Surprise Endings to Catastrophism and Controversy on the Columbia

Joseph Thomas Pardee and the Spokane Flood Controversy

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ABSTRACT
Joseph Thomas Pardee (1871-1966) played a key role in the Spokane Flood controversy, in which the cataclysmic flood origins of the Channeled Scabland were intensely debated during the decades of the 1920s, 1930s, 1940s, and 1950s. Pardee first drew attention to glacial Lake Missoula in 1910. He suggested it to J. Harlen Bretz as a source of the cataclysmic flooding, just prior to Bretz's famous presentation of the flood hypothesis to the January 12, 1927, meeting of the Washington Academy of Sciences. Though Pardee did not publicly advocate the cataclysmic flood hypothesis, his 1940 revelation of the evidence for rapid draining of glacial Lake Missoula, including giant current ripples and immense flood bars, proved to play a pivotal role in the eventual acceptance of the cataclysmic flooding hypothesis by the scientific community.

INTRODUCTION
The debate over the origin of the Channeled Scabland region of eastern Washington is one of the great controversies in the history of geology. The story, as generally recounted (Baker, 1978, 1981; Gould, 1980), centers on the singular financial event that history now has shown to have been scientifically and financially important to both geology and to GSA. The article by Vic Baker, that starts on the first page of this issue of GSA Today, relates the boiling controversy that for more than 40 years surrounded the Channeled Scablands, the Columbia Plateau, the Spokane (Bretz) Flood, and glacial Lake Missoula; this is the scientific side of the story. The singular financial event occurred upon Mary's death, when the Joseph T. Pardee Memorial Fund. The income from this $2.7 million endowment is to be used for research, study and educational advancement in the field of geology and science.

HYPOTHESIZING THE SPOKANE FLOOD
In the summer of 1922, J. Harlen Bretz began his field research with small field parties of advanced students in the Channeled Scabland. His scabland studies continued over the next seven field seasons. During those years Bretz traversed the entire region first on foot and later in his trusty Dodge 4, an early enclosed-body car. He did this with parties of students and his wife, son, daughter, and collie dog. Bretz's first paper on the Channeled Scabland was the text of an oral topographic map. This map shows the great Potholes Cataract, now recognized as the product of cataclysmic flooding (Bretz et al., 1956). The year was 1910. In that same year Pardee (1910) described the geomorphological evidence for a great glacial lake occupying the intermontane basins of western Montana during the late Pleistocene. He described the prominent strandlines of the lake (Fig. 1) and the evidence for lake impoundment behind a glacial lobe in the basin of modern Lake Pend Oreille in northern Idaho. These relations were well known. Pardee (1910, p. 376) even credited T. C. Chamberlin with the discovery of the lake strandlines: "Chamberlin conceived the idea of a glacial dam and furthermore tentatively suggested that its location was in the Pend Oreille region with outflow by way of Spokane." The glacial lake was named for Missoula, Montana, where its strandlines were particularly prominent (Fig. 1).
SPOKANE FLOOD continued from p. 169

presentation to the Geological Society of America (Bretz, 1932a). In that paper, he took special care not to call upon catastrophic origins. The paper provided a detailed description of physiographic relations in the region. He did note, however, that the indicated channel cutting was on igneous and religious grounds of water. Referring to the three outlets at the south end of the Hartline Basin (Lake Chelan, Lower Canyon, and Long Lake Canyon), Bretz (1923a, p. 593–594) stated, “... these are truly unusual features, distributive or braided course of the Spokane glacial flood over a basalt surface which produced no adequate pre-Spokane valleys.”

