Footprints in the Sands of Time

Can one adhere to a personal philosophy and faith, and still retain scientific credibility?

by Leonard R. Brand

How should science relate to ideas that seem unusual, outrageous, or simply absurd? Take for example, the biblical concept of origins, including informed intervention (Creation) and a world-wide catastrophe (the Flood). Some scientists would dismiss these as absurd, with little to contribute to science. But is this fair? Back in 1926, the then president of the Geological Society of America said something that scientists will do well to remember. He urged geologists to be willing to give serious consideration to "outrageous hypotheses," since any new idea seems outrageous at first.[1]

One of the primary attributes of science is its openness to new ideas. Scientific theory, by definition, has the following characteristics:

1. It explains and organizes previously unrelated facts.
2. It suggests useful experiments, thus stimulating scientific progress.
3. It is testable; its conclusions can be verified, and its claim to truth are open for verification.
4. It predicts the outcome of untried experiments. If the prediction is verified, our confidence in that theory will increase.

Testable and untestable hypotheses

The most critical of these features is that of testability. If a theory cannot be tested, it is outside the realm of science (even though it may be true). This, some would conclude, eliminates informed interventionism from the realm of science. But it is not as simple as that, for both interventionism and naturalistic evolution have testable and untestable features. Scientists would generally agree that the hypothesis "God created life" cannot be tested by science. That is to say, science cannot design an experiment or a set of observations that would potentially falsify that hypothesis. This leaves us with the alternate hypothesis, "Life was not created by God." This alternate position is usually accepted as valid science.

Remember our definition of a useful scientific theory: it can be tested. Let us return to the hypothesis, "Life was not created by God." Can anyone design an experiment or a set of observations that would potentially falsify that hypothesis? The concepts "God created life" and "God did not create life" are therefore equally untestable. Science should either (a) devise a valid experimental test for one or (b) stop trying to say that one is scientific and the other is not.

The biblical concept of a global catastrophe presents additional dilemmas for science. Before we discuss this, let's turn to the issue of bias.

Is bias a religious problem?

From 1923 to 1932 the geologist J. Harlen Bretz presented evidence that canyons in the Channeled Scablands of eastern Washington State were the result of a gigantic flood. After a long struggle to maintain traditional, non-catastrophic interpretations for the Channeled Scablands, the geological community finally accepted the evidence for catastrophic draining of glacial Lake Missoula across the Scablands (the Spokane flood). This involved a major struggle because geology had rejected the biblical catastrophism common in the 1800s, when Charles Lyell developed his theory of uniformitarian geology.

Consequently, some geologists believed that accepting any catastrophic interpretation would be unscientific. Now, however, abundant catastrophic processes are recognized in the geologic record, but that recognition did not come easily.

V. R. Baker summarizes this historic episode: "The Spokane flood hypothesis established a conflict between two cornerstones of geological philosophy; (i) The triumph of the glacial theory over diluvial myth and (ii) the scientific tolerance of outrageous hypotheses. It is a classic dilemma for the scientist to distinguish absurdity from outrage."[2]

How can we tell in which category to place an idea before it has been thoroughly tested? Bretz's Spokane flood hypothesis seemed absurd to many geologists at the time, but subsequent evidence has confirmed his hypothesis.

It seems to me that there is an answer to this dilemma. The key is to recognize that where an idea comes from is not what determines whether it is scientific. Scientists get ideas in many unique ways, even in dreams or from chance observations. Where the idea comes from is beside the point. The idea can be scientifically useful *if it can be tested.* If the idea can be framed as a hypothesis, and one can design experiments, or observations that would disprove it if incorrect, then it is a useful scientific idea. Even if a geologist's unorthodox belief in a worldwide geological catastrophe suggests to him or her a hypothesis for the formation of some geological feature, the source of that idea is immaterial. If the hypothesis can be successfully tested it is a good scientific hypothesis, even if it seems outrageous.

