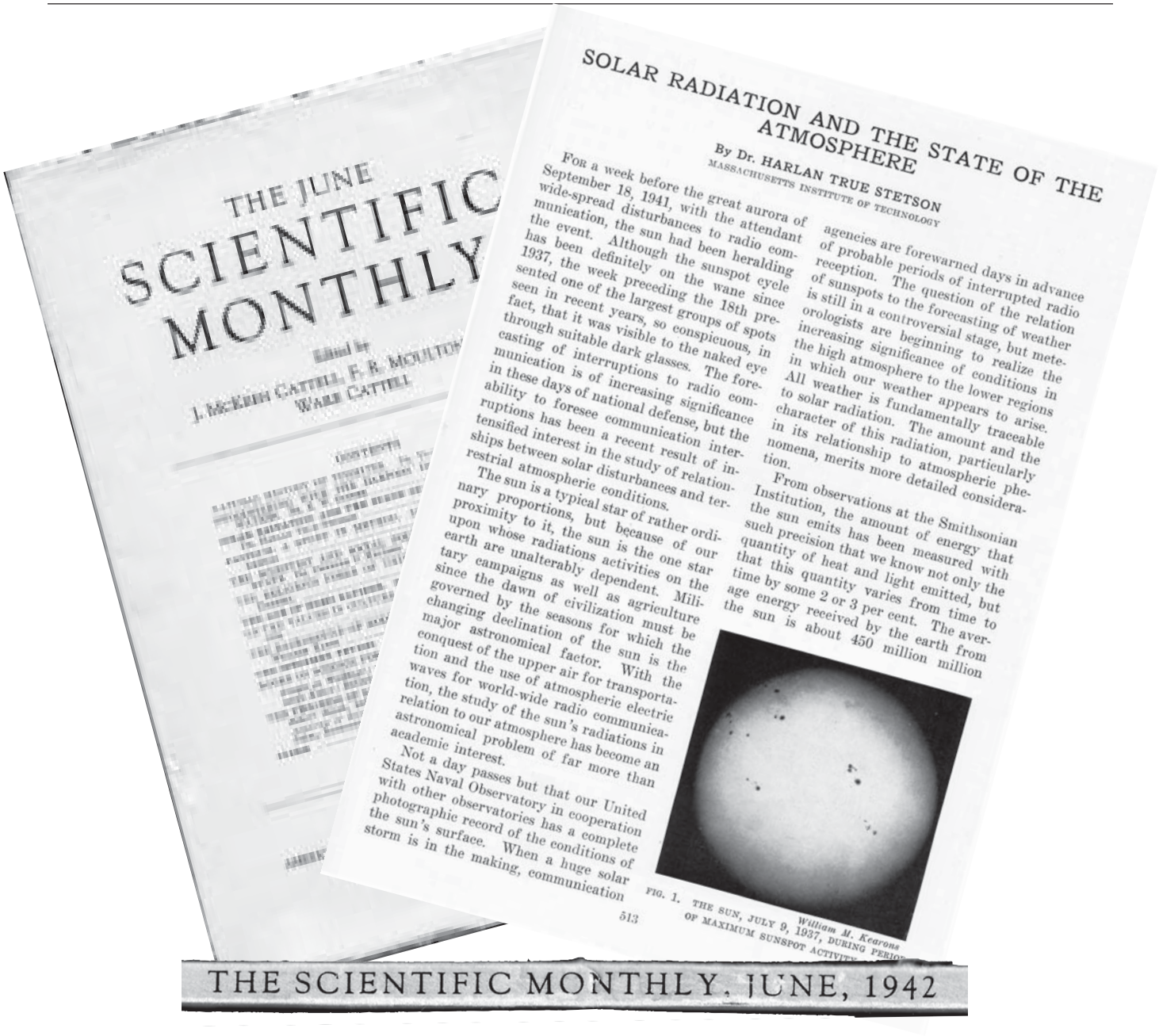
> Man is gradually backing into the truth, beginning in error, progressing in error, and finally attaining the threshold of truth. Only with the arrival of the scientific method has he faced forward (88:4.3).

It's at this level of study that perplexities and controversies occur, as believers grapple with the faith-threatening possibility that some of the UB's science statements—all of which are expressed in a this-is-how-it-is-and-we-know-whereof-we-speak style—are wrong.

Typically, when a science statement is suspected of being erroneous, whether in a study group, in print, or in an Internet discussion, the first reaction among believers is to parse the allegedly erroneous statement in an attempt to interpret away the perceived error. For example, when the Urantia Book asserts, "On Urantia there are forty-eight units of pattern control—trait determiners—in the sex cells of human reproduction," is it necessarily referring to chromosomes? Is the clause-laden sentence in 57:6.2—"Such gravitational influences also contribute to the stabilization of planetary orbits while acting as a brake on the rate of planetary-axial revolution, causing a planet to revolve ever slower until axial revolution ceases, leaving one hemisphere of the planet always turned toward the sun or larger body, as is illustrated by the planet Mercury and by the moon, which always turns the same face toward Urantia"—actually saying that Mercury's rotation has ceased, or rather that it is still slowing down? In both cases the ambiguous wording allows for alternative interpretations, although the most straightforward one coincides with what was believed at the time the Urantia Book was written but has since been refuted.

When the Urantia Book's assertions clearly clash with modern findings—as in such matters as the chronology it assigns to geologic and biologic periods on Earth, the distance to Andromeda, the formation of our solar system, etc.—believers point to the fact that scientific discoveries and developments may be wrong or misleading, that it's impossible to be sure of the accuracy of every supposed discovery, that science has vacillated on many matters. (On the other hand, many believers throw caution to the wind and confidently embrace any new findings which appear to converge with the Urantia Book's science, claiming they prove the book's prophetic nature.)

When error in the Urantia Book is entertained as a probability, or conceded as a given, readers cite "The Limitations of Revelation," Dr. Sadler being the first in a long line of Urantians to do so. But by quoting only the first two paragraphs in his "Some Criticisms," Sadler skirted the section's peculiar double-jointedness. One of its incongruities was mentioned above: the claim that revelation is limited to "the co-ordinating and sorting of present-day knowledge" followed by the claim that revelation co-ordinates "known or about-to-be-known facts and observations." A second incongruity is equally perplexing: In the first paragraph, we're told that the inclusion of cosmological instruction in a revelation has always "made trouble for the future," because students of the revelation are destined to "discover errors on the face of the associated cosmologies therein presented" owing to the revelators' mandate forbidding them to impart unearned knowledge. A few paragraphs later, however, we're told that one of revelation's immense values is its "authoritative elimination of error." Is the UB, then, really admitting errors or simply the inclusion of dated material which will be perceived as erroneous by future readers? The section is further clouded by the failure to define ambiguous terms such as 'cosmology,' 'uninspired,' 'in need of revision,' etc. (Interestingly, John Baillie's 1929 *The Interpretation of Religion*—a major source for Papers 101 to 103—seems to have inspired much of "The Limitations of Revelation." In one passage Baillie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MONTHLY

SOLAR RADIATION AND THE STATE OF THE ATMOSPHERE

By Dr. HARLAN TRUE STETSON
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FIG. 1. THE SUN, JULY 9, 1937, DURING PERIOD OF MAXIMUM SUNSPOT ACTIVITY

THE SCIENTIFIC MONTHLY, JUNE, 1942

points to "trouble" caused by "welding into a single system the abiding convictions of Christian faith and the most up-to-date scientific cosmology." He warns: "The more assiduity we show in forging links of steel between the faith of Christ and even such scientific results as for the time being look most secure, the more deeply disturbing will it be for us when these latter come . . . to be called in question." In a later passage, on the history of the idea of revelation, he discusses the meanings of the word 'inspired.' These passages and others will be discussed in my book on Papers 85 to 103.)

Some readers not only accept errors in the Urantia Book's science but consider their presence salutary. In the Spring 1989 issue of his former journal, *Cosmic Reflections*, Richard Bain proposed the now well-known "time bombs" theory, surmising that the Urantia Book's superhuman authors deliberately included minor errors to prevent the book from becoming a fetish. This line of speculation has been developed by Ken Glasziou in several articles published in his journal, *Innerface International*. (The Urantia Book Fellowship's website contains a complete set of issues.) Glasziou is probably the Urantia movement's premier commentator on the science content of the Urantia Book, having spent years tracing possible prophecies and errors. In the September/October 2001 issue of *Innerface*, he calls the Urantia Book's science "a mystery of inexplicable prophecy . . . compounded by inexplicable error" and suggests that, despite its many errors, the Urantia Book contains enough prophetic information to lure science-minded people to the book, and win them over by its spiritual revelations. (Over the years his inventory of prophecies has diminished—the September/October 2001 lists a few—and his catalogue of errors has grown. The May/June 2002 *Innerface* lists several newly recognized errors in the Urantia Book's historical geology.)

As far as published critiques of the Urantia Book from the outside scientific community, only two have appeared in English, ➤

as far as I know. In 1995, science journalist and skeptic Martin Gardner published *Urantia: The Great Cult Mystery*, an attempted exposé of the Urantia Book and its believers. Despite its rude tone and Gardner's frequent misreading of the Urantia Book, the book contained two highly instructive chapters on the UB's science. Gardner highlighted errors not previously noted and effectively refuted several claims of predictive science. He contended that the science was probably written by Dr. Sadler himself both before and after 1935, and that "The Limitations of Revelation" was inserted by Sadler as a veiled disclaimer of his own limitations. In 1998, Mark A. S. McMenamin, a geology professor at Mt. Holyoke College, appraised the Urantia Book more favorably in his *The Garden of Ediacara*.[6] Though stating that "there are reams of scientifically untenable material in *The Urantia Book*," he marveled at the book's "remarkable scientific revelations" about a Proterozoic supercontinent existing 750,000,000 years ago, whose breakup coincided with the emergence of complex life. McMenamin apparently failed to notice that the Urantia Book does not posit a Proterozoic supercontinent; according to the UB's idiosyncratic timetable, 750,000,000 years ago the planet was still completely lifeless. In fact, we're told in Paper 58 that the Life Carriers delayed the advent of life until the supercontinent had broken apart. The UB's Proterozoic era began hundreds of millions of years after the original supercontinent had fragmented, with animals making their appearance 450,000,000 years ago. Thus, the Urantia Book's correspondence with modern findings of a pre-Pangea supercontinent is only partial, and possibly coincidental. McMenamin adds: ". . . I can't help but wonder whether science would benefit by having scientists themselves or friends of science systematically scan the various nonscientific literatures for writings such as those appearing in *The Urantia Book*. Scientists would ordinarily ignore and dismiss such writings, but a discerning eye might pick up some gems."

> Faith does not shackle the creative imagination, neither does it maintain an unreasoning prejudice toward the discoveries of scientific investigation (101:8.4).

IN THE MIDST of these science inquiries, for the past ten years I have been discovering that a considerable amount of the material in the science sections, like much of the rest of the Urantia Book, appears to have been derived from previously published works. Since my first science-related source discovery—W. F. G. Swann's 1934 *The Architecture of the Universe*[7] —in 1992, I have identified books and articles in physics, astronomy, geology, biology, and anthropology which contain passages so closely paralleled in the Urantia Book as to suggest that they were used as base texts in the writing of several sections in Papers 12, 15, 36, 41, 42, 49, 57-65 and elsewhere.

These sources, like the tablets describing the lost civilization of Dilmun "silently resting on the dusty shelves of many museums" (77:4.8), have lain for years on the shelves of used book stores and libraries across the Anglo-American world. Written mostly in the 1920s and 1930s by eminent scientists such as Thomas C. Chamberlin, Sir James Jeans, Sir Arthur Stanley Eddington, Henry Fairfield Osborn, and Charles Schuchert, they were read widely by university students and the general public. Martin Gardner, born in 1914, recognized similarities between the Urantia Book's science and what he'd read in his university textbooks, and mentioned several source authors (not knowing how copiously the Urantia Book had drawn from their works) in his discussion of the science of the period in which the UB was written. He did identify one major science source, Sir James Jeans's 1929 *The Universe Around Us*, first pointing it out to me in a letter in late 1992, after hearing about my source research.

I have not been able to ascertain whether anyone in the Contact Commission or the Forum read any of the source books, or recognized them as sources if they did read them. Suspecting that Sadler co-wrote the UB, Martin Gardner reckoned that Sadler drew from contemporary science books, citing parallels between passages in Paper 57 and passages in Jeans' *The Universe Around Us* as evidence. In my study of Sadler's writings, I have found one science-related source book, along with several other source books in other fields, listed in the bibliography of his 1936 textbook, *Theory and Practice of Psychiatry* (1936). On examining the remains of Bill Sadler's library during a visit to the Urantia Foundation headquarters in December of 1997, I found copies of two science sources I'd discovered a few years earlier—Reginald Daly's *Our Mobile Earth* (1926), used in Paper 58's description of the mechanism of continental drift, and Chamberlin and Salisbury's *College Geology* (1909), a major source of Papers 57 to 61. Curiously, these books had no underlining or marginal markings. The contents of Sadler Sr.'s library were gone.

Whether my findings are discoveries of a previously unknown revelatory process, or an uncovering of buried secrets, they promise to contribute to one of the more intriguing unveilings in literature. Knowledge of its sources is crucial to an informed and intelligent understanding of any text; and in the Urantia Book's case, the tracing of its extensive source use has the added benefit of permitting us a glimpse into the minds and methods of the book's mysterious authors. New light is thrown on the whole of the Urantia Book's science as we now approach it not only item by item by text by text. In the coming months and years, I and others will examine every science-related section in the Urantia Book, analyzing source use, highlighting original elements, and appreciating how the derived and original elements were integrated with each other and woven into the higher teachings of the papers.

THIS ESSAY implements the parallel-column method of examining source use. It charts and interprets the parallelisms between section 2 of Paper 58, "The Urantia Atmosphere," and "Solar Radiation and the State of the Earth's

Atmosphere," a 17-page article by astronomer Harlan True Stetson, published in the June 1942 issue of a now-defunct U.S. journal, *Scientific Monthly*.

I chose the Stetson article because, like Leslie D. Weatherhead's *Jesus and Ourselves* (1930), the subject of a source study I published last year,[8] its straightforward relationship with a single section in the Urantia Book lends itself well for a magazine article. Further, both the Weatherhead study and this one are unconnected with sections covered in my upcoming book. At the time I chose this source study, last year, I had only roughly worked up the parallel chart and hadn't analyzed it too deeply, but I expected the essay to proceed along the same lines as the Weatherhead. In many ways it has, but its results are far more problematic.

THE SECTION THAT used Weatherhead, "Instruction for Teachers and Believers" (159:3), prefaces Jesus' instruction with the words: "Summarized and restated in modern phraseology, Jesus taught: . . ." Further, it is found in Part IV, whose author acknowledges that "the majority of the ideas and even some of the effective expressions I have utilized had their origin in the minds of the men of many races who have lived on earth during the intervening generations, *right on down to those who are still alive at the time of this undertaking*" (121:8.12, italics added)—as Weatherhead was. The parallel chart revealed where and how the UB author drew from *Jesus and Ourselves* in fashioning the section. In the analysis we saw how the UB emboldened Weatherhead's observations and insights about Jesus by transforming them into pithy injunctions by Jesus himself. Once readers got over the shock of the *prima facie* plagiarism, they could easily see the Weatherhead appropriations as consonant with the midwayers' stated intentions and procedures, and thus a confirmation of Part IV's revelatory authenticity.[9]

"The Urantia Atmosphere," on the other hand, is not preceded by any qualifier or acknowledgment of the use of human sources. (Contrary to popular interpretation, the acknowledgment at the end of the Foreword applies only to the papers in Part I.) However, since the Urantia Book occasionally refers to human scientists (e.g. "This era is known to your researchers as the Proterozoic" and " . . . Urantian geologists have very accurately deduced the various stages of [the development of the Great Lakes]"), its use of the works of Stetson and other scientists, as reference points and guides to terminology, is not surprising. As I studied the Stetson-52:8 parallels more carefully, I noticed tweaks of Stetson's figures, and a firming of his tentative suggestions into fact, analogous to the midwayer's emboldening of Weatherhead. Was the Urantia Book correcting and verifying Stetson, exercising its revelatory function of reducing confusion by the authoritative elimination of error and co-ordinating known or about-to-be-known facts and observations? In an attempt to find out, I was driven to explore understandings, past and present, of the issues in question. The Internet made it easy to look into current studies of the sun and the atmosphere. My collection of astronomy and geology textbooks from most decades of the 20th century, supplemented by old articles from *Scientific American* and other science magazines I found at local libraries, filled out my research materials.

