

style is direct and spontaneous. The subject matter should be of great appeal to anyone interested in the convergence of natural catastrophes and the history of humanity's spurious civilization. At times, sections in the book seem somewhat disconnected but this may well be inevitable when addressing such rich material. With every page, Schoch and McNally draw the reader towards a network of tantalizing questions and mysteries. As with any good thesis, more questions are raised than are answered. Ultimately a glaring question remains. Who built the Sphinx?

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Impact! The Threat of Comets and Asteroids by Gerrit L. Verschuur. Oxford, UK: Oxford University Press, 1996. \$30.00, cloth. ISBN 019501057; Softcover, 1997, ISBN 0195119193.

In *Impact! The Threat of Comets and Asteroids*, astronomer Gerrit L. Verschuur presents an insightful and historical case for the potential for comet or asteroid impacts on Earth. Though this book is a few years old, most of its content is still very relevant to the big question: Are asteroids and comets a serious threat to both the Earth and human civilization? Throughout the book, Verschuur goes to great lengths to prove that we are far from immune to the devastating consequences of a major impact, an impact that he believes is inevitable. In making his case, he describes historic and prehistoric impacts, discusses meteoroid debris in the Solar System and describes the significance of the Shoemaker-Levy comet impact into Jupiter. Not only is the book a summary of our knowledge of impact events, it is also a warning that Verschuur thinks we need to take seriously. The author's theories and conclusions are based deeply in catastrophic geology, which has seen a revival since the early 1980s. As a geologist, I generally agree with him about the significance of catastrophic events in

Earth history and that they have played a more dominant role in the evolution of the Earth than has been typically considered by mainstream geology.

But like many books on impacts and other catastrophic events, the worst-case scenarios often seem to be pushed to the forefront of the arguments. An analogy for catastrophic impacts on Earth is bolstered by Verschuur's analyses of the Shoemaker-Levy impact. He spells out clearly that if what happened to Jupiter were to happen to Earth, it would be the end of civilization. He also uses the Chicxulub impact and the extinction of the dinosaurs to show how much we are at risk from these seemingly mindless events—in other words—we are in danger. Though I agree that impacts pose great risks, I have reservations with the way the author sometimes envisions their potential danger, mainly through statements like "...civilization will sooner or later come to an end through, at the very least, comet or asteroid impact." or "We almost got wiped out by an asteroid in 1937, and again in 1989." These statements seem to play more to the emotions than to the intellect. The history of the Earth has seen numerous impacts and numerous extinctions—that is a proven fact. But life still managed to survive. The correlation between impacts and extinctions is far from ironclad and in fact, even the Chicxulub event is not really resolved as one will find if they read deeply enough into the literature. Nevertheless, I agree with Verschuur that the potential for asteroid and comet impacts is real and should be taken seriously.

I found chapters 6, 7 and 8 to be extremely interesting because they concern many historical aspects of "impact" science. Some of these ideas may have laid the groundwork for our current understanding of asteroid and comet impacts. Verschuur has done his homework here. It is illuminating to be shown once more that some of what we believe today, and is claimed by the media to be "novel" research, was kicked around some 50 to 200 years ago, but was not taken seriously then. For example, in 1957, M. W. de Laubenfels proposed that the dinosaur extinctions might have been caused by a large meteoric impact. This suggestion, though ignored at the time, pre-dated the Alvarez hypothesis by 23 years! Allan O. Kelly and Frank Dacheille published a book in 1953—*Target Earth*. In it they stated that impact events may have shaped the Earth and that extinctions may have been caused by impacts. They also envisioned a system of satellites that could protect the Earth from future collisions.

Verschuur also touches on the work of Edith Kristan-Tollmann and Alexander Tollmann who published an article in 1992 correlating the flood stories of many cultures to a series of comet impacts on the Earth. Their scientific evidence chiefly relies on several groups of tektites they believe to date around 10,000 years, including a tektite fragment found in tree bark that is definitively dated to 9,500 BP. Elevated levels of carbon-14 in fossilized trees dating to the same time have also been found. The Tollmanns' remaining evidence is based on the flood stories, which tell of great earthquakes, floods, and stars falling from the skies; incidents that they equate to prehistoric impacts. Verschuur tentatively supports their hypothesis, but clearly indicates that more study

needs to be done. He also agrees with the Tollmanns that we should be open to ancient legends as possible accounts of catastrophic events witnessed by ancient peoples, rather than just as fables. I agree with his statement. In recent years, a number of credible authors have shown that it is possible to tie ancient legends into the context of geologic events. These authors have also shown there is evidence that extraterrestrial catastrophic events may have occurred relatively recently on Earth. Are the Tollmanns correct? Did impacts cause the “death and destruction” envisioned in flood legends? Were impacts (at least in part) responsible for the mammal extinctions of the Pleistocene? Is the timing correct? The conclusive evidence to support the Tollmanns’ theory has yet to be found, but we should never assume that it will not be found.

Insights into the studies of Laubenfels, Kelly, Datchille, and the Tollmanns make for fascinating reading and show that some researchers had the insight (and daring) to consider such ideas knowing they might face stiff opposition. Since these ideas were summarily rejected or ignored, it also gives us a vision of the closed-mindedness of the scientific community of their times.

As in many other books on catastrophes in Earth history, Verschuur also delves into legends, such as those of the Flood, to show possible links between impacts and events in ancient history. He puts it succinctly: “Ancient people, for some reason, are not trusted to have gotten it right.” Evidence is mounting, though not yet universally accepted, that impacts may have resulted in marked changes in the course of some civilizations on Earth. But as much as Verschuur may speculate about such events and the possible implications, he is always ready to ask if there is scientific evidence to back up the claims. Does it exist, or doesn’t it?

Though it bothers me some that Verschuur is so persistent in making the risk factor of impacts seem enormous, that was clearly the intent of his book. And he does have some heavy evidence to back his claims, like the Tunguska impact of 1908 and the Barringer meteorite crater, only 50,000 years old. As I once stood on the edge of the mile-wide Barringer crater and peered into the deep gouge in the terrain, I became imbibed with both admiration and awe. What if this rather modest meteorite had landed in a city? What destruction would it have wreaked? Will such an event happen in our lifetimes? Are we prepared? Would something bigger be the end of civilization? Frankly, I would rather not experience the answer to those questions, but Verschuur tries to “shake us up” with his perspective on the problem. Should we be complacent or should we fear? What truly are the odds?

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