That argument leads me to propose that scientifically useful (testable) theories can originate from religious concepts. We cannot directly test whether God involved Himself in earth history, but if He did (for example, through a global catastrophe), those events should have produced some evidence in the natural world. If such evidence does exist, the scientist who uses the Bible as a source of ideas for developing hypotheses should be able to operate as a successful researcher.

Some would respond at this point that we must keep our science and religion separate, and not let religion bias our science. Is that a problem? Will religion bias our science? It is possible that it could, but we run the risk of being very superficial if we do not look at several sides of this issue. Every scientist works from within a worldview, with a specific set of assumptions. Those assumptions will strongly influence the interpretation of data. That is true whether or not the person's assumptions include theistic components.

Compare the differences between these two questions about the history of life:

1. Which hypothesis is correct?
   a. Living things arose by naturalistic evolutionary hypothesis A.
   b. Living things arose by naturalistic evolutionary hypothesis B.
2. Which hypothesis is correct?
   a. Living things arose by naturalistic evolutionary hypothesis A.
   b. Living things arose by naturalistic evolutionary hypothesis B.
   c. Living organisms were created by an intelligent Designer.

For the past century or more, science has chosen working assumptions that allow a scientist to ask only question 1. Is this not a biasing influence?

It has been pointed out that Charles Lyell's theory (that all geological change occurs slowly and gradually) was culturally derived and imposed upon the data,[3] and that the biblical catastrophists of Lyell's time were at least as committed to science as he was. The historians do not say this because they agree with the biblical views of Lyell's opponents, but they recognize that regardless of the source of those Bible-believing geologists' ideas, they were more careful observers than Lyell. As Lyell's experience shows, one's philosophy can bias his or her scientific ideas. Bias, then, is not a religious problem; it is a human problem that we must each recognize and seek to resolve.

Bias control in science

The scientific method of bias control includes the following components:

- Use good research design and careful data collection.
- Discuss specific results with scientific colleagues and present papers at scientific meetings.
- Submit papers for publication in refereed scientific journals.

Such a method is really a peer-review system, which helps to maintain quality in science. This strategy cannot deal with philosophical or religious questions, but whenever philosophy can help us define a hypothesis and collect data from rocks, fossils, or living organisms to test that hypothesis, such research can be productively subjected to the process outlined above.

At present, science adheres to the philosophy of naturalism, which rules out any divine activity in earth history. "If there is one rule, one criterion that makes an idea scientific, it is that it must invoke naturalistic explanations for phenomena, and those explanations must be testable solely by the criteria of our five senses."[4] I agree that science cannot experimentally test the supernatural, but science has gone further by accepting only theories that do not imply or require any supernatural activity at any time in history. This concept would undercut the credibility of Lyell's colleagues, since the Bible had influenced their view of earth history. However, modern historians of science accept them as effective scientists because they were careful observers whose geological conclusions were consistent with their data. If these catastrophist geologists had continued their research during and after Lyell's time, their influence could have provided a philosophical balance. Geology might then have been saved from a century of rigid adherence to the faulty portions of Lyell's theory.

I believe that science will benefit if it respects and accepts careful scientists with varying philosophical views, if they work with the scientific peer-review process. There is no quality control quite like knowing that when we present a paper on our latest work, others, including some who disagree with us, will be ready to point out the mistakes that we have overlooked! Scientists with

