Sodom and Skepticism

Abstract

Bunch et al. reported abundant evidence of a cosmic event at the Middle Bronze Age City of Tall el-Hammam and speculated as to whether that event could have inspired the Biblical story of the destruction of Sodom, without attempting a conclusion. In a non-peer-reviewed rebuttal, Boslough engages in a long *ad hominem* attack on one of the 21 authors of the article and accuses them of "photoshopping" images "to match the hypothetical compass direction of the supposed blast." *Scientific Reports*, in which the original article appeared, conducted an extensive, post-publication forensic examination of the images and concluded that some "had been manipulated to remove the features irrelevant to the scientific content depicted," with no evidence for intent to mislead. *Scientific Reports* has republished the article with the original, unaltered images. This exchange provides a case study illustrating the increased care that publishing scientists must now take to avoid any hint of image or data manipulation. In addition, it demonstrates that legitimate scientific discourse should be about evidence and not about authors or funding organizations. Most importantly, the evidence for a cosmic event at Tall el-Hammam remains unchallenged.

Introduction

On September 20, 2021, *Scientific Reports* published "A Tunguska Sized Airburst Destroyed Tall el-Hammam a Middle Bronze Age City in the Jordan Valley Near the Dead Sea," by Bunch et al. [henceforth, BEA.][1] The abstract concluded: "Tall el-Hammam may be the second oldest city/town destroyed by a cosmic airburst/impact, after Abu Hureyra, Syria, and possibly the earliest site with an oral tradition that was written down (Genesis). Tunguska-scale airbursts can devastate entire cities/regions and thus, pose a severe modern-day hazard." Scholars have long debated whether Tall el-Hammam could be the Biblical city of Sodom. No doubt in part because of its possible relevance to the Biblical story, by mid-February 2022, the article had been accessed more than 370,000 times and earned an Altmetric score of over 5000, making it one of the most widely read scientific papers of the last decade.

BEA summarized the evidence for cosmic impact in their abstract:

> A city-wide ~ 1.5-m-thick carbon-and-ash-rich destruction layer contains peak concentrations of shocked quartz (~ 5–10 GPa); melted pottery and mudbricks; diamond-like carbon; soot; Fe- and Si-rich spherules; CaCO3 spherules from melted plaster; and melted platinum, iridium, nickel, gold, silver, zircon, chromite, and quartz.

In the January/February 2022 issue of *Skeptical Inquirer*, Mark Boslough published a rebuttal of BEA titled, "Sodom Meteor Strike Claims Should Be Taken with a Pillar of Salt."[2] The Committee on Skeptical Inquiry (CSI), of which both Boslough and this author are members, publishes *Skeptical Inquirer*. CSI began in 1976 as CSICOP: The Committee for the Scientific Investigation of Claims of the Paranormal. In 2006, CSICOP changed its name to CSI to emphasize that its purview had broadened beyond the paranormal to "encourage careful, rational, critical examination of unusual claims."[3]

CSI defines skepticism and denial as follows:

> The word "skepticism" comes from the ancient Greek skepsis, meaning "inquiry." Skepticism is, therefore, not a cynical rejection of new ideas, as the popular stereotype goes, but rather an attitude of both open mind and critical sense.
>
> Denial, on the other hand, is the a priori rejection of ideas without objective consideration.[4]

In this response, I assess whether Boslough's critique lives up to the best practices of skepticism as defined by the Committee, beginning with the title of his article.

An "Unusual Claim"?

Does the assertion of a cosmic airburst/impact at Tall el-Hammam qualify as "unusual?" Evidently not, as in an article titled, "Low-altitude airbursts and the impact threat," Boslough and Crawford wrote, "Low-altitude airbursts are by far the most frequent impact events that have an effect on the ground."[5] Boslough endorses the findings of "Widespread glasses generated by cometary fireballs during the late Pleistocene in the Atacama Desert, Chile," which reports evidence nearly identical to that found at Tall el-Hammam.[6] Moore et al. reported similar evidence of a cosmic airburst to account for the destruction of another Middle Eastern archeological site, at Abu Hureyra in Syria.[7] Thus a hypothesis that appeals to a cosmic airburst is not "unusual" but mainstream science.