The results of this study, in my opinion, are completely different from the Weatherhead one. Instead of substantiating the Urantia Book's claims, they indicate that the section fails by even the most liberal interpretation of "The Limitations of Revelation." Rather than co-ordinating the highest existing knowledge or eliminating error, the writer of 58:2 appears to have endorsed errors that were already being questioned, and introduced new ones, some of which are so serious that they betray a basic ignorance of solar and atmospheric phenomena, phenomena with which a Life Carrier would, presumably, be thoroughly familiar. Since I've recently found that William S. Sadler, in writing several of his own books, culled from sources in much the same way the Urantia Book does,[10] I am forced to face the hard question of whether Sadler himself wrote this deeply flawed section and others, as Martin Gardner suspected.

However, as a non-scientist who learned as I went, I disclaim superior knowledge of any of the subjects covered, and would be happy to be corrected, instructed, or challenged on any point or contention.

Before displaying and analyzing the parallels, I will provide information about each text and its respective author.

STETSON AND "SOLAR RADIATION AND THE STATE OF THE ATMOSPHERE"

HARLAN TRUE STETSON (1885-1964) was an American astronomer. When he wrote "Solar Radiation and the State of the Atmosphere" he was a researcher at the Massachusetts Institute of Technology and director of the Cosmic Terrestrial Research Laboratory in Needham, Massachusetts. He authored numerous other articles and at least five books, including *Earth, Radio and the Stars* (1934), *Sunspots and Their Effects* (1937), and *Sunspots in Action* (1947).

In 1937, a week after the publication of *Sunspots and Their Effects*, he was profiled in a *Time* magazine article called "Stetson's Spots." After noting his "impeccable credentials" as a scientist, the article focused on Stetson's unorthodox speculations about the possible influence of sunspots on human affairs. Is intense sunspot activity, Stetson wondered, connected in some way to increased levels of warfare on the planet? Was it coincidental that four of the last five major economic downturns followed in the wake of sunspot maxima? Does the increased ultraviolet radiation occurring during sunspot peaks affect moods and emotions? The article concluded: "Dr. Stetson admits that . . . the effort to match sunspot curves with indices of human activity . . . must necessarily be far from conclusive. But he feels that the evidence for sunspot influence is too good and too stimulating to be thrown out of court."[11]

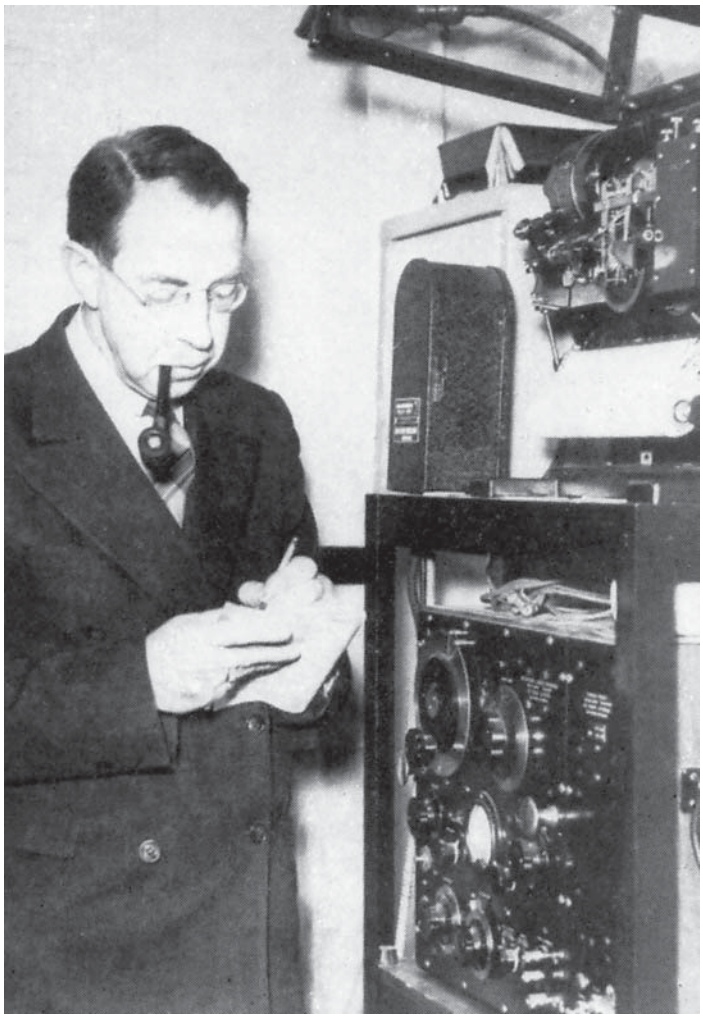
Stetson makes no mention of the possible psychosocial effects of sunspots in "Solar Radiation and the State of the Atmosphere," although much of the article was probably derived from *Sunspots and Their Effects*. He begins by reviewing contemporary understandings of the sun and its radiations, and the Earth's atmospheric layers. He then briefly describes sunspots and observes how aurorae and variations in the Earth's magnetic field parallel the 11-year sunspot cycle. Writing in wartime, Stetson is particularly interested in how radio communication is adversely ➤

affected by the increased ionization of the upper atmosphere that occurs during sunspot peaks. He devotes much of the article summarizing his radio propagation research, including his measurements of a radio station's field strengths during periods of increased solar activity. He concludes by reviewing other scientists' attempts to discern correlations between solar phenomena and climate and weather patterns.

The UB draws copiously from the first several pages of the article, leaving off where Stetson discusses his radio propagation studies. Because of the close and consecutive culling, and the retaining of some of Stetson's wording ("These diurnal wanderings of the compass . . ."), I could tell within minutes that the article was a source.

I discovered it in October 1997. By then I had already found several scientific source books, all published before 1935, which paralleled much of Papers 41, 42, and 57-61. But certain sections of these papers—including 41:8 ("Solar-Energy Reactions"), 42:8 ("Atomic Cohesion"), and 58:2 ("The Urantia Atmosphere")—remained unparalleled. Ken Glasziou explained in "The Science Content of *The Urantia Book*" (1991) and elsewhere, that the first two of these sections contained prophetic science, information not known and/or verified in 1934. As for 58:2, the section under study here, my research showed that it described the atmosphere in a more informed way than pre-1935 literature. Correspondences with the section were stronger in astronomy textbooks of the late '30s and 1940s; by then the ionosphere was recognized as a separate atmospheric level, and the features of the ozone layer were better clarified. But parallelisms of a source-like nature were absent in the books I'd seen.

I didn't know whether these sections had identifiable source texts; perhaps they were the products of several sources supplemented by the "about-to-be-known" information alluded to in "The Limitations of Revelation." In any case, I wanted to pinpoint when science was most in sync with the UB. Through his investigations into the Urantia Book's science, Martin Gardner awakened me to the possibility that magazines and journals were source texts. But I didn't explore this avenue until the fall of 1997, when Fred Beckner, who was discussing mesotrons on a UB-related Internet forum, asked me if I'd found anything about mesotrons being 180 times the mass of electrons, as stated in 42:8. I hadn't. A few weeks later, hearing that the Internet discussion about mesotrons was still going on, I went to a library in Chicago and looked through volumes of the *Reader's Guide to Periodical Literature*, under "Mesotrons." I found no topical listing for that term until I got to the July 1937 - June 1939 volume.[12] I quickly located suggestive articles, and eventually found one that not only listed the mass of the mesotron as "about 180 times as heavy as the electron" but closely paralleled information in the entire section. This source article was C. W. Sheppard's "The Evanescent Mesotron," appearing in the October 1940 issue of *Scientific American*.



Harlan True Stetson

That same week, charged by the discovery of the Sheppard article, I found two more sources by looking in *Reader's Guide to Periodical Literature*, under "Atmosphere" and "Neutrinos." The first was the Stetson article, the second was Dr. G. Gamow's "Neutrinos vs. Supernovae," published in the January 1942 issue of *Scientific Monthly*. I shared my finds with several science-minded UB readers, who agreed that they were unmistakable sources. We realized, sadly, that they confirmed Martin Gardner's contention that the UB's science was not finished in 1934 or 1935—despite the dates given at the end of each of the Urantia Book's first three Parts, and despite William S. Sadler's apparently confirmatory claim in "Some Criticisms of the Urantia Book," quoted above, that "The science of the Urantia Papers bears the closing date of A.D. 1934."[13]

But by 1997, counter-indications were already available. In 1991, Mark Kulieke, the son of Forumites, published *Birth of a Revelation*, a short history of the Urantia movement in which he wrote that minor modifications to the Urantia Papers were made between 1935 and 1942 in response to further questions from the Forum. A few years later, Dr. Sadler's private history of the Urantia movement, from which Mark had apparently drawn his information about the post-1935 textual additions, surfaced as evidentiary material in the Urantia Foundation vs. Kristen Maaherra copyright case.[14] In a deposition made in 1994, also in connection with the UF-Maaherra case, Helen Carlson, a longtime Forumite and resident of 533 Diversey Parkway, stated that material continued to be added to the Urantia Papers well into the

1940s.[15] Further, by 1997 I had already found several non-scientific source books first published after 1935.

In 2000 the Sherman diaries, whose existence was first made known in Martin Gardner's *Urantia*, became available. Among the entries was this one:

> *Sunday, January 2, 1944*.—The first Forum meeting of the new year was well attended and Dr. Sadler read the paper which dealt with early life on Urantia. He announced dramatically that it contained some new material, and then proceeded to read some statistics related to how much the heat of the sun would cost to people of Chicago daily if they had to pay for it in terms of kilowatt hours. The figure was something like a hundred million dollars a day. The Doctor remarked that this mention of Chicago was the only time it had been mentioned in all the papers. . . .

This eyewitness account of a Forum study group meeting, in which Dr. Sadler read Paper 58, "Life Establishment on Urantia," and referred to a passage included in the section under study here, vividly confirms that 58:2 was added well after 1934. Other entries record Dr. Sadler or his son Bill announcing new material in other papers. As many Urantia Book readers know from reading Harold Sherman's highly abbreviated account of their Forum years in their 1976 book, *How to Know What to Believe*, Sherman clashed with the Sadlers on a number of issues, and eventually rejected—at least partially—the Urantia Book's revelatory authenticity, anticipating Martin Gardner in suspecting Dr. Sadler of editing and/or co-writing the Urantia Papers. Nevertheless, the Shermans' voluminous diaries, begun in 1942 and ending in 1947, report on Forum activity with unmatched vividness and immediacy and thus are of primary value in the study of early Urantia history.[16]

A final puzzle piece: The July 1941 - June 1943 volume of the *Reader's Guide* indicated that Stetson's *Scientific Monthly* article was a revision of an article he had written for the 1938 *Annual Report* of the Smithsonian Institution, called "The Sun and the Atmosphere." The library I was using did not have this earlier article. In June of 1999, Ernest Moyer, who'd attended a lecture I gave in which I mentioned the 1942 Stetson article and other findings, reminded me of the 1938 article and e-mailed me some parallels he'd drawn between the two texts. Last year I got the article myself. The 1938 is indeed close. But a careful comparison indicates that, in the several cases where the 1942 differs from the 1938, the UB culls from the 1942 text every time. (The differences are detailed below.)

THE LIFE CARRIER AND 58:2

The stated author of 58:2 is a Life Carrier. Uniquely created by the Creator Son, the Creative Spirit, and an Ancient of Days, Life Carriers are divine Sons entrusted with the awesome task of designing and implanting life on individual planets. As part of their training they study the whole panoply of life phenomena on the Life Carrier worlds of Salvington. They then assemble on the system capitals prior to going forth on their planetary assignments. When their assigned planet is ripe for life, they implant the life plasm they have chosen as best suited to the planet's physical conditions. This original plasm, we are told, "must contain the full potential for all future developmental variations and for all subsequent evolutionary changes and modifications" (36:2.10). A corps of Life Carriers remain on the planet, fostering life evolution for hundreds of millions of years until the advent of human life. At this point they either leave the planet or stay on as advisers to the planetary government, gaining new powers when the planet achieves light and life.

The Life Carrier who authored Paper 58 is one of fourteen members of his order (two seniors and twelve assistants and custodians) who have resided on Earth since life began, supposedly 550,000,000 years ago. He may or may not have authored the entire series of papers from Paper 57 to 65, each of which is attributed to an unnamed resident Life Carrier; but all these papers read consistently as a revealed history of our planet, presented by witnesses of or participants in the events they describe. No human sources are acknowledged; Paper 57's preamble states: "In presenting *excerpts from the archives of Jerusem* for the records of Urantia respecting its antecedents and early history, we are directed to reckon time in terms of current usage . . . We will use the nearest whole numbers as the better method of presenting these *historic facts*" (italics added). In "The Limitations of Revelation" we are further assured that "the historic facts and religious truths of this series of revelatory presentations will stand on the records of the ages to come" (101:4.2). These declarations, coupled with the authoritative tone assumed throughout the narrative, conduce to automatic confidence in the accuracy of the information given.

Papers 57 to 64 are threaded by an italicized timeline, beginning at 987,000,000,000 years ago. The story opens with the genesis of a component of our local universe, followed by the formation of our solar system and the origin and early growth of Urantia. One billion years ago, "the date of the actual beginning of Urantia history," the planet approximately reached its current size. A hundred million years later, a corps of Satania personalities visited the planet and decided it was ideally suited to be a life-experiment world. A commission of Life Carriers arrived 600,000,000 years ago to study the physical conditions of the planet prior to implanting life. They returned 50,000,000 years later, when the land-and-sea configuration was most favorable, and implanted identical life packages in the inland seas of three continents.

The first three sections of Paper 58 discuss the planetary and cosmic features that had to evolve to a favorable status before the Life Carriers could establish life. Section 1 is mainly concerned with marine conditions; section 2, the section under study here, deals with the atmosphere; section 3 concerns the "spatial environment," with the Life Carrier making the dubious claim that the presence of vast hydrogen clouds and their accompanying cosmic rays are "germane to the essential environment of life establishment." When these three conditions were satisfactory, the Life Carriers implanted life, as narrated in section 4.

"The Urantia Atmosphere," 58:2, is something of an anomaly in that the historical thread is dropped. The entire section discusses the *present* atmosphere, abruptly breaking from section 1's description of the planet and its CO_2-charged atmosphere 600,000,000 years ago. (The next mention of the developing atmosphere occurs in 59:4.17, during the Devonian period.) It is thus possible to read Paper 58's preamble and section 1 and then skip to section 3 without missing a historical beat. It is also easy to see 58:2 as a later addition to the paper. ➤

HOW TO READ THE PARALLELS

A chart displaying the parallels appears below. On the *right column* is the complete, sequential text of 58:2, "The Urantia Atmosphere." A small numeral precedes each of the section's ten paragraphs. On the *left column* are the corresponding passages from "Solar Radiation and the State of the Atmosphere." The number in parentheses at the end of each passage indicates the page on which it appears in the article.