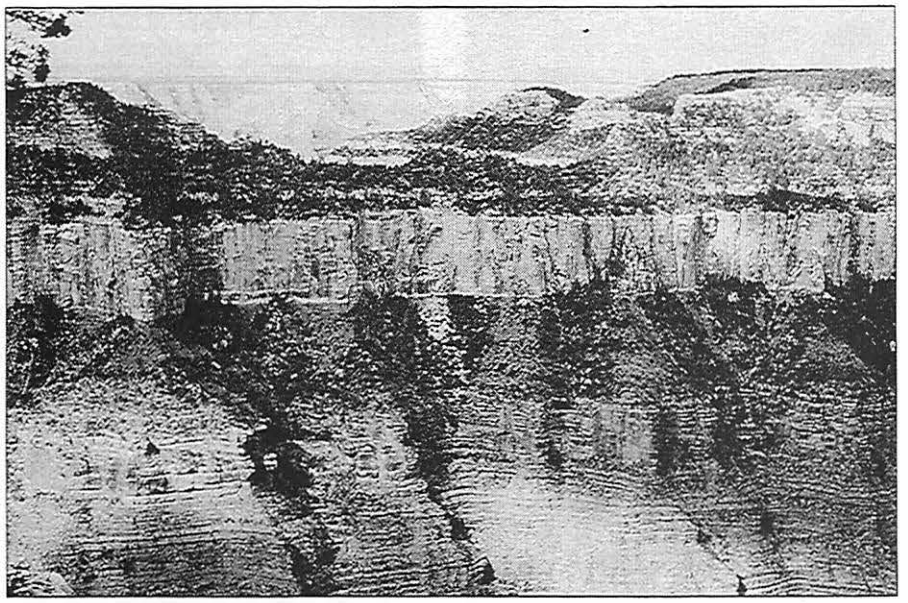

Figure 1. The Coconino Sandstone is the whitish cliff near the top of the Grand Canyon.

different philosophies may differ considerably in their personal views of how the data will eventually fit into an overall paradigm of earth history, but when they analyze specific rock formations, they can talk the same language since they all deal with the same data.

The Coconino Sandstone

One current research project will illustrate how catastrophic geology theory suggests hypotheses to be tested. Scattered around the world are a number of sandstone formations that scientists usually interpret as originating from desert sand dunes. These formations are crossbedded—that is, composed of many slanted layers. As the slanting layers of sand were being deposited, amphibians or reptiles walked on them, leaving footprints that were covered and preserved by subsequent layers. When the sediments became cemented into rock, the footprints became fossils.

How were these extensive bodies of sand, with their animal footprints, deposited? Can they tell us something about geological processes occurring during a worldwide catastrophe? Catastrophist theory suggests that these sandstones may not have been formed in a desert. These intriguing questions have stimulated a research project in one of these sandstones, the Coconino Sandstone of the Grand Canyon area in Arizona (Fig. 1).

The current explanation of the Coconino Sandstone fossil tracks was developed primarily by geologist Edwin McKee.[5] He also compared the footprints of living vertebrates with the fossil footprints,[6] and concluded that the Coconino fossil tracks were most likely formed in dry desert sand. However, it is now clear that his research did not go far enough to test this hypothesis.

I began my study with experiments like McKee's, but went beyond his work. I found that the experimental tracks most similar to the fossil tracks were made under water.[7] Recently I also found one very special circumstance that will preserve good tracks on dry sand. If the sand is wetted, as by a light rain, then dried overnight, there is just enough cohesion between the sand grains to allow animals to make good tracks. Contrary to some published papers, good preservation of tracks is not necessarily evidence for desert conditions. Since clear tracks can be produced both underwater and on dampened dune sand, the clarity of the tracks does not indicate under which condition the tracks were made. Some other type of evidence is needed to settle that question.

Since McKee did his work, scientists have found that the criteria formerly used to identify sand deposits formed in the desert are not reliable. They have also found that sand dunes form under the ocean, and that modern submarine dunes or sandwaves are virtually identical in form and scale to wind-deposited (eolian) dunes.[8] In recent years sedimentologists have studied more features of these sandstones. They are now more confident that they can identify eolian sand deposits, and still generally consider the Coconino Sandstone to be an eolian deposit of desert sand.[9] However, not all geologists agree, and my research has produced evidence pointing to an underwater origin for the fossil footprints.

