Anniversaries

Hypothesizing mega-flooding 100 years ago

J HARLEN BRETZ AND THE CATACLYSMIC LATE PLEISTOCENE MEGA-FLOODING ORIGIN OF THE CHANNELED SCABLAND

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At the beginning of the nineteenth century a great debate emerged between two opposing groups of geologists in their study of the past causes operating on the Earth. The great historian and philosopher of science, William Whewell (1794–1866), gave the following names to these opposing groups: "catastrophists" versus "uniformitarians."

Following Sir Isaac Newton's "Rules of Reasoning" as outlined in his *Principia Mathmatica*, Sir Charles Lyell (1797–1875) sought to identify for geology what might be considered true causes (ver*a causae* in Newton's terminology) (Baker, 1998). In an exceptionally influential book *Principles of Geology* Lyell employed his rhetorical skills to argue that only by invoking causes now in operation will geologists achieve the kind of epistemological certainty needed to have the scientific rigor exemplified by Newton's physical mechanics. This is because it is only present-day causes that can reliably be observed and verified. Moreover, given the long duration of geological time, present-day causes should be sufficient to produce satisfactory explanations for all the phenomena of geology. As the resulting methodological principle was later expressed by Sir Archibald Geikie (1835–1924): "The present is the key to the past."

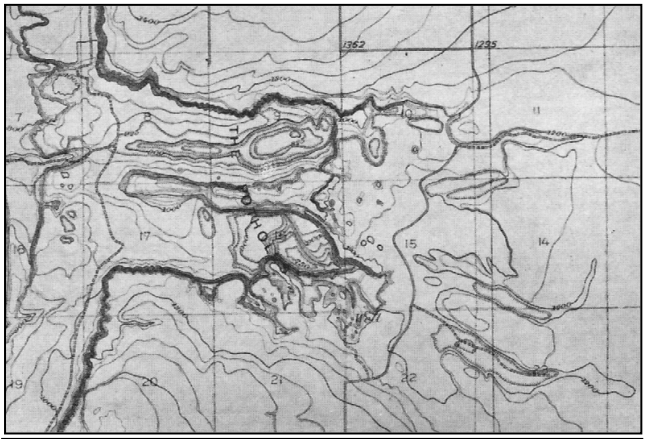

Figure 1. 1910 topographic map of the Potholes cataract published by Bretz (1923a). The contour interval is 7.6 m, and each numbered section square measures about 1.6 x 1.6 km.

By the early twentieth century this uniformitarian philosophy had come to dominate both the scientific thinking of working geologists and the textbooks for the discipline. One hundred years earlier the debate about catastrophism versus uniformitarianism had focused on the role of rivers in shaping landscapes, and a new fluvial paradigm arose that Earth landscapes are shaped by the long-acting, moderate flow processes of rivers. The contrasting diluvial view of a cataclysmic flooding origin for landscapes became viewed as an anachronism.

The elegant simplicity of the uniformitarian fluvial paradigm began to be questioned in 1923 with the publication of two papers authored by Dr J Harlen Bretz (1882–1981), University of Chicago. Bretz hypothesized a cataclysmic flooding origin for the Channeled Scabland, an anomalous landscape developed on the Columbia Plateau of eastern Washington state, USA. In the first of these papers Bretz (1923a) interpreted a topographic map as depicting an ancient cataract (Fig. 1) that had been eroded into the

basalt bedrock by late Pleistocene meltwater sourced from the Cordilleran Ice Sheet. This first paper was based on field work done in the summer of 1922, and it was submitted in January 1923 for publication in the *Bulletin of the Geological Society of America*. Though the paper did not directly invoke catastrophic processes, it did note that features like the cataract required prodigious quantities of water for their fluvial erosion. More surprising, however, was that this cataract was one of four major outlets from a structural basin into which the glacial meltwater had flowed. All these outlets seem to have operated at approximately the same elevation during the late Pleistocene. How could this be possible?

In a second paper, published September 1923, Bretz (1923b) reported on results of his 1923 field work. He presented a detailed regional map of anastomosing channel ways incised through the regional cover of early Pleistocene loess and cut deeply into the underlying basalt bedrock (Fig. 2). The eroded basalt was scoured into an array of rock basin, buttes, and inner channels, all which comprise a topography that was locally known as "scabland."

Bretz (1923b) inferred that the pre-Pleistocene valleys of the Columbia Plateau had been inundated by so much floodwater that they overspilled into adjacent valleys. His conclusion was stated in the last sentence of the paper. It flew in the face of the prevailing uniformitarian views of his fellow geologists: "It was a debacle which swept the Columbia Plateau" (Bretz, 1923b, p. 649).