Because the author of 58:2 gleaned consecutively from Stetson's article, the left column of the chart reads coherently. It is recommended that you read this column from top to bottom *first*, before studying the parallel rows, to get an overview of Stetson's remarks and a feel for his style. (*Note*: The notation [**contd**] means that the successive passages follow each other directly in the article, without intervening sentences.)

Verbatim or near-verbatim parallelisms have been **bolded**. Words marking significant deviations between Stetson and the UB have been <u>underlined</u>.

PARALLEL CHART

STETSON	THE URANTIA BOOK
"SOLAR RADIATION AND THE STATE OF THE ATMOSPHERE"(1942)	2. THE URANTIA ATMOSPHERE
From observations at the Smithsonian Institution, the amount of energy that the sun emits has been measured with such precision that we know not only the quantity of heat and light emitted, but that this quantity varies from time to time by some 2 or 3 per cent.... Because of the relatively insignificant size of the earth, and also the great distance that separates us from the sun[,] a distance of 93 million miles, our <u>planet</u> can <u>intercept</u>	❶ The planetary <u>atmosphere</u> <u>filters through</u> to the earth
but about one two billionths of the total solar <u>output</u> (513-14).	about one two-billionths of the sun's total <u>light</u> emanation.
[contd] Even so, if we stop to consider what the cost to us would be were we charged for a year's service of <u>heat</u> and light from the Solar Utilities Power and Light Company,	If the light falling upon <u>North America</u> were paid for
we would find our indebtedness mounting to staggering proportions. At a price of 1¾ cents per kilowatt hour,	at the rate of two cents per kilowatt-hour,
the annual budget that would have to be allowed for sunshine	the annual light bill
for the <u>continental United States</u> alone	
would represent an expenditure of 327 quadrillion dollars (514).	would be upward of 800 quadrillion dollars.

STETSON	THE URANTIA BOOK
[contd] Such figures are indeed difficult to imagine. If we change our picture to a more restricted one, we can say that the cost of sunshine for Greater New York at the above figure	Chicago's bill for sunshine
would amount to approximately 100 million dollars for the average day (514).	would amount to considerably over 100 million dollars a day.
	And it should be remembered that
If we analyze the radiation **from the sun** we discover that it covers a wide range of wave-lengths. Certain of these wave-lengths or frequencies produce their own special effects upon the earth and its atmosphere (514).	you receive **from the sun** other forms of energy—
	light is not the only solar contribution reaching your atmosphere.
The visible range to which the eye responds represents frequencies etending from 400 million million cycles per second to a frequency just about double this, or 800 million million cycles per second.... But outside this so-called **visible range** to which the eye responds there is a **vast** scale of [solar] radiations	**Vast** solar energies pour in upon Urantia embracing wave lengths ranging
both beyond the red end of the spectrum, which we call the infrared, and far down below the violet, which we call the ultra-violet (514).	both above and below the recognition **range of human vision**.
Observations with the spectroscope indicate that there is much radiation **at the extreme ultra-violet end of the spectrum** to which the earth's atmosphere is completely opaque (516).	❷ The earth's atmosphere is all but opaque to much of the solar radiation **at the extreme ultraviolet end of the spectrum**.
[contd] A great deal of the absorption of this region of the solar spectrum of very short wave-lengths is caused by a layer of ozone	Most of these short wave lengths are absorbed by a layer of ozone
which exists at an average height of about 22 kilometers [*13.67 miles*], but which probably occupies a region	which exists throughout a level
extending from 15 to 35 kilometers [*9.321 miles to 21.749 miles*] (516).	about ten miles above the surface of the earth, and which extends spaceward for another ten miles.

STETSON	THE URANTIA BOOK
[contd] If all the ozone in this region	The ozone permeating this region,
were to be brought to the standard **conditions** of temperature and pressure of our atmosphere at the earth's surface,	at **conditions** prevailing on the earth=s surface,
it would represent a layer of only 2 to 3 millimeters [*0.0788 to 0.1182 inches*] in thickness (516).	would make a layer only one tenth of an inch thick;
[contd] Yet **this small amount of ozone**	nevertheless, **this** relatively **small** and apparently insignificant **amount of ozone**
is the defense between us and	protects Urantia inhabitants from
extremely dangerous radiations in the ultra-violet region of the sun's light (516).	the excess of these dangerous and destructive ultraviolet radiations present in sunlight.
[contd] Were this absorption, however, of this region of the solar spectrum even a little greater than it is,	But were this ozone layer just a trifle thicker,
we should be deprived of that small amount of ultra-violet light	**you would be deprived of** the highly important and **health-giving** ultraviolet rays
filtering through our atmosphere	which now reach the earth's surface,
that is so **essential** for **health** and the production of our sunshine vitamin D (516).	and which are ancestral to one of the most **essential** of your vitamins.
	❸ And yet some of the less imaginative of your mortal mechanists insist on viewing material creation and human evolution as an accident. The Urantia midwayers have assembled over fifty thousand facts of physics and chemistry which they deem to be incompatible with the laws of accidental chance, and which they contend unmistakably demonstrate the presence of intelligent purpose in the material creation. And all of this takes no account of their catalogue of more than one hundred thousand findings outside the domain of physics and chemistry which they maintain prove the presence of mind in the planning, creation, and maintenance of the material cosmos.
The sun	❹ Your sun

STETSON	THE URANTIA BOOK
not only radiates its health-giving sunshine, but it also emits literally **death-dealing rays** (516).	pours forth a veritable flood of **death-dealing rays**,
We can be confident ... that it is a **fortunate** combination of the sun and our atmosphere that makes **life on the earth** possible (516).	and your pleasant **life on Urantia** is due to the "**fortuitous**" influence of
	more than two-score apparently accidental **protective** operations similar to the action of this unique ozone layer.
Were it not for	❺ Were it not for
the **protecting** shield of the earth's atmosphere, the sun would be the annihilator of us all (516).	
[contd] The atmosphere ... is a sort of buffer state, the very top of which receives a violent bombardment of high frequency radiations from the sun, and the lower layers of which form a **blanket**	the "**blanketing**" effect of the atmosphere
that enables the earth to retain during the night much of the warmth generated by the sunshine that has penetrated through it, thus mitigating the extremes of temperature between night and day to which the earth would otherwise be subjected (516-17).	at night, heat would be lost by radiation so rapidly
	that life would be impossible of maintenance except by artificial provision.
[contd] If we look at a cross-section of the earth's atmosphere, it may for convenience be divided into three zones or layers in which the stratosphere occupies the middle ground. The region below the stratosphere is that which contacts our immediate surroundings and provides the **winds and atmospheric currents**, giving rise to all our **weather** (517).	
[contd] We call this lower region comprising perhaps the first 5 or 6 miles the troposphere (517).	❻ The lower five or six miles of the earth's atmosphere is the troposphere; this is the region of **winds and air currents** which provide **weather** phenomena.

STETSON	THE URANTIA BOOK
[contd] The region above the stratosphere	Above this region
is the ionosphere (517).	is the inner ionosphere
	and next above is the stratosphere.
[contd] If we send a recording thermometer aloft, we find that while passing through the troposphere	Ascending from the surface of the earth,
the temperature steadily falls until a height of 10 or 12 kilometers [*6.214 to 7.4568 miles*] is reached,	**the temperature steadily falls** for six or eight miles,
when the temperature reaches the extremely low value of -55°C., or some 68° below zero Fahrenheit (517).	at which height it registers around 70 degrees below zero F.
[contd] Strangely enough, for the next 30 miles or so there appears to be little change in temperature (517).	This temperature range of from 65 to 70 degrees below zero F. is unchanged in the further ascent for forty miles;
[contd] This is the region of the stratosphere (517).	this realm of constant temperature is the stratosphere.
At a height of 60 kilometers or some 40 miles,	At a height of forty-five or fifty miles,
the temperature would begin to rise again (517).	the temperature begins to rise,
	and this increase continues until,
[contd] Recent investigations give some evidence that at extreme heights, up where the auroral fires play,	at the level of the auroral displays,
temperatures of 1,000°C. [*1832°F.*] have to be postulated	a temperature of 1200° F. is attained,
to account for the presence of the ionized oxygen that is there (517).	and it is this intense heat that ionizes the oxygen.
[contd] The extremely **rarefied** condition of this upper atmosphere, however,	But temperature in such a **rarefied** atmosphere
calls for perhaps a quite different interpretation of temperature than that to which we are ordinarily accustomed when	is hardly comparable with
determining temperatures by the thermometer at the earth's surface (517).	heat reckoning at the surface of the earth.

STETSON	THE URANTIA BOOK
	Bear in mind that
[contd] Ascending through the cross-sections of the atmosphere, we find there is a rapid decrease in the amount of atmospheric pressure. Within the **first 3 miles** from the earth's surface, **half** the total amount of oxygen and nitrogen, the principal atmospheric ingredients, are included (517).	one **half** of all your atmosphere is to be found in the **first three miles**.
[contd] The limiting height to which the thinning atmosphere extends	The height of the earth's atmosphere
is somewhat difficult to fix. Perhaps we should place it at 200 to 300 miles, although recently Dr. Carl Störmer has observed **auroral streamers** reaching to heights of 600 kilometers [*372.84 miles*] or more. Where the auroral streamers go, some of the thin atmosphere must extend (517).	is indicated by the highest **auroral streamers**—about four hundred miles.
[contd] If we make a chart of the numbers and occurrences of aurorae we find there seems to be a curious connection between the frequency and brightness of auroral displays and the state of the sun as marked by the appearance of sunspots (517).	❼ Auroral phenomena are directly related to sunspots,
It was in 1908 that the late Dr. George Ellery Hale, the founder and director of the Mount Wilson Observatory, first observed that sunspots were giant **cyclones** in the sun's atmosphere (518).	those solar **cyclones**
[contd] They are indeed very similar in their formation to the tropical hurricanes that originate in the West Indies and sweep northward. ... To carry the analogy still further, spots north of the sun's equator are in general whirling in one direction while corresponding spots south of the equator **whirl in the opposite direction**.	which **whirl in opposite directions** above and below the solar equator,
If the rotation of the one is clockwise, that of the other is counter-clockwise (518).	

STETSON	THE URANTIA BOOK
[contd] This again is characteristic of the differences of rotation of **tropical hurricanes** on the earth originating in the northern and southern hemispheres, respectively (518).	even as do the terrestrial **tropical hurricanes**.
	Such atmospheric disturbances whirl in opposite directions when occurring above or below the equator.
It has long been known that the frequencies of light waves are distorted if there is a powerful magnetic field surrounding the light source.... When the Mount Wilson observers first examined and actually measured the frequency of **light** coming from the centers of sunspots, it was found to have **changed frequency** in exactly the way that light waves are distorted in the laboratory when a powerful electromagnet is placed around the source of light being examined (519).	❽ The power of sunspots to **alter light frequencies**
Thus came the startling revelation that	shows that
sunspots were not only terrific hurricanes but every **center** was in itself a powerful **magnet** (519).	these solar storm **centers** function as enormous **magnets**.
Since a magnetic field	Such magnetic fields
may exert a repulsing effect upon swiftly moving electrons, we see some reason that **charged** electric **particles** can be actually **hurled** from sunspot centers	are able to **hurl charged particles** from the sunspot craters
at velocities which may carry them through space into the earth's atmosphere,	out through space to the earth's outer atmosphere,
thus ionizing the upper regions of the air in a way	where their ionizing influence
that would **produce auroral displays** (519).	**produces** such spectacular **auroral displays**.
[contd] In the light of such a mechanism, therefore, we see a possible reason why	Therefore
aurorae occur in greater numbers and at greater brilliance	do you have the greatest auroral phenomena

STETSON	THE URANTIA BOOK
at times when these solar storms occur most frequently (520).	when sunspots are at their height—
The time when aurorae appear most frequently would seem to be about 2 years **after** the passing of the maximum of sunspots (517).	or soon thereafter—
There is, I believe, a good reason for the fact that the maximum in the auroral displays occurs a year or two after the year of most sunspots. As sunspots begin to wane in numbers,	at which time
they are nevertheless occurring in regions progressively nearer the solar equator,	the spots are more generally equatorially situated.
and as the sun's equator is inclined but slightly to the plane of the earth's orbit, we may draw the inference that sunspots are most effectively associated with the aurorae when, other things being equal, they are most nearly in the geometrical plane that the earth travels in its journey around the sun (517-18).	
Perhaps the terrestrial effect that has most nearly paralleled the sunspot cycle is the variation in the state of the earth's magnetic field. For over 100 years, it has been definitely known that the direction of the **compass needle** and the intensity of the earth's magnetic field show definite relationships (520).	❾ Even the **compass needle** is responsive to this solar influence
	since
[T]he compass needle is constantly wandering back and forth every day by a slight amount. When the sun rises in the east, the north end of the compass needle **turns slightly** toward that direction.	it **turns slightly** to the east as the sun rises
By noon when the sun is south, it is pointed in its normal position (520-21).	
[contd] Then in the afternoon as the sun wanders and sets in the west, the compass needle wanders likewise to the west,	and slightly to the west as the sun nears setting.

STETSON	THE URANTIA BOOK
coming back again to its normal position about midnight when the sun is below the northern horizon (521).	
[contd] This goes on day after day, month after month—	This happens every day,
but during the years when sunspots are most numerous	but during the height of sunspot cycles
these daily excursions of the compass needle	this variation of the compass
will on the average be twice as great as during the years when the sunspots are lacking (521).	is twice as great.
[contd] **These diurnal wanderings of the compass** needle	**These diurnal wanderings of the compass**
can now be roughly explained as due to	are in response to
the effects of ionization of the upper atmosphere	the **increased** ionization of the upper atmosphere,
by sunlight (521).	which is produced by the sunlight.
We may infer ... that at times of sunspot maxima the number of ... ions in the upper air is materially **increased**, producing a more marked magnetic effect (521).	
[*Fig. 2 on p. 515 shows <u>three</u> levels: D, E and F*]	⓾ It is the presence of <u>two</u> different levels of
... Professor Kennelly of Harvard [postulated] that there must exist high above the earth's surface ... an **electrified conducting** layer	**electrified conducting** regions
from which the electromagnetic waves emitted from the powerful [radio] antennae were reflected back to earth (521).	
[The Kennelly-Heaviside layer, a.k.a. the E layer, at an altitude of from 100 to 130 kilometers] lies far above the stratosphere	in the superstratosphere
and generally above the region that is usually regarded as that where ozone is manufactured (522).	

STETSON	THE URANTIA BOOK
	that accounts for
Radio waves emitted from a sending station in all directions arriving in this ionized region have their velocity and direction changed as they penetrate further and further into the region, until at length they are bent back to earth again, reaching receiving stations hundreds and sometimes thousands of miles from the source when they were broadcast (522).	the long-distance transmission
This E layer is particularly favorable for reflecting or turning back radio waves of the frequencies which are most generally used for commercial broadcasting in connection with our entertainment programs (522).	of your long-
[contd] Radio waves of much **shorter wavelengths** or of higher frequencies penetrate and actually traverse through this region until they reach what appears to be another ionized region called the F layer ... [which] lies some 200 kilometers high or in the territory where auroral streamers stage their gorgeous displays (522).	and **short-wave** radiobroadcasts.
During the last few years of sunspot activity, there have been occasions when remarkable fadeouts have occurred in radio communication (523).	Your broadcasting is sometimes disturbed
Could we visualize the ethereal substance of the ionosphere as we visualize the surface of the ocean, we should find times when **terrific storms** were **raging**	by the **terrific storms** which occasionally **rage**
in this ionosphere (524).	in the realms of these outer ionospheres.

ANALYSIS

I. STETSON-STETSON COMPARISON

Before analyzing the UB-Stetson parallels, I will address how the 1938 article differs from the 1942.