Fossil behavior, and a laboratory analogue

The type of evidence with the greatest potential to test whether the tracks were made underwater would be evidence about the buoyancy of the animal—evidence that while making its tracks, the weight of its body was being supported partly or completely by the water. I have found many fossil tracks demonstrating behavior that could occur only under water.[10]

Normal upslope fossil trackways (Fig. 2A) show a regular alternation of left and right feet, as well as toe marks pointing approximately in the direction the animal is moving. These trackways almost always head up the slope of the crossbeds. In contrast, 87 trackways were found with evidence that the animals moved sideways (Fig. 2B), with the toemarks of all visible prints pointed in one general direction—not the direction in which the animal was moving. In some cases the trackway is headed at almost right angles to the direction in which the prints are pointed. Tracks of this type were found at field sites or on museum specimens of the Coconino Sandstone from all localities studied. These trackways were pointed across the slope, with the toemarks pointed up the slope.

Any interpretation of the Coconino Sandstone must explain the behavior of the animals that accounts for these trackways. I know of no evidence that reptiles or amphibians can walk sideways, crossing their legs under their

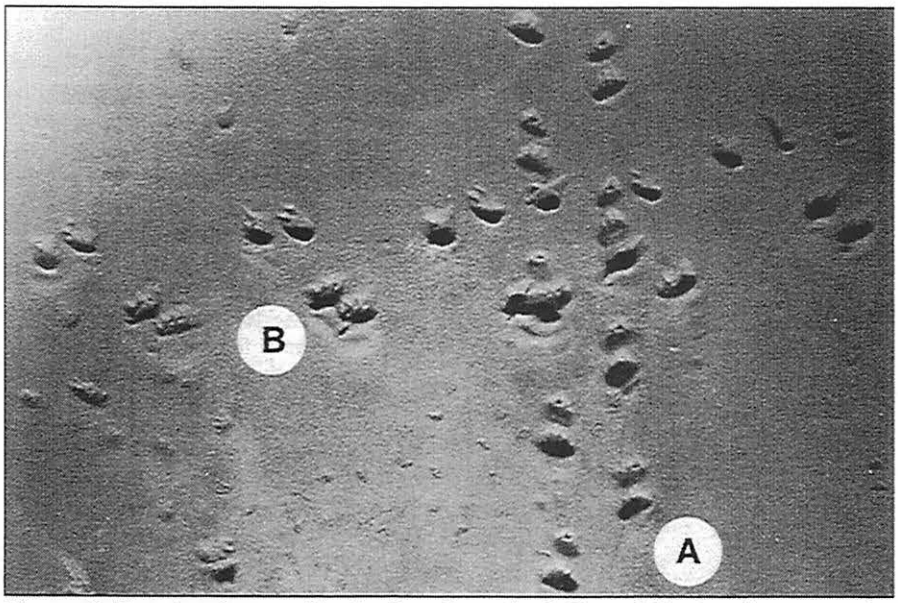

Figure 2. Two trackways illustrating the orientation of the trackways and the individual prints. One trackway was made by an animal walking in a normal pattern (A), and the other while moving sideways (B).

Figure 3. A salamander walking on sand in the experimental chamber in the laboratory.

body in order to keep their toes pointed forward, while they move to the side.

I hypothesized that these tracks could be explained by animals that were walking underwater, as gentle water currents moved the animals sideways while they were trying to walk forward. Experiments were done to test this hypothesis, with living salamanders walking underwater in the laboratory (Fig. 3). Sometimes they walked directly into or with the current, but often the current moved them sideways. They then continued to walk while drifting at some angle to the direction in which their body was oriented. The trackways produced under these conditions closely resemble the sideways trackways observed in the Coconino Sandstone.

These trackways can be most easily explained if the animals were walking underwater. If the submerged animal was walking on the sand while partially buoyed up by the water (as is typical in modern salamanders), it could easily drift sideways when pushed from the side by a lateral current. Since the animal's weight does not rest on the substrate, it can be moved sideways by a fairly gentle current. On the other hand, if the animal was not in water, but was walking on a desert sand dune, no mechanism now known could account for the marked sideways drift evident in many of the fossil trackways.