The cover of *Skeptical Inquirer* calls attention to Boslough's article: "SPECIAL REPORT: Take Sodom Meteor Strike Claims with a Pillar of Salt." As in the title of the article itself, this use of "claim" misleads the reader. Merriam Webster defines "claim" as "to say that (something) is true when some people may say it is not true."[8] BEA did not claim in this sense that Tall el-Hammam was the Biblical city of Sodom. Rather they wrote that, "It is worth speculating that a remarkable catastrophe, such as the destruction of Tall el-Hammam by a cosmic object, may have generated an oral tradition that, after being passed down through many generations, became the source of the written story of biblical Sodom in Genesis." Given that scholars had long made the possible connection, BEA could hardly avoid speculating about it. But to "speculate" is not to "claim."

The BEA article is thus not "unusual" nor does it make a "claim" about Sodom. It appeared in a prestigious, peer-reviewed journal. For all three reasons it should have been beyond the purview of the non-peer-reviewed *Skeptical Inquirer*.

An Open Mind

In his keynote address to the 1994 CSICOP conference, well worth reading today, Carl Sagan described the criteria of proper scientific skepticism, saying that "*Ad hominem* arguments…are irrelevant…." He went on to warn against an "Us vs. Them" polarization—"the sense that we have a monopoly on the truth…." and closed by saying, "Too much skepticism—especially rejection of new ideas before they are adequately tested—and you're…closed to the advance of science."[9]

Instead, Boslough devotes ~50% of his article to a detailed, *ad hominem* attack on a single one of the 21 BEA authors: Dr. Allen West. His prejudice against West precedes the BEA article by at least a decade, as in a 2011 interview, Boslough said, "I don't think there is any reason to accept what West reported. I have a serious problem with everything from him."[10] This shows that Boslough did not approach his rebuttal of BEA with the open mind of the true skeptic, but in the light of his past suspicions about West. In his *Skeptical Inquirer* article, Boslough reports that "West…was fined by California and convicted for masquerading as a state-licensed geologist when he charged small-town officials fat fees for water studies." This is a distortion of the facts. West has explained[1] that some twenty years ago, he mistakenly failed to obtain the necessary

license to conduct hydrological studies in California. At the time, he admitted to his error and repaid the state for the costs of its investigation, after which the California court accepted a "not guilty" plea, dismissed the charges, and expunged the misdemeanor conviction from his record.[11] Nevertheless, this incident led Boslough to write that he "no longer trusted any data that West had handled." By implication, Boslough accuses West of manipulating the Tall el-Hammam evidence. But the article had 20 other co-authors, who as noted under the article's Methods section, supervised, designed, and/or performed the majority of the analyses independently of West.

In what might be called a parallel *ad classis* accusation, Boslough devotes another ~20% of his article to three organizations that have supported archeological research at Tall el-Hammam. One is the Comet Research Group, which says that it "cooperates with and provides funding for selected impact research scientists around the world."[12] In their article, BEA thanked "the thousands of donors and members of the Comet Research Group…who have been crucial in making this research possible." Boslough writes that the group "has discovered that fearmongering is an effective fundraising tool for their fringe investigations despite its potential damage to the credibility of serious scientists engaged in planetary defense." Yet Boslough had previously written that low-altitude airbursts can "generate megaton-scale explosions ... about once per century on average."[5]

BEA reported that the archeological excavation at Tall el-Hammam "is under the aegis of the School of Archaeology, Veritas International University, Santa Ana, CA, and the College of Archaeology, Trinity Southwest University, Albuquerque, NM, under the auspices of the Department of Antiquities of the Hashemite Kingdom of Jordan." The two universities, Boslough writes, have an "agenda of prov[ing] the veracity of the Bible." Boslough implies that the BEA authors adjusted their findings to "satisfy the dictates of all three sponsoring [religious] organizations." But a religious affiliation is no indicator of poor science, as witness the research of such prestigious universities as the University of Notre Dame, Boston College, and Southern Methodist University.

To sum up, ~70% of Boslough's article deals with his pre-existing suspicion of the dig sponsors and one of the 21 BEA authors.