The earlier article was presented as a lecture (sponsored by the Smithsonian Institution in Washington, D.C.), and is somewhat longer. About 80% of its content is the same. Stetson spends more time discussing the then-question of whether aurorae and other atmospheric disturbances are produced by sun's UV radiation alone or also by streams of charged particles emanating from the sun. (It is now known that the latter is the case.) More attention is given to the connection between sunspots and the increase of atmospheric ozone, and to the relationship between sunspot cycles and weather patterns. The reporting of his radio field-strength research, prominent in the 1942 article, is less lengthy here.

In five cases the Urantia Book author derives wordings or content from the 1942 article which are not found in the 1938: ➤

(1) In Paragraph 1, the UB incorporates a mistake not found in the better-edited first article—the unnecessary 's' in "one two billionths." (The UB hyphenates it to "one two-billionths.") The 1938 had "one two-billionth," the correct form.[17]

(2) Stetson's description of the ozone layer, so verbally similar to the UB's in Paragraph 2, is worded differently in the 1938 version.

(3) In Paragraph 4, Stetson's statement about the "*fortunate* combination of the sun and our atmosphere that makes life on the earth possible" is apparently referenced in the UB's comment about the "'*fortuitous*'" combination of protective operations in the atmosphere that makes life on Urantia possible. The 1938 text does not use the trigger word 'fortunate'; its corresponding sentence is: "Thus, we see that it is the combination of the sun and our atmosphere that makes life on the earth possible."

(4) The cross-sectional description of the atmosphere, in Paragraph 6, is identical in both texts, with one exception. In pegging the height of the highest auroral streamers, the 1938 gives the figure of 600 miles. The 1942 says 600 *kilometers.* The UB's 400-mile figure was apparently arrived at by rounding up the 373-mile equivalent of 600 km to the nearest hundred.

(5) Stetson's suggestion as to why aurorae occur most frequently a year or two after sunspot maxima, which the UB incorporates in Paragraph 8, is absent in the 1938 article.

On no point is the 1938 article closer to the UB than the 1942. The fact that an earlier post-1935 article existed in published form and that a later one was used, underscores that we are not dealing here with a pre-1935 idea stream or unpublished manuscript, but rather with a particular version of a particular article published at a particular time and place. So, the "new material" in Paper 58, which Sadler announced to the Forum in January of 1944, could have been added any time after the June 1942 issue of *Scientific Monthly* came out. (Note that the addition was probably made after May 31, 1942 when, according to Sadler's history, the Forum ceased being an assembly whose questions elicited answers in the Urantia Papers.) Further, the use of *Scientific Monthly* instead of the less popular *Annual Report* of the Smithsonian Institution is consistent with my findings that, in general, the Urantia Book's sources were popular texts widely available in the Anglo-American world.

II. COMPARISON OF STETSON AND THE UB

Although 58:2 was an add-on, the techniques used in creating it are essentially no different from those I have seen in hundreds of other sections throughout the Urantia Book. The close, consecutive paraphrasing with occasional verbatim lifting, and the stopping of the culling part way through the text, are typical. As it does with other science sources, the UB strips Stetson's remarks of their tentativeness (e.g. "there appears to be," "we see good reason that," "in general," "we may draw the inference that," "can now be roughly explained as due to," etc.), and restates them as hard fact. The superhuman perspective is achieved by replacing Stetson's "the sun" with "your sun," his "life on the earth" with "your pleasant life on Urantia," his "we should be deprived" with "you would be deprived," etc. This stance is further signaled by the directives "It should be remembered that" and "Bear in mind that." Stetson's references to the work of his predecessors and colleagues, such as Hale, Störmer, and Kennelly, are removed; the section's only reference to human scientists is the disapproving remark about unimaginative mechanists with their notion of an accidental universe. A tantalizing allusion to midwayer knowledge is made but no examples of it are provided.

Paragraph-by-Paragraph Analysis

PARAGRAPH 1. *Sun's radiation reaching Earth*. Stetson's observation that the Earth receives about one two-billionth of the sun's total radiation, was common knowledge among astronomers. It was arrived at by a simple analysis of the size and distance relationships between the two bodies, as implied by Moulton in 1926: "The earth as seen from the sun would look like a tiny speck, as small as Mars appears from the earth. Consequently the earth receives only an insignificant fraction of the energy the sun radiates; in fact, only one two-billionth."[18] Stetson's utility-bill illustrations showing how vast this amount of energy is, were likewise anticipated in scientific literature; a 1927 astronomy textbook comments: "If the solar radiation which strikes the earth [at the top of the atmosphere] in a single second could be converted into power, its value at the low rate of 1 cent per kilowatt hour would be $478,000,000."[19] Both the textbook and Stetson (1938) credit a Dr. Abbot of the Smithsonian Institution for accurately determining the average amount of this solar radiation, called the solar constant,[20] which made these hypothetical calculations possible. Knowing the solar constant and the landmasses of the continental United States and Greater New York, Stetson simply set a price, did the math, and arrived at the annual bills.

58:2's opening sentence modifies Stetson's parallel statement in two ways: First, it narrows his "total solar output" to "total light [i.e., *visible* light] emanation"; second, it specifies that the atmosphere "filters through" about one two-billionth of this total light emanation, whereas Stetson says only that the planet can "intercept" (i.e., not necessarily filter through to the surface) the same percentage of the total solar output. The second modification is significant because it is known that a considerable percentage of the sun's light is blocked from reaching sea-level by atmospheric opacity.

From Henry Norris Russell's *Astronomy* (1927):

> Only about 70 per cent of the initial solar radiation gets through to sea-level when the sun is at the zenith and the air is free from dust and clouds. . . . Furthermore, the normal opacity may be much increased by the presence of dust, smoke, and water-vapor (pp. 530-31).

From MIT's Haystack Observatory website[21]:

> The sun radiates a tremendous amount of energy, but only one two-billionth of the total solar radiation reaches the vicinity of the Earth. Of this amount only about 20% is absorbed in the Earth's atmosphere. This heats the atmosphere. Most of the absorption of solar energy occurs in the ozone layer and in the ionosphere.
>
> 30 to 40% of incoming solar radiation may be reflected back into space from clouds, air molecules, dust particles, and the surface of the Earth itself. This radiation is not available for heating the lower atmosphere or the surface of the Earth. Thus only 40-50% of incoming solar radiation is available

> to be absorbed by the surface of the Earth. These percentages are averages, and vary from place to place depending on the amount of cloud cover and the nature of the surface of the Earth that the solar radiation reaches.

In tweaking Stetson, then, is the UB asserting, contrary to science, that 100% of the sun's visible light *does* pass through the atmosphere? Or is it implying, also contrary to science, that the Earth receives more than one two-billionth of the sun's total light radiation but that about one two-billionth is filtered through? If neither of these scientifically significant points was intended, perhaps the change was made for purely literary reasons—to frame the section "The Urantia Atmosphere" with "The planetary atmosphere" as its first term, resulting in an inadvertent error.

The parallels continue as the UB offers its own hypothetical utility bills, using a slightly higher price and changing Stetson's "continental United States" to "North America" and his "Greater New York" to "Chicago." Since the surface area of North America is more than double that of the continental United States, the 800 quadrillion dollar figure is accordingly more than double that of Stetson's 327 quadrillion. But the UB may be deviating erroneously from Stetson in basing its bill on the light "falling upon" North America. In doing so, it charges for a year's worth of "filtered" sunlight, whereas Stetson's U.S. bill is apparently based on a year's worth of full-strength sunlight—the light falling on the top of the atmosphere—applied to the surface area of the U.S. If this is so, then the UB's North American bill is 30 to 50% higher than it should be.[22]

The accuracy of both bills should be checked. If the UB's is found to be in error, then it is likely that the UB writer mistakenly inferred how Stetson did his figuring. Perhaps if Stetson had been more explicit about his use of the solar constant, the UB would not have tweaked the terms of the bill in the way it did.

The paragraph concludes with the UB reminding us of the rather obvious fact that "light" is not the only solar radiation.

PARAGRAPH 2. *Ozone layer and ultraviolet rays.* Stetson and the UB agree, though not exactly, in their descriptions of the altitude range and relative thickness of the ozone layer. This altitude range agrees with current scientific determinations,[23] as does the relative thickness.[24]

But the UB strays significantly from Stetson at the outset. By tweaking Stetson's "completely opaque" to "all but opaque," it denies his claim that the atmosphere prevents the extreme-end UV rays from reaching the Earth's surface. Today's science supports Stetson. The following quotes, reflecting current understandings of the UV spectrum, all mention that UVC—the highest-frequency UV radiation—never penetrates the atmosphere:

> From Environment Canada[25]:
>
> "Living with Ultraviolet" / "UV - The ABC's"
>
> There are three types of ultraviolet: UV-A, UV-B and UV-C. UV-A is the weakest form. It causes skin aging, wrinkles and can also damage outdoor plastics and paint. UV-B, which is stronger than UV-A, is the most harmful to us and other life forms. UV-B causes skin cancer and cataracts . . . UV-B and UV-A cause suntans and sunburns. UV-B also reduces the growth of plants, and may affect the health of wildlife and other animals. *UV-C, which is even stronger than UV-B, never reaches the earth's surface because it is filtered out by the atmosphere* [italics added].

From New Zealand's National Institute of Water and Atmospheric Research[26]:

> UV radiation is subdivided into three wavelength bands; UVA (315-400 nm), UVB (290-315 nm) and UVC (220-290 nm). UVA radiation is important in the generation of photochemical smog and also in fading and damage to plastics, paints and fabrics. *UVC is totally absorbed by ozone and other gases*, and does not reach the Earth's surface. Only 1% of solar radiation is within the UVB band, and most of this is absorbed by ozone. . . . Although UVB radiation has some beneficial effects, including the production of vitamin D in humans, the harmful effects can be serious, causing skin cancer and damage to eye tissue [italics added].

From the University Corporation for Atmospheric Research[27]:

> The F region starts around 105km and has a maximum around 600km. It is the highest of all of the regions [of the ionosphere]. Extreme ultra-violet radiation (EUV) is absorbed there.

If some EUV (or UVC) does indeed penetrate the atmosphere, then the UB writer countered the consensus and replaced error with fact. If not, then the UB replaced fact with an egregious error. If the latter is the case, it may well have been due to a misinterpretation of Stetson's loosely worded first two sentences. His first sentence mentions "the extreme ultra-violet end of the spectrum" (which corresponds to UVC or EUV); the following one mentions "*this region* of . . . very short wave-lengths." It is difficult to tell whether "this region" refers only to UVC/EUV or to the entire UV spectrum. Either referent may be correct according to today's science: a great deal of the entire UV spectrum is indeed absorbed by ozone, and some UVC may be as well, as indicated in the above passage from NIWA, though it appears that most of it is absorbed in the F layer, as indicated in the above passage from UCAR. But the UB equates "the extreme ultraviolet end of the spectrum" with the entire UV range, harmonizing its first two sentences according to this probable misunderstanding.

After the UB's problematic first sentence, the parallelisms with Stetson are tight. However, the UB introduces a confusing element not found in Stetson: It refers to "dangerous and destructive" UV radiations in one sentence, and to "highly important and health-giving" ones in the next, giving the false impression that there are two types of UV rays, one dangerous and one helpful. As the above passages indicate, no UV rays have wholly beneficial effects; they are all dangerous despite their benefits when absorbed in small quantities.

PARAGRAPHS 3 & 4. *"Fortuitous" or planned?* As shown in the parallel chart, I have found no direct parallel with Stetson for Paragraph 3. But the UB's comments in Paragraphs 3 and 4 seem to have been triggered by Stetson's remark in Paragraph 4: "We can be confident . . . that it is a *fortunate* ➤

combination of the sun and our atmosphere that makes life on the earth possible." Stetson's observation of this apparently lucky combination of factors is shared by other apparent "mortal mechanists." In 1934 Sir James Jeans commented: "The ozone does not shut off all the ultra-violet radiation, and this is fortunate since a certain amount of it is beneficial to us."[28] And a 1974 physical geography textbook says: "Fortunately, little ultraviolet radiation actually reaches the surface of the earth; most of it is filtered out in the upper atmosphere."[29]

But what exactly is the UB asserting here? In alluding to "more than two-score *apparently* accidental protective operations similar to the action of this ozone layer," is the writer implying that superhumans are involved in creating and/or controlling particular atmospheric phenomena? If so, which superhumans are involved, and how?

In searching for answers elsewhere in the Urantia Book, I found no specific mention of superhumans—Master Physical Controllers, power centers, midwayers, Life Carriers, et al.—managing such local processes as atmospheric phenomena on individual planets. In fact, the following passages, vague as they are, imply that the beings operating on or near the inhabited worlds are primarily involved in balancing and equalizing certain basic universe energies which are beyond our ken.

> These power centers, in association, function to produce the living system of control and equalization which operates to maintain the balance and distribution of otherwise fluctuating and variable energies. *Power centers are not, however, concerned with transient and local energy upheavals, such as sun spots and system electric disturbances; light and electricity are not the basic energies of space; they are secondary and subsidiary manifestations* (41:1.2; italics added).

> The Universe Power Directors initiate the specialized currents of energy which play between the individual stars and their respective systems. These solar furnaces, together with the dark giants of space, serve the power centers and physical controllers as way stations for the effective concentrating and directionizing of the energy circuits of the material creations (41:3.1).

> The power-energy supervision of the evolutionary inhabited worlds is the responsibility of the Master Physical Controllers, but these beings are not responsible for all energy misbehavior on Urantia. There are a number of reasons for such disturbances, some of which are beyond the domain and control of the physical custodians. Urantia is in the lines of tremendous energies, a small planet in the circuit of enormous masses, and the local controllers sometimes employ enormous numbers of their order in an effort to equalize these lines of energy. They do fairly well with regard to the physical circuits of Satania but have trouble insulating against the powerful Norlatiadek currents (41:2.8).

> These [energy] transformers [a type of Master Physical Controller] are . . . skillful in their efforts to insulate the planets against the powerful energy streams passing between gigantic planetary and starry neighbors. Their energy-transmutive attributes render them most serviceable in the important task of maintaining universal energy balance, or power equilibrium. At one time they seem to consume or store energy; at other times they appear to exude or liberate energy. The transformers are able to increase or to diminish the "storage-battery" potential of the living and dead energies of their respective realms (29:4.17).

The last two passages refer to the Master Physical Controllers' attempts to insulate the planets, but neither indicates that they do so by fashioning or refashioning planetary atmospheres. Rather, they act by their personal presence and as the occasion demands. We are told that they protect the planets "against the powerful energy streams passing between gigantic planetary and starry neighbors," not against the radiations of the planet's own solar source.

Indeed, the whole thrust of the Urantia Book's teachings about planetary evolution is that planets and their atmospheres (if the planets have atmospheres) develop naturally. Before life is inaugurated, the Life Carriers examine the physical features of the planet, survey its solar and cosmic environment, and forecast the development of the planet and the solar-planetary relationship. If the planet is found to be inhabitable, the Life Carriers then decide on the appropriate life plasm. Section 2 of Paper 49, "The Inhabited Worlds," outlines the variety of physical types the Life Carriers create to best fit the varying conditions on each planet. We are told in 49:2.3 that "The physical differences of the worlds of mortal habitation are chiefly determined by the nature of the atmosphere; other influences which contribute to the planetary differentiation of life are relatively minor." Rather than adjusting the atmosphere, then, the Life Carriers design life that can best adjust itself *to* the atmosphere. As explained in the section that immediately precedes 58:2:

> But as this era opens, Urantia is in every way evolving toward a state favorable for the support of the initial forms of marine life. Slowly but surely physical developments on earth and in adjacent space regions are preparing the stage for the later attempts to establish *such life forms as we had decided would be best adapted to the unfolding physical environment—both terrestrial and spatial* (58:1.5).