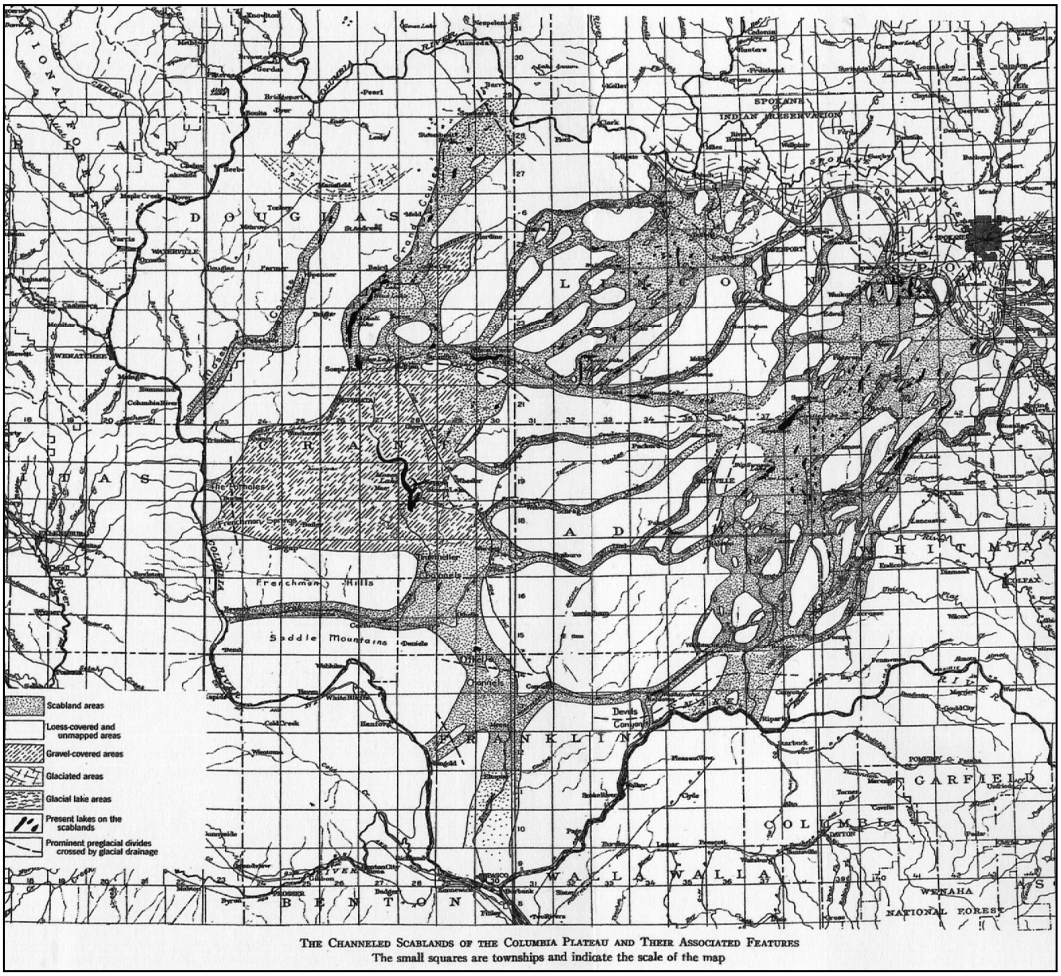

Figure 2. Map of the Channeled Scabland region of Washington state (Bretz, 1923b). The margin of the late Pleistocene Cordilleran Ice Sheet is shown to the north of the anastomosing pattern of eroded scabland channels (dark shading). Subsequent work showed that the ice margin is incorrect in the northeastern part of the map, and that Glacial Lake Columbia occupied that area. The square zonations on the map designate townships measuring approximately 10 by 10 km.

The ensuing debate over the origin of the Channeled Scabland lasted well into the 1960s (Baker, 2008). In the half century since the general acceptance of the cataclysmic flooding origin of the Channeled Scabland, cataclysmic flooding features have been documented for late Pleistocene landscapes over much of planet Earth (Baker, 2020). In the early 1970s spacecraft imagery revealed scabland-like landscapes on the planet Mars (Baker and Milton, 1974; Baker, 1978). Once thought to be an aberration, Bretz's "outrageous geological hypothesis" of cataclysmic flooding is now recognized as the discovery of a fundamental geological process.

How was it possible for Bretz to get his second 1923 paper published? The first 1923 paper was published in the journal of a major scientific society. It was mainly descriptive, and it did not invoke a cataclysmic explanation. It had previously been presented at the 1922 annual meeting of the Geological Society of America, where it received general approval.

In 1923 fortuitous circumstances arose for the publication of Bretz's outrageous hypothesis. The first event was the promotion of Assistant Professor J Harlen Bretz to the tenured rank of Associate Professor. The second event was a change in the editorial structure of the *Journal of Geology*. One of the two overall editors of the journal, Rollin D. Salisbury (who had been the advisor for Bretz's 1913 Ph.D. dissertation), died in late 1922. To replace him one editor from the group of four subject area editors moved up to the open position. The resulting subject area editorship for 1923 was then filled by the newly tenured associate professor Bretz. Thus, J Harlen Bretz was able to approve for publication in a prominent scientific journal his own paper that initiated a major transformation in the understanding of geological processes.

Further Reading

Baker, V.R., 1978, The Spokane Flood controversy and the Martian outflow channels: Science, v. 202, p. 1249-1256.

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Publication online: Posted IUGS Website / INHIGEO Website Anniversaries
April 2023
IUGS E-Bulletin Issue 196, April 2023.

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History of Geological Sciences (INHIGEO)

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