Critical Sense

CSI does not define "critical sense," but presumably one requirement of a true skeptic would be to use only relevant and appropriate evidence. To the contrary, Boslough devotes another ~10% of his text to irrelevant and obsolete comments about the Younger Dryas Impact Hypothesis, which he has long opposed. He begins this section with a discussion of a 2010 report of ET nanodiamonds at the Younger Dryas boundary (YDB) in the Greenland ice.[13] He writes, "As of 2021, this discovery has never been replicated, even by the same group." This implies that the finding may be false and that peer-reviewed findings cannot be accepted until independent scientists have replicated them and published the results, a claim refuted by a glance at any scientific journal. He neglects to point out that scientists *have* reproduced the finding of ET nanodiamonds at 25 YDB sites and directly replicated them at 8 of those.[14]

Boslough goes on to list "other claims" of ET markers at the YDB, the essence of the Younger Dryas Impact Hypothesis, saying that they have "unraveled" and listing several examples. Let us examine these in order:

"Some of the [YDB] diamonds were actually graphene." This claim stems from the work of Tyrone Daulton and colleagues, most of whose samples did not come from the YDB layer and therefore cannot be used as evidence against the Younger Dryas Impact Hypothesis.[14,16,17]

"Carbon spherules were actually fungus and bug poop." The samples on which this statement depends are the same as those referred to above and thus did not come from the YDB layer.

"Other claimed impact markers" were not present in "significant concentrations." This statement is categorically false. To the contrary, researchers have reported ET microspherules at 34 YDB sites and directly replicated them at 13 of those. They have found enriched platinum group elements (including iridium) at 38 sites and evidence of possible impact-induced wildfire at 39.[14]

"Samples that were supposed to be 12,900 years old contained modern carbon." This likely refers to a report by Boslough et al.[18] of a single microspherule from the Gainey, MI Clovis site that he had arranged to have carbon-dated and which gave 207 ± 87 years BP, compared to the ~12,800-year-age of the Younger Dryas. Based on this single measurement, Boslough et al. concluded that "Particles identified as diamond-containing carbon microspheres and presumed to

be related to the purported YD impact may actually be [1] younger than the YD, [2] unrelated to the YD or to an impact, and [3] might be modern contaminants." The Gainey site has proven difficult to date using radiocarbon, but Wittke et al. report a thermoluminescence age of 12.36 ± 1.23 ka, which spans the YDB.[19] Furthermore, the Fe-rich microspherules at Gainey are intermixed with Clovis-equivalent cultural artifacts, leaving no doubt that they are of YD age. Thus, of the three possibilities, only the third makes sense: some but not all of the carbon spherules were emplaced from younger sediment into the YDB layer. The point here is that for Boslough to include in his rebuttal a single, anomalous radiocarbon age from a site known to be difficult to date but of YD age, and which has nothing whatsoever to do with Tall el-Hammam, hardly evinces critical sensibility.

Boslough cites only one reference favorable to the YDIH: the article in which Firestone et al. (2007) introduced it.[20] He does not mention any of the scores of articles that have corroborated the hypothesis, including one by this author and another by Sweatman (2021) who reviewed the evidence and summed up: "Probably, with the YD impact event essentially confirmed, the YD impact hypothesis should now be called a 'theory.'"[14,15]

"Photoshopping"

Boslough addresses the scientific evidence reported by BEA in only one section of his article. In a "disturbing discovery," he writes, "Images from the Tall el-Hammam excavation had been photoshopped and rotated to match the hypothetical compass direction of the supposed blast." As shown below, this claim has been falsified. Boslough goes on to imply that these image adjustments allowed BEA to make false scientific conclusions:

> Innocent explanations involving mistakes cannot be ruled out…Nevertheless, these biblically correct rotations of images satisfy the dictates of all three sponsoring organizations, paraphrased here [Note that the following statements bear little if any resemblance to the actual mission statements of the three organizations and instead are Boslough's invention.]
>
> CRG: Our mission is to prove that killer comets are more common than you've been taught.
>
> TSU: The Bible is God's only inspired representation of reality to humankind.
>
> VIU: Biblical inerrancy applies to all historical and scientific statements.