Several passages in "The Overcontrol of Evolution" and in other papers of the 57-65 series illustrate the Life Carrier-designed ability of life forms to adapt themselves to a changing environment. Here are two:

> At the proper degree of saltiness in the oceans animal life evolved, and it was comparatively simple to allow the briny waters to circulate through the animal bodies of marine life. But when the oceans were contracted and the percentage of salt was greatly increased, these same animals evolved the ability to reduce the saltiness of their body fluids just as those organisms which learned to live in fresh water acquired the ability to maintain the proper degree of sodium chloride in their body fluids by ingenious techniques of salt conservation (58:6.5).

> One of the most serviceable and complex episodes in the evolution of the higher types of animals consisted in the development of the ability of the iron in the circulating blood cells to perform in the double role of oxygen carrier and carbon dioxide remover. And this performance of the red blood cells illustrates how evolving organisms are able to adapt their functions to varying or changing environment (65:6.4).

This principle of adaptative evolution has, of course, been recognized by scientists ever since Darwin. The following two passages refer specifically to adaptations to UV radiation.

From Sir James Jeans' *Through Space and Time* (1934):

> The ozone layer controls the supply of ultra-violet radiation we receive from the sun, and broadly speaking, gives us just about the amount we need. When we travel on other planets [during Jeans's imaginary excursion through the solar system], we may find that their atmospheres let through too much or too little of this radiation to suit us and our health will suffer accordingly. Yet once again the reason that our own atmosphere appears to treat us so well is probably that our bodies have, after millions of generations, learnt how to get on with exactly what is meted out to them. If we had lived for millions of generations on some other planet, we might find the amount of ultra-violet radiation on earth intolerable (p. 64).

From NASA's Earth Observatory website[30]:

> Ultraviolet Radiation: How It Affects Life on Earth, by Jeannie Allen, September 2001
>
> Ultraviolet (UV) radiation that reaches the Earth's surface is in wavelengths between 290 and 400 nm. . . . Radiation at shorter wavelengths of 290-320 nm, designated as UV-B, causes damage at the molecular level to the fundamental building block of life—deoxyribonucleic acid (DNA). . . .
>
> But living cells are "smart." Over millions of years of evolving in the presence of UV-B radiation, cells have developed the ability to repair DNA. A special enzyme arrives at the damage site, removes the damaged section of DNA, and replaces it with the proper components (based on information elsewhere on the DNA molecule). This makes DNA somewhat resilient to damage by UV-B.

Turning to the ozone layer, Allen continues:

> In addition to their own resiliency, living things and the cells they are made of are protected from excessive amounts of UV radiation by a chemical called ozone. A layer of ozone in the upper atmosphere absorbs UV radiation and prevents most of it from reaching the Earth. Yet since the mid-1970s, human activities have been changing the chemistry of the atmosphere in a way that reduces the amount of ozone in the stratosphere (the layer of atmosphere ranging from about 11 to 50 km in altitude). This means that more ultraviolet radiation can pass through the atmosphere to the Earth's surface, particularly at the poles and nearby regions during certain times of the year.
>
> Without the layer of ozone in the stratosphere to protect us from excessive amounts of UV-B radiation, life as we know it would not exist. Scientific concern over ozone depletion in the upper atmosphere has prompted extensive efforts to assess the potential damage to life on Earth due to increased levels of UV-B radiation. Some effects have been studied, but much remains to be learned.

Allen refers in her last paragraph to "scientific concern" over ozone depletion. Are the superhumans concerned as well, and if so, are they doing anything to curb or reverse the process? If we take the UB to mean that the ozone and other insulating layers in the atmosphere are designed and not accidental, will the superhumans work to repair the layer that is being accidentally damaged? And how will they do it?

The UB's comments in Paragraphs 3 and 4 are indeed puzzling. Certainly, if the writer had expounded on even a few of the midwayers' facts and findings which pertain to atmospheres, or if the writer had described even a few of the "more than two-score *apparently* accidental" protective operations and explained why they are not accidental, we would have a firmer basis for reflection.[31]

PARAGRAPH 5. *Natural blanket and artificial provision.* The UB follows Stetson in his description of the atmospheric blanket but adds an intriguing allusion to the "artificial provision" of life maintenance in the absence of such a blanket. As with Paragraphs 3 and 4, whose elliptical statements are not supported elsewhere in the book, I have been unable to find cross-references that explain exactly what is meant by "artificial provision." Two passages may have a bearing on the question:

> These beings [the energy transmitters, a type of Master Physical Controller], together with the energy transformers, are indispensable to the maintenance of mortal existence on those worlds having an impoverished atmosphere, and they are an integral part of the technique of life on the nonbreathing planets (29:4.24).
>
> On the nonbreathing worlds the advanced races must do much to protect themselves from meteor damage by making electrical installations which operate to consume or shunt the meteors.... These worlds are also subject to disastrous electrical storms of a nature unknown on Urantia. During such times of tremendous energy fluctuation the inhabitants must take refuge in their special structures of protective insulation (49:3.3).

PARAGRAPH 6. *Atmospheric profile.* The parallelisms in this paragraph are so close as to be virtually clause-by-clause. It is thus quite easy to trace the UB's paraphrasing operations and to pinpoint its tweaking. In doing research on the subjects covered in this paragraph, however, I found the UB's statements fraught with probable errors, some of which are not attributable to Stetson's datedness.

a) *Layers of the atmosphere.* In the first sentence the UB, unlike Stetson, mentions an "inner ionosphere" lying between the troposphere and the stratosphere. I have never read of such an ionosphere, either surmised or identified, anywhere else. I believe that the insertion of this "inner ionosphere" is a serious error which came about through a misreading of Stetson's atypical cross-sectional description of the atmosphere. Instead of beginning at ground level with the troposphere and working his way up, Stetson starts with the stratosphere. He takes a step down to mention the troposphere and then two steps up to mention the ionosphere. The UB joins Stetson midway into his description, at the troposphere, and, like him, jumps two steps to the ionosphere, terming it the *inner* ➤

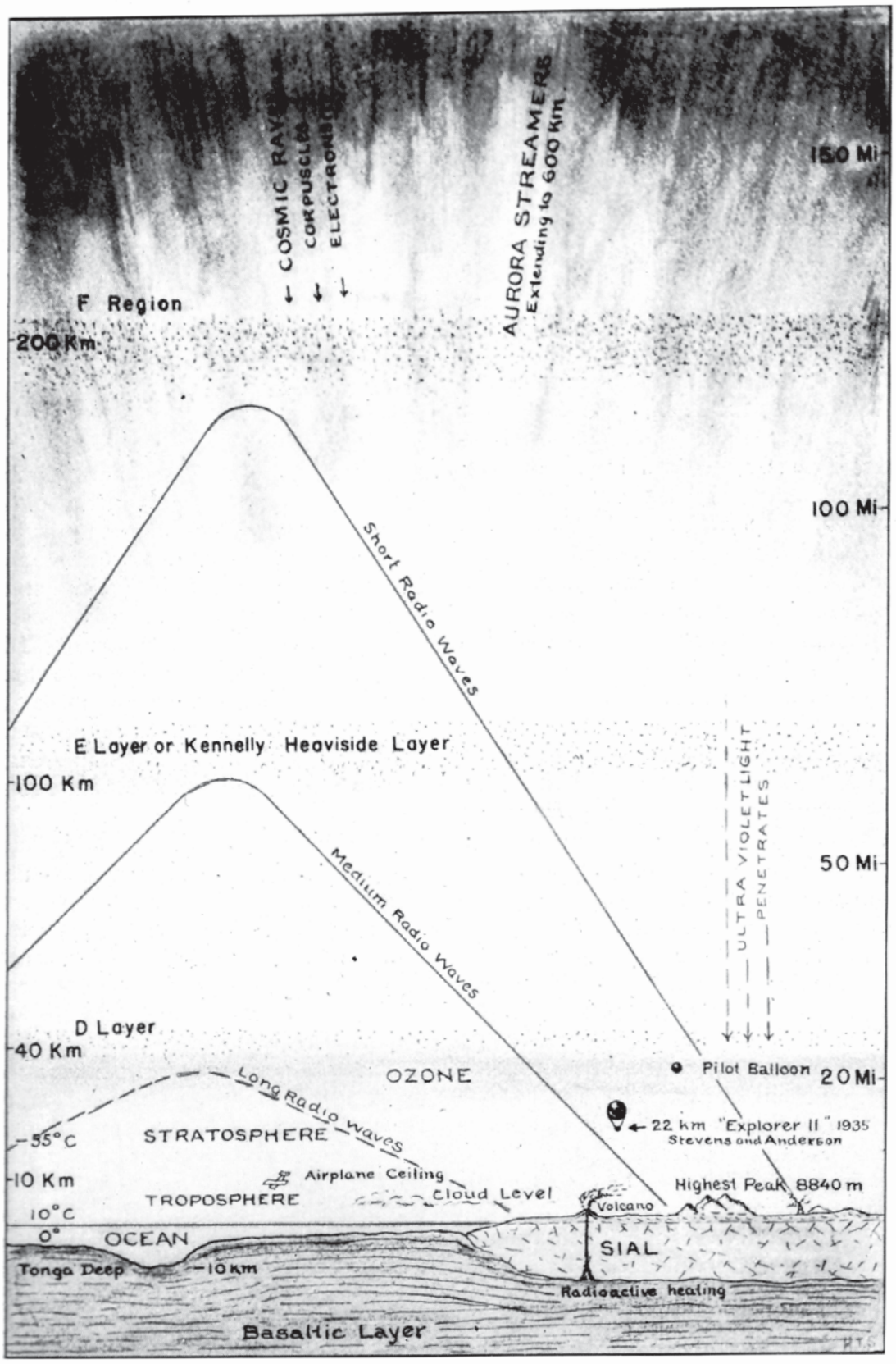


FIG. 2. CROSS SECTION OF EARTH'S ATMOSPHERE.

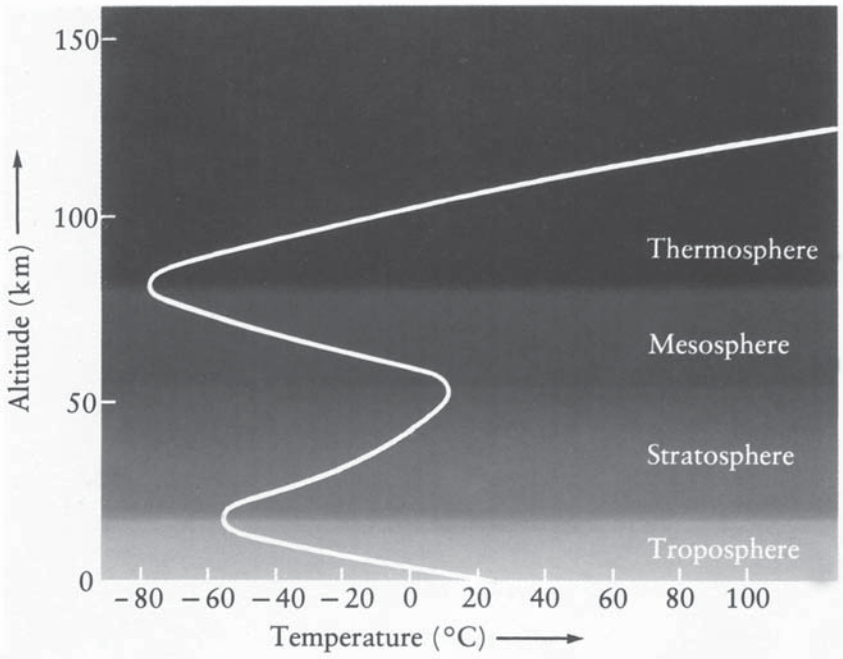


FIGURE 8-17 Temperature Profile of Earth's Atmosphere The atmospheric temperature varies with altitude because of the way sunlight interacts with various atoms and ions at different elevations.

ionosphere to distinguish it from the "outer ionospheres" mentioned later in the section. It then adds the stratosphere.

Tellingly, this "inner ionosphere" is ignored in the next sentence, where the atmospheric levels are described in greater detail and the UB adheres more strictly to Stetson. Today's scientists call the level between the troposphere and the stratosphere the *tropopause.* Quoting from *The New Penguin Dictionary of Science*:

> The tropopause is characterized by a change in the temperature profile of the atmosphere: the temperature fall with altitude halts, and instead the temperature remains steady or rises with altitude.... The level of the tropopause is of interest to pilots of jet aircraft because the jet stream tends to be strongest just below the tropopause.[32]

b) *Vertical profile.* Both Stetson and the UB claim—or rather, Stetson tentatively suggests and the UB positively asserts—that the temperature in the stratosphere remains constant for at least 30 miles upward. This was the prevailing speculation at the time of Stetson's article. Today it is accepted that the stratosphere is, for the most part, a region of rising temperatures.

From A *Dictionary of Earth Sciences*:

> *Stratosphere*: The atmospheric layer above the troposphere, which extends on average from about 10 to 50 km [about 7 to 31 mi] above the Earth's surface. The stratosphere is a major stable layer whose base is marked by the tropopause, and where temperatures overall average approximately -60°C. Temperature in the lower stratosphere is isothermal but increases markedly in the upper part, to reach a maximum of about 0°C at the stratopause. High stratospheric temperatures result from absorption of ultraviolet radiation (0.20-0.32 [mu]m wavelengths) by ozone concentrated at 15-30 km. Due to the very low air density, even the small amount of ozone concentrated in the upper stratosphere is extremely effective in absorbing radiation, thus giving high temperatures at 50 km.[33]

From a 1994 astronomy textbook:

> Above [the troposphere] is the region called the stratosphere, which extends from 11 to 50 km (about 7 to 31 mi) above the Earth's surface. Ozone (O_3) molecules in the stratosphere efficiently absorb solar ultraviolet rays, thereby heating the air in this layer.[34]

From NASA's Earth Observatory website:

> The stratosphere and stratopause stretch above the troposphere to a height of 50 km. It is a region of intense interactions among radiative, dynamical, and chemical processes, in which horizontal mixing of gaseous components proceeds much more rapidly than vertical mixing. The stratosphere is warmer than the upper troposphere, primarily because of a stratospheric ozone layer that absorbs solar ultraviolet energy.[35]

But even before Stetson, it was suggested that the temperature does rise in the stratosphere. In an article on the Northern Lights that appeared in the August 1938 issue of *Scientific American,* A. S. Eve commented:

> The sound of big guns or of heavy explosions passes upward into the cool and rarefied air and is then refracted or bent back again to the earth, so that sometimes, like shortwave radio, it cannot be heard or detected at intermediate distances.... The fact that sounds are bent back again to the earth necessitates a warmer layer above the cold. It seems that with increasing altitude the temperature may gradually decrease down to many degrees below zero, Fahrenheit, but at a height of 30 miles there is an increase up to 80 degrees, Fahrenheit, and *the heat to maintain this may be connected with the formation of ozone from oxygen by the sun's ultra-violet light* (p. 217, italics added).

Eve's temperature estimates do not match today's measurements, but his surmise about stratospheric warming caused by UV absorption does agree with current understandings.

AS THE MODERN diagram on this page shows, the temperature rises till it reaches 50km and then declines until it reaches 80km. This region of declining temperature is now known as the *mesosphere*. Temperatures begin to rise again ➤

at the latter altitude. Here the UB appears to be more accurate than Stetson, who speculates that the rise occurs "at a height of 60 kilometers or some 40 miles." (On the other hand, scientists recognize that levels and temperatures vary around the globe and in response to seasonal changes.[36]) Today, the region of rising temperatures above the mesosphere is known as the *thermosphere*, though the term "ionosphere" is still also used.