Another line of evidence for buoyance of the animals in water is found in several trackways. These tracks begin suddenly in the middle of a smooth surface, or end suddenly with no trace of where the animal went. Fossil slump features that occur in the Coconino Sandstone could cover part of a trackway, making it appear to end abruptly. However, these trackways do not show any evidence of slumps or other disturbances that could have obliterated the missing parts of the trackways.

These unusual trackways can be explained most readily by a depositional environment that allows tracks to be made underwater. While walking on the bottom, the animals were abruptly buoyed up by the current or simply swam up into the current.

The strong evidence for buoyancy seen in the trackways described above, which are widely distributed in the Coconino Sandstone, would be very difficult to explain if the tracks had not been made underwater. These features include trackways that drift sideways, that start or stop abruptly, and irregular trackways in which a floating animal only occasionally touches the substrate. These data indicate that the fossil trackways do not support the hypothesis of an eolian sand dune origin. Rather, they point to underwater deposition for at least part of the Coconino Sandstone.

Conclusion

Has this research proven that the Coconino Sandstone was produced during a global catastrophe? No. It would not be correct to make that claim. If these sandstones were deposited underwater, that can be accommodated by non-catastrophist geological theory. It is not feasible to think in terms of proving scientifically whether such a broad theory as the biblical global catastrophe is true. What the Coconino Sandstone research has done is to demonstrate how catastrophists can use their theory to develop specific hypotheses about a geologic feature (the Coconino Sandstone), and successfully carry out scientific research to test that hypothesis. This is one criteria that science used to determine the scientific value of any theory.

To some, the philosophy presented

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the bank gave me all I needed. But the vice chancellor wanted to interview me. I attended the interview with no intention of accepting the job. My intention received reinforcement when I was told that my salary would be about one-fourth of what I was making at the bank. Still, to be courteous, I promised to consider the offer and get in touch with the university later.

The intervention

Seven months later, during my morning devotional, I read the following statement from Ellen White's *Testimonies to Southern Africa*: "The men who will give themselves to the great work of teaching the truth are not the men who will be bribed with wealth or frightened by poverty" (p. 7). I felt God was speaking to me directly. He seemed to be saying, "I have called you and you have refused to follow Me. I am requiring from you not only your honest tithe and offerings, but also your talents. I want you to trust Me with your career goals."

I began justifying myself. I was a single parent. I needed the extra income to meet the needs of my family. Suddenly Psalm 37:25 challenged my thoughts: "I have been young, and now am old; yet have I not seen the righteous forsaken, nor his seed begging bread" (KJV). At that point I pledged with God that if He would call me again I would not refuse.

Come Sabbath, the vice chancellor, visiting Zimbabwe, was coincidentally at my home church. As soon as I drove into the church yard, I noticed him. A voice seemed to be saying to me, "Emily, you promised to come when I called you." I decided to pretend not to have seen him. But he spotted me, and said, "Mrs. Dube, I am still waiting for your decision."

All weekend, I pondered my decision. I knew God was calling me to join the university. The call was so strong, the pull of the Spirit irresistible. Finances became irrelevant. The commitment followed immediately.

I am at the university now. Or should I say, I am in God's vineyard? I live each day by His promises, while learning to face life's interruptions and disruptions under His guidance. ❑

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here will seem outrageous, but the advantage to science of including persons with different philosophies is that each may recognize some types of data that the others might overlook. The ultimate test of scientists' claim is their honesty in dealing with the data and the quality of their research, not their personal philosophy. For science to simply judge a person on his or her honesty and effectiveness should be enough. This would eliminate a lot of battles over philosophical issues. An outrageous hypothesis, no matter what its source, is not absurd if it can be tested by careful research. ❑

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Notes and References

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