Boslough's allegation raises an important issue that goes well beyond the BEA article and his response. As Rossner and Yamada, editors of *Cell Biology*, wrote in 2000[21], "It's all so easy with Photoshop. It is now very simple, and thus tempting, to adjust or modify digital image files. Many such manipulations, however, constitute inappropriate changes to your original data, and making such changes can be classified as scientific misconduct." Several of the largest scientific publishers have recently developed a three-level protocol to classify image manipulation to make clear what is acceptable and what not.[22,23] Level 1 applies under the following conditions:

> Image aberrations include substantive or possible aberrations restricted to a subset of image panels or the source data provided. Image irregularities can in principle be due to inadvertent mistakes in data processing or **cosmetic image processing ('beautification')** that nonetheless potentially affects the proper interpretation of the data by the reader. **There is no evidence for intent to mislead**. If the corresponding author(s) can provide a satisfactory explanation for the aberrations, compelling source data for the aberrant images and reverse the image processing underlying the aberrations, the revised figure may be published in place of the aberrant figure in a fully traceable and transparent manner, typically in form of a written corrigendum. [Emphasis added.]

After publication of Boslough's article and comments by him and others on PubPeer.com, *Scientific Reports* conducted an extensive forensic investigation of the 51 figures in BEA, most of which were composites of several individual panels, bringing the total number of images to more than 200. They concluded that:

> Some of the figure panels have been manipulated to remove the features **irrelevant to the scientific content** depicted in those (e.g. measuring tape, previous image labels, visible fingers etc.). The Authors recognize that this level of manipulation was inappropriate, and provide original images. [Emphasis added.]

Scientific Reports has now republished the article with the original, uncorrected images and an accompanying "Author Correction."[24] In particular, *Scientific Reports* states that the image referred to by Boslough above (Panel 15b) "was horizontally flipped in relation to the original and had the arrow pointing north obscured. It has now been replaced with a correct image." To augment the conclusions of *Scientific Reports*, the BEA authors have posted a detailed summary of salient changes to the figures.[25] By implication, the changes to images made by BEA belong to Level 1 of the altered image protocol that *Scientific Reports* follows. They present no evidence of intent to mislead and do not change any conclusions of the article.

This discussion and the new protocol show that in the age of image manipulation software, publishing scientists will have to be more careful. Content that would previously have been deemed irrelevant may no longer be casually removed. Scales and color may not be re-adjusted, images may not be flipped horizontally, and so on. Acceptable modifications such as cropping and adjusting contrast and brightness are acceptable but should be described in the text or Methods.

Radiocarbon

In addition to Boslough's criticisms, a commenter on PubPeer.com questioned the radiocarbon dating techniques used in the BEA paper.[26] In the corrected version, BEA further clarified how they had used the OxCal radiocarbon dating tool, adding a new subsection called "Bayesian analyses of radiocarbon dates" at the end of Methods section and citing two new references. In summary, the commenter was mistaken; BEA used the correct Bayesian protocol.

Summary

Boslough's article fails several tests of proper skepticism as defined by CSI. Instead of an open mind, he shows a clear *a priori* prejudice against the BEA authors and dig sponsors. Most of his argument is *ad hominem* or *ad classis* and thus as Sagan said, irrelevant. As part of "Proper Criticism," CSI recommends using "the principle of charity."[27] Instead, Boslough falsely accuses one of the BEA authors of having a criminal record and implies that as a group they may have committed scientific misconduct. He uses loaded and prejudicial language (e.g., photoshopping, fearmongering, masquerading, tampering, mishandling, giggle factor…) and vague innuendo: "I'm aware of many additional critical comments about this paper by other subject matter experts, including geologists and archaeologists, some of which have already been submitted for publication. The undisclosed and inappropriate digital tampering of images suggests the possibility of similar mishandling of other evidence."

The crux of the matter to science is the evidence that BEA reported for a cosmic event at Tall el-Hammam, summarized in the quotation at the beginning of this article. Were that evidence found to be faulty, there would be no need to speculate as to whether the site could have been the Biblical Sodom. The worst failing of Boslough's article is that he never discusses that evidence, giving the impression that he rejected it without objective consideration.

Ideally, a critique of a peer-reviewed article would itself be peer-reviewed and appear in the same journal. *Nature* encourages this practice, writing that its "research journals recognize the importance of post-publication commentary on published research as necessary to advancing scientific discourse."[28] These commentaries, "after peer review, may be published online, usually alongside a Reply from the original *Scientific Reports* authors." Boslough could have followed this route, but instead chose to publish in *Skeptical Inquirer*, avoiding peer review and a published response by BEA.

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