Stetson and the UB then describe the conditions of the upper ionosphere where the aurorae occur. Stetson deduces that temperatures in this region must be very high since ionized oxygen is present there. The UB goes one step further, saying that the intense heat indicated by these temperatures *causes* the ionization of oxygen. But this obscures the real causes of ionization—the sun's rays and particles. Increased heat *results* from the impact of these solar agents on the oxygen molecules. In ascribing "heat" as the ionizing agent, the UB begs the question of how the heat got there. Later in the section the UB identifies the real agents, following Stetson more closely.

The UB lowers Stetson's estimated temperatures in the ionosphere from 1000°C. (1832° F.) to 1200°F. (approximately 680°C.). This lowered figure approximately matches the 700°C. given in a 1947 textbook, Skilling and Richardson's *Astronomy*. But Stetson's estimate was not incorrect. NASA's Windows to the Universe states: "Temperatures in the thermosphere are very sensitive to solar activity and can vary from 500°C to 1500°C."[37] A recent article on Space.com explains: "During solar minimum, the gas temperature in the thermosphere is around 1,290°Fahrenheit (700°C). But during solar maximum, the temperature can more than double . . . The extra heat causes the atmosphere to expand during solar maximum.[38] In stating that "a temperature of 1200°F. is reached," the UB implies a zone of stable temperature, ignoring the cyclical fluctuations.

The UB asks us to bear in mind the confusing statement that "one half of all your atmosphere is to be found in the first three miles." Stetson is more helpful in specifying that one half the total amount of oxygen and nitrogen is found there. Other scientists say half the atmosphere's *pressure* or *mass* is contained within this altitude.

In the next sentence, dealing with the height of the earth's atmosphere, the UB incorporates information resulting from an apparent typo that crept into the 1942 version of Stetson's article (referred to in the "Stetson-Stetson" analysis above). The information deals with the height of the highest auroral streamers observed by Norwegian scientist Dr. Carl Störmer over the years 1910 to 1913. Stetson's 1938 article, like many textbooks and articles before it,[39] says the aurora's height was 600 or more *miles*. The 1942 article changes the 600 miles to 600 kilometers, and the UB apparently converted the kilometer figure to miles and rounded it up to the nearest hundred, arriving at 400 miles.

Today's texts, such as the 1994 edition of Kauffmann's *Astronomy*, indicate that aurorae typically occur from about 100 to 400 km above the Earth's surface. According to the website "How Stuff Works":

> As the electrons [from the solar wind] enter the earth's upper atmosphere, they will encounter atoms of oxygen and nitrogen at altitudes from 20 to 200 miles above the earth's surface. The color of the aurora depends on which atom is struck, and the altitude of the meeting. Green = oxygen, up to 150 miles in altitude; red = oxygen, above 150 miles in altitude; blue = nitrogen, up to 60 miles in altitude; purple/violet = nitrogen, above 60 miles in altitude.[40]

I have been unable to find any recent texts mentioning the occurrence of aurorae at 600 miles up, or even at 400. Stetson's 1942 change, whether inadvertent or deliberate, thus agrees more with current observations though it may still be too high. However, even if aurorae do reach 400 or even 600 miles, scientists do not infer that the highest aurorae mark the height of the whole atmosphere but just the height of the thermosphere. Above the thermosphere they recognize the *exosphere*, described by *Compton's Online Encyclopedia* as follows:

> The highest layer of the atmosphere, the exosphere, extends beyond the thermosphere. The density of the air is so low in this layer that the concept of temperature loses its customary meaning. Ultraviolet rays fill the exosphere, and faint glows called zodiacal light that are due to sunlight reflected from particles of meteoric dust originate in this layer.[41]

NASA's Earth Observatory states:

> At the exosphere, beginning at 500 to 1,000 km above the Earth's surface, the atmosphere blendsinto space. The few particles of gas here [helium and hydrogen] can reach 4,500°F (2,500°C) during the day.[42]

Only a brave person is willing honestly to admit, and fearlessly to face, what a sincere and logical mind discovers (160:1.7).

Interestingly, the UB contradicts its own assertion that "The height of the earth's atmosphere is indicated by the highest auroral streamers—about four hundred miles" in Paper 42, where it comments:

> Practically speaking, space is not empty. Even the atmosphere of Urantia thins out increasingly until at about *three thousand miles* it begins to shade off into the average space matter in this section of the universe (42:4.6; 473, italics added).

PARAGRAPHS 7 & 8. *Sunspots and aurorae.* Stetson's remarks on sunspots are very cursory, far less informative than that of introductory astronomy textbooks available at the time and since. And yet the Urantia Book limits itself to his observations, solidifying his descriptions and conjectures by removing all tentativeness. This results in a number of misstatements not found in Stetson.

He touches upon two features of sunspots which were already well-known: (1) their hurricane-like appearance when seen in hydrogen light, first observed in 1908 by Dr. George Ellery Hale of the Mount Wilson Observatory in California, and (2) their magnetic nature, also discovered by Hale through spectrographic analysis. The UB closely paraphrases Stetson in these descriptions.

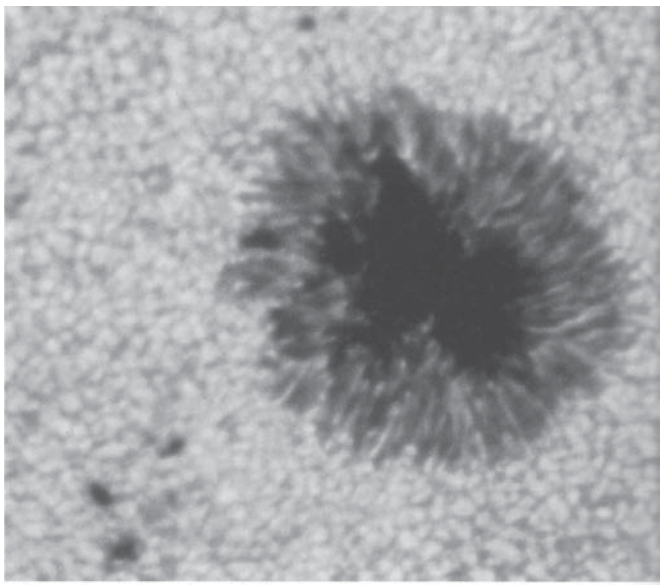
But the UB overstates the hurricane metaphor by removing Stetson's qualification that "in general" the spots in the sun's northern and southern hemispheres whirl in opposite directions. By 1942 it was already well-known that the motions were more complicated than those of terrestrial hurricanes.

From Moulton's *An Introduction to Astronomy* (1916):

> Hale's discovery is a proof of cyclonic motion in the upper parts of sunspots. *Unlike cyclones on the earth*, the direction of motion in a hemisphere is not always the same. Hale found numerous examples where two spots seemed to be connected, one having one polarity and the other the opposite. It has been suggested they are the two ends of a cylindrical whirl. This idea is confirmed, at least to some extent, by the fact that, so far as observational evidence goes at present, when two spots are near together, they always have opposite polarity. Another remarkable fact is that if two neighboring spots are in the northern hemisphere of the sun, the one which is ahead has a counter-clockwise vortical motion, while the motion in the other is in the opposite direction. The conditions are the opposite in the sun's southern hemisphere (384-85, italics added).

Stetson and the UB ignore another long-observed characteristic of sunspots not shared by terrestrial hurricanes—their reversal of polarity with each new sunspot cycle. As described by Robert H. Baker's *Astronomy* (1938):

> From [Hale's] studies of the magnetic properties of the vortices underlying the spots, from which the existence and direction of rotation of the vortices are inferred, it appears that the preceding principal spots of the groups whirl in opposite directions in the sun's northern and sourthern hemispheres, and that *these directions are both reversed with the beginning of each new cycle*. It also appears from the magnetic effects observed that *the follower spot of each group whirls in the opposite direction from that of the leader spot*. Neither of these effects is completely understood (282-83, italics added.)



A sunspot group (from Kaufmann, Universe, 1994)

Because of this reversal of polarity pattern every eleven years, astronomers prefer to speak of the entire solar cycle as having a period of twenty-two years.

As to the question of how, exactly, sunspots are connected to aurorae, Stetson proposes this possible modus operandi: "Since a magnetic field may exert a repulsing effect upon swiftly moving electrons, we see *some reason* that charged electric particles can be actually hurled *from sunspot centers* at velocities which may carry them through space into the earth's atmosphere, thus ionizing the upper regions of the air in a way that would produce auroral displays [italics added]." Emphasizing the provisional nature of his speculations he adds:

> Whether all the effects produced in the earth and its atmosphere that are noticed at sunspot maxima are the result of the sunspots themselves or whether the state of the sun and its whole surroundings are so activated as to change materially the cosmic environment of the earth isa question still unanswered (528).
>
> With the new unsurpassed equipment installed at the McMath-Hulbert Observatory of the University of Michigan, motion pictures of the sun's surface have been made on many different frequencies of the sun's radiation. . . . Some of the movements in the high solar atmosphere over the regions of sunspots revealed by this new process of recording continuous motion at present defy explanation and may yet completely revolutionize our ideas of the sun's behavior pattern (520).

In contrast to Stetson's tentative tone, the UB declares that "Auroral phenomena are directly related to sunspots" and that "Such magnetic fields are able to hurl charged particles from the sunspot craters out through space to the earth's outer atmosphere . . ." (italics added). The UB's use of the word 'craters' suggests a resemblance to volcanos; Sir James Jeans, in *Through Space and Time* (1934), described sunspots in a somewhat similar way: "[S]unspots are of the nature of vent holes from which masses of hot gas are shot out at terrific speeds" (p. 161).

In the sixty years since Stetson's article, solar astronomers have built satellite telescopes and other instruments more sophisticated than the "new and unsurpassed equipment" installed at McMath-Hulbert Observatory. Major progress has been made in examining if not in fully understanding the complexities of solar phenomena. Stetson wasn't even sure that electrons were fired from the sun at all; today, vast particle emissions--the solar wind, solar flares and coronal mass ejections—are recognized as the causes of aurorae, though how they are triggered is still largely a mystery. Modern science contradicts the UB's assertions that sunspots are directly related to aurorae in the sense of being their immediate cause.

From a NASA Q & A webpage dedicated to "auroral science"[43]:

> [Q.] Do sunspots affect the brightness and color of auroras?
>
> [A.] Well, *not directly*. The mechanism that produces auroras is controlled mostly by the solar wind [i.e. vast amounts of gases containing free electrons and ions, known as plasma, streaming from the sun's corona] and by the ejection of large clouds called 'coronal mass ejections' from the solar surface. ➤

> *Sunspots are not directly involved in these two phenomena, but only serve to show the relative level of solar activity which does correlate with producing auroras*. When the wind is agitated or when more of these CMEs are being spawned in a given time, the sun is in its 'active' state which also includes more sunspots on the surface. The brightness and color of auroras are pretty much controlled by how energetic, tangled, and magnetically active the solar wind and CMEs are as they impact the earth's space environment. They can shake loose and accelerate more energetic particles in the earth's environment, and these flow down into the polar regions to produce more, or less, dramatic auroral storms [italics added].

Another site, the Exploratorium,[44] describes the indirect role of sunspots in producing geomagnetic storms and the accompanying aurorae:

> Sunspots . . . have an indirect but significant impact on life here on earth. As early as the nineteenth century, scientists noticed that high levels of activity on the sun, like flares and sunspots, were followed shortly by strong fluctuations in magnetic instruments on earth. They wondered what caused these changes.
>
> Scientists today have discovered a lot about the way the sunspots affect the earth. According to [David] Dearborn [a stellar physicist at Lawrence Livermore Laboratories], "*The sunspot itself, the dark region on the sun, doesn't by itself affect the earth. However, it is produced by a magnetic field, and that magnetic field doesn't just stop, it comes to the surface and expands out above the surface. . . .*" Hot material called plasma *near* a sunspot interacts with magnetic fields, and the plasma can burst up and out from the sun, in what is called a solar flare. Energetic particles, x-rays and magnetic fields from these solar flares bombard the earth in what are called geomagnetic storms. When these storms reach earth, they affect us in many ways.
>
> Ordinarily, the earth's own magnetic field protects the earth from most of the sun's emissions. But during periods of intense sunspot activity, which coincide with solar flares and coronal mass ejections, the geomagnetic flow from the sun is much stronger. These magnetic storms produce heightened, spectacular displays of the Aurora Borealis and the Aurora Australis, otherwise known as the Northern and Southern Lights [italics added].

According to a National Oceanic and Atmospheric Administration website,[45] coronal mass ejections and solar flares occur "*near* sunspots, usually at the dividing line between areas of oppositely directed magnetic fields" [italics added].

Even before 1942, sunspots' direct relationship to aurorae and geomagnetic storms was disputed. In the June 1940 issue of *Scientific American*, Stetson's astronomer colleague Henry Norris Russell published an article with the lengthy title, "What Causes Magnetic Storms?: Not Sun-Spots but Gases Erupted from the Sun and Traveling to Earth at Times of Solar Turmoil . . . Sun-Spots May but Need Not Accompany This." He wrote:

> Great numbers of magnetic storms have been observed . . . and it has been found, year by year and decade by decade, that their numbers rise and fall in striking parallelism with those of the spots upon the Sun, in a manner which leaves no possible doubt that the two are *in some way* closely connected. . . . In the same system of related phenomena belong the great displays of the aurora—the Northern Lights . . . These are practically always accompanied by pronounced magnetic disturbances, and are related in the same way to sun-spots. . . . The luminosity of the aurora and the disturbances of radio transmission occur simultaneously in the same part of the upper atmosphere, and evidently are two sides of the same event. . . . But what is the relation of all this to sun-spots? . . .
>
> Cumulative evidence has convinced everyone that the spots are not effective in themselves, but they serve as a useful—and decidedly accurate—index of the varying general activity of the Sun. *Near* an actively changing spot, the Sun's surface is in turmoil. Bright regions, as well as dark, often appear, and, when these are seen at the edge of the visible hemisphere, eruptive prominences are frequently observed. Great masses of gas are raised high above the ordinary level of the chromosphere, and subject to rapid and extraordinary changes. The admirable motion pictures obtained by Lyot in France and McMath in Michigan show that the motions are very complicated. . . . [T]here are times when great masses of it are evidently driven clean away into space, at huge and increasing velocity. . . .
>
> The regions of eruption on the Sun, from which the clouds are ejected, are usually, *but not always*, connected with spots—which explains without difficulty why the same is true of magnetic storms and aurorae on Earth (332-333, italics added).

Rather than being volcano-like "craters" from which charged particles are hurled, sunspot centers are indeed more like the eye of a hurricane. A recent article on Space.com[46] reports:

> Inside Sunspots: New View Solves Old Puzzle, by Robert Roy Britt
>
> Using a technique similar to the ultrasound that reveals a fetus inside the womb, a team of researchers from Stanford University has imaged the innards of sunspots, revealing rivers of hot gas rushing thousands of miles *toward the center of the Sun*. The motion of these vortices, predicted decades ago but never seen, provides the glue that keeps a sunspot from flying apart, according to the researchers . . . One mystery that has long dogged solar physicists involves sunspots' habit of traveling in pairs. Each sunspot has just one polarity—either positive or negative—like one end of a battery. The magnetic energy from one sunspot loops outward into the solar atmosphere and reconnects to its pair, which travels behind it as they migrate across the Sun's surface. But theories suggest that the single-polarity configuration should cause the magnetic filaments that make up a sunspot to simply fly apart, says Stanford researcher Phillip Scherrer. . . .
>
> The new view inside sunspots, provided by a spacecraft called the Solar and Heliospheric Observatory (SOHO), shows a previously unseen process that seems to resolve this puzzle. *Plasma in the middle of a sunspot zooms toward the center* of the Sun at 3,000 mph, creating a siphon of sorts that reigns in the magnetic fields. Alexander Kosovichev, a member of the research team, explained what's going on: Magnetic fields in sunspots are known to prevent the heat that's generated deep within the Sun from rising to the surface. So the plasma in a sunspot is cooler than plasma on the surrounding surface

> of the Sun. Since the sunspot plasma is cooler, it is heavier, and it plunges downward. . . .
>
> The process is *somewhat analogous to a hurricane*. A warm ocean heats air near the surface, which rises, pulling surface air inward from outside a hurricane. The inward rushing air forces more air to rise near the center of the storm, and a cycle is created that cannot be broken until the storm moves over cooler water or land. In sunspots, the converging flow, said Kosovichev, "generates dynamic pressure, like in hurricanes, which holds the magnetic elements together." . . .
>
> But the roots of sunspots are still a mystery . . . . And it's not clear whether or how the downward flow of plasma might trigger solar flares. Flares usually occur when strong magnetic fields of two opposite polarities come close to each other and reconnect, Kosovichev said. The flows beneath the sunspots may have something to do with bringing these opposite polarities together, he said, but that is still being investigated [italics added].

Discussing another observation—that the maximum number of aurorae generally occurs a year or two after the year of most sunspots—Stetson deduces that "sunspots are most effectively associated with the aurorae when, other things being equal, they are most nearly in the geometrical plane that the earth travels in its journey around the sun." The UB endorses his inference with a succinct parallel statement. Another recent article on Space.com confirms this relationship, expressing the dynamics in modern terms:

> Solar Max is Over, Earth's Future Looks Brighter, by Robert Roy Britt
>
> "The maximum sunspot number occurred in July of 2000 and we expect that date to hold," [David] Hathaway [a solar physicist at NASA's Marshall Space Flight Center] told SPACE.com. . . . But as its temper settles, the Sun still has some punch in store. "Solar flares and coronal mass ejections will decline in frequency with the sunspot number," Hathaway said. "However, magnetic storms will continue to *increase in frequency due to the high speed solar wind streams from low latitude coronal holes that form late in the solar cycle*." The visible effect will at times be stunning. Earlier this year [2001], a geomagnetic storm sparked aurora—sheets and filaments of multicolored lights caused by the excitation of gas molecules high in the atmosphere—that were seen as far south as Texas [italics added].

PARAGRAPH 9. *The compass needle.* The parallelisms are largely of the clause-by-clause variety. The UB follows Stetson's description of the fluctuations of the compass needle, and both ascribe these movements to the increased ionization of the upper atmosphere caused by the sun, especially during sunspot maxima. But Stetson is more helpful in that he discusses the compass in the context of the sun's effects on the Earth's magnetic field. In mentioning the compass needle in the isolated way it does ("*Even* the compass needle is responsive to this solar influence . . ."), the UB ignores the bigger solar-geomagnetic picture.

A 1938 astronomy textbook explains these significant solar-geomagnetic interrelationships:

> On the earth, magnetic storms and displays of aurora are more frequent and intense near the times of sun-spot maxima. A *magnetic storm* is a disturbance of the earth's magnetic field, as indicated by erratic variations of the compass needle, and often by strong earth-currents of electricity, which seriously interfere with telegraphic communication.[31]

Today's scientists recognize the Earth's *magnetosphere*—the magnetic field that "dominates space for tens of thousands of kilometers in all directions and interacts dramatically with the solar wind"[48]—as an all-important shield, protecting us against the sun's constant emanation of charged particles which move at speeds of roughly a million miles per hour. Is the magnetosphere one of the "more than two-score apparently accidental protective operations similar to the action of [the] unique ozone layer" alluded to in Paragraph 4? If so, the UB's failure to mention the Earth's magnetic field in this connection, even as it was understood in the early 20th century, is particularly uninstructive.

PARAGRAPH 10. *Radio and the ionosphere.* The first sentence is a summary of a wider discussion in Stetson rather than a paraphrase of a single sentence. It was difficult to trace the parallels with certainty because both Stetson and the UB are ambiguous in their terminology, but in opposite ways. The UB refers to, but does not name, two electrified conducting regions, and names two types of radiowaves: long- and short-wave. Stetson, on the other hand, names the two electrified conducting regions—the E and F—but does not name the two types of radiowaves. He says that the ones "which are most generally used for commercial broadcasting" are prone to be reflected back by the E layer, while those "of much shorter wave-lengths" pass through the E to the F layer.

Is the parallelism complete, that is, is the UB referring to the E and F layers, and is Stetson referring to long- and short-wave?

The situation is complicated by that fact that science recognizes not two but *three* electrified conducting layers or regions: D, E, and F (subdivided as F1 and F2), and *three* phases of wavelengths: long-, medium-, and short-wave. (Stetson's Fig. 2, "Cross Section of Earth's Atmosphere," on p. 44, sketches the three layers and the propagation arcs of the three wave types, as then estimated. The neat correlations made between the layers and the waves are an oversimplification of a highly complex set of phenomena.)

One thing is definite: In Stetson's time, the waves "most generally used for most commercial broadcasting" were in the *medium-wave* bandwidth, on the AM dial. In fact, twice in his article he calls AM the "broadcast band." FM had not yet come to rival AM, and long- and short-wave, if ever used for commercial broadcasting, were never more popular than medium-wave. His waves "of much shorter wave-lengths" must then be short-wave. An excerpt from NASA's "Windows to the Universe" supports this deduction:

> [T]he D and E regions (the lower parts of the ionosphere), reflect standard AM radio waves back to Earth. Radio waves with shorter lengths are reflected by the higher F region. Visible light, radar, television and FM wavelengths are all too short to be reflected by the ionosphere. So these types of global communication are made possible by satellite transmissions.[49]

Stetson's two types of waves, therefore, are medium-wave and short-wave, and each is characteristically affected by the E ➤

FIGURE 8-21 The Northern Lights (Aurora Borealis) A deluge of protons and electrons from a solar flare can produce aurorae that can be seen over a wide range of latitudes. Aurorae typically occur 100 to 400 km above the Earth's surface. (Courtesy of S.-I. Akasofu, Geophysical Institute, University of Alaska)

and the F layers, respectively. The situation is more complicated because, as the passage above indicates, the D region is also involved in limiting or extending the propagation of AM waves, but other sources indicate that this region is only active for a short time each day.[50]

But what of the long-wave referred to by the UB? An Internet article explains that long waves (at frequencies from 150 to 500 kHz, which are below those on the AM dial) are a type of ground wave which "can travel hundreds or thousands or miles with little attenuation. These frequencies are sometimes used for military communications, especially with ships and submarines."[51] This seems to indicate that long-wave does not need the ionosphere to enable it to reach long distances. If this is true, then the UB is mistaken in attributing its long-range propagation to an electrified conducting region in the upper atmosphere.

In any case, it seems likely that the UB did intend to parallel Stetson completely but was being unscientific, either in knowledge or in language. It was probably not using "long- and short-wave" in a technical sense. To avoid confusing radio buffs and other scientifically literate readers, the UB could have simply said "longer- and shorter-wave radio transmissions." Perhaps if Stetson had discussed all three layers and named the three wavelengths, the UB would have paraphrased him less confusingly (confusedly?). ■

ENDNOTES

[1] This essay can be found on The Urantia Book Fellowship's website: http://urantiabook.org/archive/history/sadcrit.htm

[2] This letter is in the Brotherhood/Fellowship files and has been printed in full, along with Sadler's reply, in Larry Mullins with Dr. Meredith Justin Sprunger, *A History of the Urantia Papers* (Boulder, Co.: Penumbra Press, 2000).

[3] Sadler exaggerates the length of Wilkins' involvement with the Urantia Papers. Wilkins first heard of the Urantia Papers in 1941, from Harold Sherman, and began reading them in 1942. He died in 1958. For more information about Wilkins and his involvement with Urantia, see Saskia Praamsma with Matthew Block, *The Sherman Diaries: Volume 1, Dawning Revelations* (Glendale, Ca.: Square Circles Publishing, 2002).

[4] These volumes will soon be republished by the Urantia Foundation (www.urantia.org).

[5] Re the first error: cf. A. S. Eddington's *Stars and Atoms* (1926): " . . . we find that the Companion of Sirius is a globe intermediate in size between the earth and the next larger planet Uranus. But if you are going to put a mass not much less than that of the sun into a globe not very much larger than the earth, it will be a tight squeeze. The actual density works out at **60,000 times that of <u>water</u>** [not the sun!]—just about a ton to the cubic inch" (p. 50). Eddington's book is used copiously in Paper 41. (In a letter to Harold Sherman dated August 30, 1976, Jacques Weiss, the translator of the first French edition of the Urantia Book, claimed to have brought the mistake to Dr. Sadler's attention. This letter will be published in Volume 5 of *The Sherman Diaries*.)

Re the second error: cf. Jeans's *Through Space and Time*: "Then, about ten octaves above the octave of visible light, we come to X-rays. . . . Above all these—very high indeed in the treble—come the **(-rays** [not Y rays!] which are emitted by radium . . . and finally, thirty-two octaves above the octave of visible light, come certain of the constituents of cosmic rays . . ." (pp. 55-56). Three of Jeans's books are major sources for Papers 41, 42, and 57.

Re the third error: cf. Eddington's *Stars and Atoms* (1926): "The electron is the lightest thing known, weighing **no more than 1/1,840** of the lightest atom" (p. 16). Did the UB writer mistake this to mean a little *less* than one two-thousandth? The proton error is, from a source-use point of view, still unclear.

[6] See pp. 173-176, 267.

[7] See Frederick L. Beckner's "*The Architecture of the Universe* and the Urantia Book," on p. 13 of this issue of *The Circular*.

[8] This study was published in the Summer 2001 issue of *The Fellowship Herald* and is posted on www.squarecircles.com. It would be helpful to read it before or after reading this essay.

[9] See Finlan's article, "Revelatory Mouthpiecing," in the Summer 2002 issue of *The Fellowship Herald*.

[10] See my article "Revealed! The Human Origins of Dr. Sadler's Views About Homosexuality" on the Square Circles website (www.squarecircles.com). Other examples of Sadler's UB-like use of sources will be appearing there shortly.

[11] "Stetson's Spots," *Time*, November 22, 1937, pp. 30-31.

[12] The November 26, 1938 issue of *Science News Letter* contained an article called "Mesotron Suggested as Name of New Particle." This particle had previously been referred to by various names, including 'yukon' and 'X-particle.'

[13] One wonders *why* the Urantia Book bears the false closing dates of A.D. 1934-1935, and why Sadler upheld these dates while well knowing that at least three sections of the Urantia Book's science were

added in the early 1940s. Did early Forumites, who must have remembered these later additions, question Sadler's attestation of the 1934 end date? If not, why not?

[14] This document, entitled "History of the Urantia Movement," can be found on The Urantia Book Fellowship's website: www.urantiabook.org.

[15] The transcript of Carlson's deposition can be found on Mark Turrin's Urantia site: www.ubook.org.

[16] The diaries have been transcribed by Saskia Praamsma and will be published, along with private correspondence and other material obtained from the Shermans' heirs, in five volumes by Square Circles Publishing (www.squarecircles.com).

[17] Both Uversa Press editions of *The Urantia Book* (1996, 2002) use 'one two-billionth.' The 'one two-billionths' mistake was first pointed out in 1995 by a member of the Urantia Book Fellowship committee charged with preparing the text of the first Uversa Press edition.

[18] In H. H. Newman, editor, *The Nature of the World and of Man* (Chicago: The University of Chicago Press, 1926), p. 17.

[19] Henry Norris Russell, et al., *Astronomy, Vol. II, Astrophysics and Stellar Astronomy* (Boston: Ginn and Company, 1927), p. 533. The Urantia Book uses another commercial analogy, in 41:5: "As you value energy and power on your world, sunlight would be economical at a million dollars a pound." This is paralleled in Eddington's *Stars and Atoms*: "There is no real reason why you should not buy a pound of light from an electric light company—except that it is a larger quantity than you are likely to need and at current rates would cost you something over £100,000,000" (p. 98).

[20] Cf. Skilling and Robertson's *Astronomy* (New York: Henry Holt and Company, Inc., 1939): "The measurement of the solar constant has been one of the chief occupations of the Smithsonian Institution under the direction of C. G. Abbot since 1902. . . . The average value is 1.94 calories per square centimeter per minute (1.35 X 10^6 ergs per square centimeter per second)" (p. 140). Russell, op. cit.: "Abbot's value of the solar constant . . . corresponds to . . . 0.135 watts per square centimeter, or 1.81 horsepower per square meter. This is equivalent to 4,690,000 horsepower per square mile" (p. 533).

[21] www.haystack.edu/ysp/atmosphere

[22] Surface light is—or was, in the early 20th century—measured by admitting a beam of sunlight through an aperture of known area into an instrument called a pyrheliometer. In *The Nature of Man and the World*, Moulton writes: "The amount of light and heat (radiant energy) received by the earth from the sun is enormous. On a square yard exposed perpendicularly to the sun's rays radiant energy is received at the rate of one and one-half horse-power. The average rate for the earth through the periods of darkness as well as of light is three-eighths of a horse-power per square yard. This means that 300 horse-power are received on a building 50 by 150 feet in dimensions" (pp. 16-17).

[23] *The Compton's Online Encyclopedia* website, which included a page on which the matching altitude range was stated, has been deactivated.

[24] From *The Canadian Encyclopedia* website (www.thecanadianencyclopedia.com): "*Ozone Layer*. The average thickness is about 3mm, with the smallest total amounts of ozone found over the equator and the largest over the poles in winter."

[25] www.ns.ec.gc.ca/wildlife/migratory.html

[26] http://katipo.niwa.cri.nz/lauder/uvinfo.htm

[27] www.windows.ucar.edu

[28] Sir James Jeans, *Through Space & Time* (New York: The Macmillan Company, 1934), p. 63.

[29] Robert J. Kolenkow, Ph.D., *Physical Geography Today: A Portrait of a Planet* (Del Mar, Ca.: CRM Books, 1974), p. 59.

[30] http://earthobservatory.nasa.gov/Library/UVB

[31] In its focus on the organic realm rather than the inorganic, 65:4.3's statement, "Many features of human life afford abundant evidence that the phenomenon of mortal existence was intelligently planned, that organic evolution is not a mere cosmic accident," represents the more common arguing point of modern theism. Many theistic evolutionists who accept the accidental nature of planetary and atmospheric development, agree that the phenomenon of organic evolution, if studied in all its complexity, points to a divine designer.

[32] See www.xrefer.com/entry/645399

[33] See www.xrefer.com/entry/619473

[34] William J. Kauffmann III, *Universe* (New York: W. H. Freeman and Company, 1994), p. 154.

[35] http://earthobservatory.nasa.gov:81/Library/glossary.php3?xref=atmosphere)

[36] http://earthobservatory.nana.gov:81/Library/glossary.php3?xref=atmosphere)

[37] http://windows.arc.nasa.gov/tour/link=/earth/images/profile_jpg_image.html&edu=high

[38] "Solar Max is Over, Earth's Future Looks Brighter," by Robert Roy Britt, posted 28 August 2001 on www.space.com/scienc...my/solarsystem/sun_weather_010828-1.html.

[39] E.g.: From Eve's *Scientific American* article, cited above: "The record height for the top of a streamer [as measured by Störmer] is 1000 kilometers, more than 600 miles. Similar measurements were made in Canada by Sir John McLennan and others, and the results there were in excellent agreement with the earlier determinations in Norway" (p. 216). From Moulton's *Introduction to Astronomy* (1916): "The southern ends of auroral streamers are usually more than 100 miles in height, and they are sometimes found at an altitude of 500 or 600 miles." From Edward Arthur Fath's *Elements of Astronomy* (1934): "Norwegian astronomers, especially Störmer, have made many observations on this point and they find only occasional streamers to exceed a height of 300 km. One of these reached a height of 1000 km (620 miles). We may, therefore, take this value as the approximate limit of an appreciable atmosphere for the earth" (p. 28).

[40] www.howstuffworks.com/question471.htm

[41] This site was deactivated in 2002.

[42] www.earthobservatory.nasa.gov.81/Library/glossary

[43] http://image.gsfc.nasa.gov/poetry/ask/a11798.html

[44] www.exploratorium.edu/sunspots/research5.html

[45] http://wrh.noaa.gov/fsd/astro/sunspots.htm

[46] www.space.com/news/sunspot_inside_011106.html

[47] Robert H. Baker, *Astronomy* (New York: D. Van Nostrand Company, Inc., 1938), p. 282.

[48] 48. Kauffmann, *Universe*, op. cit., p. 155.

[49] http://windows.arc.nasa.gov/cgi-bin/tour...frp=/windows3.html&fr=f&sw=false&edu=mid

[50] E.g., Steve Nordby, "Intro to Radio Wave Propagation" (http://members.aol.com/svennord/radio.htm): "In daylight hours, the lowest layers of the ionosphere called the D and E layers, about 60 to 70 miles high, refract or absorb most radio waves, limiting the distance at which refracted waves are useful. But these low layers are denser so the ionized particles bump into each other and recombine rapidly after sunset. After dark, waves pass through the lower ionosphere. At about 175 miles high, the F layer is responsible for most of the useful radio wave refraction. Thinner air at this altitude means recombination of ionized particles takes place slower than in the D and E layers, so refraction can take place after sunset, gradually decreasing during the night. The greater height of the F layer means the refracted wave returns to Earth much farther away than the daytime refraction from the lower layers."

[51] Ibid.

WORK-IN-PROGRESS (OCTOBER 23, 2011) PARALLEL CHART FOR

58:2 ("The Urantia Atmosphere")

Key

(a) Green indicates where a source author first appears, or where he/she reappears.

(b) Yellow highlights most parallelisms.

(c) Tan highlights parallelisms not occurring on the same row, or parallelisms separated by yellowed parallelisms.

(d) An underlined word or words indicates where the source and the UB writer pointedly differ from each other.

(e) Blue indicates original (or "revealed") information, or UB-specific terminology and concepts. (What to highlight in this regard is debatable; the highlights are tentative.)

(f) Pink points to a word in the first edition of *The Urantia Book* which was changed in a later edition, by either the Urantia Foundation or the Standard Reference Edition committee.

Source for 58:2

(1) Dr. Harlan True Stetson, "Solar Radiation and the State of the Atmosphere," *The Scientific Monthly*, Vol. 54, No. 6 (June 1942)

Matthew Block
23 October 2011

SOURCE OR PARALLEL

Revised 24 October 2011

THE URANTIA BOOK

PAPER 58 — LIFE ESTABLISHMENT ON URANTIA

2. THE URANTIA ATMOSPHERE

"SOLAR RADIATION AND THE STATE OF THE ATMOSPHERE" (Stetson 513)

Because of the relatively insignificant size of the earth, and also the great distance that separates us from the sun a distance of 93 million miles, our planet can intercept but about one two billionths of the total solar output (S 514).

58:2.1 The planetary atmosphere filters through to the earth about one two-billionths of the sun's total light emanation.

At a price of 1¾ cents per kilowatt hour, the annual budget that would have to be allowed for sunshine for the continental United States alone

If the light falling upon North America were paid for at the rate of two cents per kilowatt-hour, the annual light bill

would represent an expenditure of 327 quadrillion dollars (S 514).

would be upward of 800 quadrillion dollars.

If we change our picture to a more restricted one, we can say that the cost of sunshine for Greater New York at the above figure would amount to approximately 100 million dollars for the average day (S 514).

Chicago's bill for sunshine would amount to considerably over 100 million dollars a day.

If we analyze the radiation from the sun we discover that it covers a wide range of wave-lengths. Certain of these wave-lengths or frequencies produce their own special effects upon the earth and its atmosphere (S 514).

And it should be remembered that you receive from the sun other forms of energy—

light is not the only solar contribution reaching your atmosphere.

SOURCE OR PARALLEL	THE URANTIA BOOK
[Outside the] so-called visible range to which the eye responds there is a vast scale of radiations both beyond the red end of the spectrum, which we call the infrared, and far down below the violet, which we call the ultra-violet (S 514).	Vast solar energies pour in upon Urantia embracing wave lengths ranging both above and below the recognition range of human vision.
Observations with the spectroscope indicate that there is much radiation at the extreme ultra-violet end of the spectrum to which the earth's atmosphere is completely opaque.	58:2.2 The earth's atmosphere is all but opaque to much of the solar radiation at the extreme ultraviolet end of the spectrum.
A great deal of the absorption of this region of the solar spectrum of very short wave-lengths is caused by a layer of ozone which exists at an average height of about 22 kilometers [*13.67 miles*],	Most of these short wave lengths are absorbed by a layer of ozone which exists throughout a level about ten miles above the surface of the earth,
but which probably occupies a region extending from 15 to 35 kilometers [*9.321 miles to 21.749 miles*].	and which extends spaceward for another ten miles.
If all the ozone in this region were to be brought to the standard conditions of temperature and pressure of our atmosphere at the earth's surface, it would represent a layer of only 2 to 3 millimeters in thickness. [*0.0788 to 0.1182 inches*]	The ozone permeating this region, at conditions prevailing on the earth's surface, would make a layer only one tenth of an inch thick;
Yet this small amount of ozone is the defense between us and extremely dangerous radiations in the ultra-violet region of the sun's light (S 516).	nevertheless, this relatively small and apparently insignificant amount of ozone protects Urantia inhabitants from the excess of these dangerous and destructive ultraviolet radiations present in sunlight.
Were this absorption, however, of this region of the solar spectrum even a little greater than it is,	But were this ozone layer just a trifle thicker,
we should be deprived of that small amount of ultra-violet light filtering through our atmosphere that is so essential for health	you would be deprived of the highly important and health-giving ultraviolet rays which now reach the earth's surface,

SOURCE OR PARALLEL	THE URANTIA BOOK
and the production of our sunshine vitamin D (S 516).	and which are ancestral to one of the most essential of your vitamins.
	58:2.3 And yet some of the less imaginative of your mortal mechanists insist on viewing material creation and human evolution as an accident. The Urantia midwayers have assembled over fifty thousand facts of physics and chemistry which they deem to be incompatible with the laws of accidental chance, and which they contend unmistakably demonstrate the presence of intelligent purpose in the material creation. And all of this takes no account of their catalogue of more than one hundred thousand findings outside the domain of physics and chemistry which they maintain prove the presence of mind in the planning, creation, and maintenance of the material cosmos.
We can be confident, however, that it is a fortunate combination of the sun and our atmosphere that makes life on the earth possible. The sun not only radiates its health-giving sunshine, but it also emits literally death-dealing rays (S 516).	58:2.4 Your sun pours forth a veritable flood of death-dealing rays,
	and your pleasant life on Urantia is due to the "fortuitous" influence of more than two-score apparently accidental protective operations similar to the action of this unique ozone layer.

SOURCE OR PARALLEL	THE URANTIA BOOK
[The atmosphere] is a sort of buffer state, the very top of which receives a violent bombardment of high frequency radiations from the sun, and the lower layers of which form a blanket that enables the earth to retain during the night much of the warmth generated by the sunshine that has penetrated through it, thus mitigating the extremes of temperature between night and day to which the earth would otherwise be subjected (S 516-17).	58:2.5 Were it not for the "blanketing" effect of the atmosphere at night, heat would be lost by radiation
	so rapidly that life would be impossible of maintenance except by artificial provision.
[contd] If we look at a cross-section of the earth's atmosphere, it may for convenience be divided into three zones or layers in which the stratosphere occupies the middle ground. The region below the stratosphere is that which contacts our immediate surroundings and provides the winds and atmospheric currents, giving rise to all our weather. We call this lower region comprising perhaps the first 5 or 6 miles the troposphere.	58:2.6 The lower five or six miles of the earth's atmosphere is the troposphere; this is the region of winds and air currents which provide weather phenomena.
The region above the stratosphere is the ionosphere.	Above this region is the inner ionosphere and next above is the stratosphere.
If we send a recording thermometer aloft, we find that while passing through the troposphere the temperature steadily falls until a height of 10 or 12 kilometers [*6.214 to 7.4568 miles*] is reached,	Ascending from the surface of the earth, the temperature steadily falls for six or eight miles,
when the temperature reaches the extremely low value of -55º C., or some 68º below zero Fahrenheit.	at which height it registers around 70 degrees below zero F.

SOURCE OR PARALLEL	THE URANTIA BOOK
Strangely enough, for the next 30 miles or so there appears to be little change in temperature.	This temperature range of from 65 to 70 degrees below zero F. is unchanged in the further ascent for forty miles;
This is the region of the stratosphere (S 517).	this realm of constant temperature is the stratosphere.
At a height of 60 kilometers or some 40 miles, the temperature would begin to rise again.	At a height of forty-five or fifty miles, the temperature begins to rise,
Recent investigations give some evidence that at extreme heights, up where the auroral fires play, temperatures of 1,000º C. [*1832º F.*] have to be postulated	and this increase continues until, at the level of the auroral displays, a temperature of 1200° F. is attained,
to account for the presence of the ionized oxygen that is there.	and it is this intense heat that ionizes the oxygen.
The extremely rarefied condition of this upper atmosphere, however, calls for perhaps a quite different interpretation of temperature than that to which we are ordinary accustomed when determining temperatures by the thermometer at the earth's surface (S 517).	But temperature in such a rarefied atmosphere is hardly comparable with heat reckoning at the surface of the earth.
[contd] Ascending through the cross-sections of the atmosphere, we find there is a rapid decrease in the amount of atmospheric pressure. Within the first 3 miles from the earth's surface, half the total amount of oxygen and nitrogen, the principal atmospheric ingredients, are included.	Bear in mind that one half of all your atmosphere is to be found in the first three miles.
The limiting height to which the thinning atmosphere extends is somewhat difficult to fix. Perhaps we should place it at 200 to 300 miles, although recently Dr. Carl Störmer has observed auroral streamers reaching to heights of 600 kilometers [*372.84 miles*] or more. Where the auroral streamers go, some of the thin atmosphere must extend (S 517).	The height of the earth's atmosphere is indicated by the highest auroral streamers—about four hundred miles.

SOURCE OR PARALLEL	THE URANTIA BOOK
[contd] If we make a chart of the numbers and occurrences of aurorae we find there seems to be a curious connection between the frequency and brightness of auroral displays and the state of the sun as marked by the appearance of sunspots (S 517).	58:2.7 Auroral phenomena are directly related to sunspots,
It was in 1908 that the late Dr. George Ellery Hale, the founder and director of the Mount Wilson Observatory, first observed that sunspots were giant cyclones in the sun's atmosphere (S 518).	those solar cyclones
To carry the analogy still further, spots north of the sun's equator are in general whirling in one direction while corresponding spots south of the equator whirl in the opposite direction. If the rotation of the one is clockwise, that of the other is counter-clockwise.	which whirl in opposite directions above and below the solar equator,
This again is characteristic of the differences of rotation of tropical hurricanes on the earth originating in the northern and southern hemispheres, respectively (S 518).	even as do the terrestrial tropical hurricanes.
	Such atmospheric disturbances whirl in opposite directions when occurring above or below the equator.
When the Mount Wilson observers first examined and actually measured the frequency of light coming from the centers of sunspots, it was found to have changed frequency in exactly the way that light waves are distorted in the laboratory when a powerful electromagnet is placed around the source of light being examined (S 519).	58:2.8 The power of sunspots to alter light frequencies
Thus came the startling revelation that sunspots were not only terrific hurricanes but every center was in itself a powerful magnet (S 519).	shows that these solar storm centers function as enormous magnets.

SOURCE OR PARALLEL	THE URANTIA BOOK
Since a magnetic field may exert a repulsing effect upon swiftly moving electrons, we see some reason that charged electric particles can be actually hurled from sunspot centers at velocities which may carry them through space into the earth's atmosphere,	Such magnetic fields are able to hurl charged particles from the sunspot craters out through space to the earth's outer atmosphere,
thus ionizing the upper regions of the air in a way that would produce auroral displays.	where their ionizing influence produces such spectacular auroral displays.
In the light of such a mechanism, therefore, we see a possible reason why aurorae occur in greater numbers and at greater brilliance at times when these solar storms occur most frequently (S 519-20).	Therefore do you have the greatest auroral phenomena when sunspots are at their height—
There is, I believe, a good reason for the fact that the maximum in the auroral displays occurs a year or two after the year of most sunspots.	or soon thereafter—
As sunspots begin to wane in numbers, they are nevertheless occurring in regions progressively nearer the solar equator, and as the sun's equator is inclined but slightly to the plane of the earth's orbit, we may draw the inference that sunspots are most effectively associated with the aurorae when, other things being equal, they are most nearly in the geometrical plane that the earth travels in its journey around the sun (S 517-18).	at which time the spots are more generally equatorially situated.
Perhaps comparatively few who are not geomagneticians realize that the compass needle is constantly wandering back and forth every day by a slight amount. When the sun rises in the east, the north end of the compass needle turns slightly toward that direction (S 520-21).	58:2.9 Even the compass needle is responsive to this solar influence since it turns slightly to the east as the sun rises

SOURCE OR PARALLEL	THE URANTIA BOOK
Then in the afternoon as the sun wanders and sets in the west, the compass needle wanders likewise to the west, coming back again to its normal position about midnight when the sun is below the northern horizon.	and slightly to the west as the sun nears setting.
This goes on day after day, month after month—	This happens every day,
but during the years when sunspots are most numerous these daily excursions of the compass needle will on the average be twice as great as during the years when the sunspots are lacking.	but during the height of sunspot cycles this variation of the compass is twice as great.
These diurnal wanderings of the compass needle can now be roughly explained as due to the effects of ionization of the upper atmosphere by sunlight (S 521).	These diurnal wanderings of the compass are in response to the increased ionization of the upper atmosphere, which is produced by the sunlight.
Somebody experimenting with wireless and listening in found himself quite unconsciously eavesdropping on Marconi waves from the other side of the Atlantic.... This led Professor Kennelly of Harvard to postulate that there must exist high above the earth's surface, perhaps 100 miles or so up, an electrified conducting layer from which the electromagnetic waves emitted from the powerful antennae were reflected back to earth (S 521).	58:2.10 It is the presence of two different levels of electrified conducting regions
This region [*i.e.* the Kennelly-Heaviside layer, also designated as the E layer] lies far above the stratosphere and generally above the region that is usually regarded as that where ozone is manufactured.	in the superstratosphere

SOURCE OR PARALLEL	THE URANTIA BOOK
This E layer is particularly favorable for reflecting or turning back radio waves of the frequencies which are most generally used for commercial broadcasting in connection with our entertainment programs [*i.e.* medium wave]. Radio waves of much shorter wave-lengths or of higher frequencies penetrate and actually traverse through this region until they reach what appears to be another ionized region called the F layer, originally postulated by Professor Appleton in England (S 522).	that accounts for the long-distance transmission of your long- and short-wave radiobroadcasts.
During the last few years of sunspot activity, there have been occasions when remarkable fadeouts have occurred in radio communication (S 523).	Your broadcasting is sometimes disturbed
Could we visualize the ethereal substance of the ionosphere as we visualize the surface of the ocean, we should find times when terrific storms were raging in this ionosphere (S 524).	by the terrific storms which occasionally rage in the realms of these outer ionospheres.