The idea of truly a catastrophic flood appeared in Bretz's second scabland paper (Bretz, 1922b). His interpretation of the monodimensional scabland gravel depositional bars led directly to the requirement for great water depths. This paper also included the first detailed geomorphic map of the entire Channeled Scabland, showing the overall anastomosing pattern assumed by a great flood of water. Much of the 1920s research in the scabland region centered around Spokane, Washington, where the glacial margin was presumed to be located. Bretz named the hypothesized 1927 scabland flood (Spokane Flood) because the flood source seemed to lie near that city. A year prior to Bretz's first scabland work, W. W. Cady, chief, Pleistocene geology at the U.S. Geological Survey, sent a junior geologist to the Pardee lands. J. T. Pardee, to be more precise, scabland region near Spokane. The result was a brief article (Pardee, 1922) proposing that the Channeled Scabland was created by glaciation of rather unusual character. Bretz visited Pardee's fields a season or two later and found that Pardee's “glacial” deposits were actually flood bars (Bretz, 1974). Various correspondence in the 1920s led Bretz to believe (Bretz, 1978, personal communication) that Pardee was actually considering flooding from a glacial lake Missoula as a cause for the scabland topography. Bretz (1974) speculated that Alden dissuaded Pardee from this idea. Bretz saw a memorandum of David White, chief geologist of the U.S. Geological Survey, in which Pardee's wordings were: “... very significant phenomena were discovered in the region surrounding Spokane. They must be attributed to the latter far... require caution in their interpretation. The conditions warn against premature publication...”

At the famous 1927 “scabland debate” at the Geological Society of America (Bretz, 1927) Pardee was silent on the Missoula source for the flood. Bretz believed that Pardee's superiors at the Survey, particularly Alden and Kirk Bryan, were antagonistic to the catastrophic flood hypothesis. Did Pardee indeed first propose catastrophic flood flooding associated with the Spokane Flood controversy? Did the critical reception accorded Bretz's hypothesis (Baker, 1978) provide a deterrent to his own theorizing? J. T. Pardee wrote to Bretz in 1925 suggesting that Bretz consider the draining of a glacial lake as a possible source for the Channeled Scabland flood. In 1926 correspondence to J. C. Mertmann, Bretz wrote: Mr. Pardee of the Federal Survey, who has seen much of the scablands, has suggested that his glacial Lake Missoula might have afforded the water for these enormous rivers if it were suddenly drained out across the plateau. This comment indicates that Bretz was considering glacial Lake Missoula and concomitant glacial drainage emplacement. Even our ultra-conservative in Pleistocene geology, Dr. Alden, wrote that the phenomena I describe certainly appear to be river work if you could only control the water so that it could run from its source in three stages."

PARDEE'S SCABLAND HYPOTHESIS

Brian K. McDonald, grandson of Thomas D. and Pardee in the 1920s, has extended the research and correspondence relating to the origins of the cataclysmic flood hypothesis. Thomas D. Pardee, one of Pardee's closest colleagues, maintained correspondence with Pardee's theories concerning scabland origins. Correspondence (researched by Brian K. McDonald, 1995) between Pardee and W. E. Evermann, contains the following passages:

One of Pardee's most interesting theories is that this broad belt of rough land extending from central Idaho and Lake Chelan down through the state to Pasco is due to sub-glacial water erosion. Neither glacial nor river erosion will account for it as it has no gradient, while water under pressure under the ice could cut out huge gaps of the size of the region where resistance was least. I have as yet not been able to pick any clues in the hypothesis. As yet we are very much in doubt about the effect of the ice sheet. Some evidence which I would have indicated not over 200 feet between Cheney and Medical Lake. Objection will be made that it is impossible to see such movement over so large an area but it must be remembered that there is an average slope from here to Pasco of about 20 feet per mile.

Prof. J. Harlan Bretz of U. of Chicago has been to see me twice since I wrote you. He has a group of geology students and they have gone over some of my work. He thinks that glacially carved “parries” may be Wisconsin but I am quite sure he does not think they are Wisconsin in 1927 this climate and its effect on flowing down weathering. Furthermore he must account for the other two glacial

SPOKANE FLOOD continued on p. 171

ANNOUNCEMENT

TRAVEL GRANT PROGRAM

30th IGIC in Beijing, China • August 4–14, 1996

The Geological Society of America is accepting applications for the International Geology Congress (IGC) Travel Grant Program. This program was established as a final act of the Organizing Committee for the U.S.-hosted 28th IGC held in Washington, D.C., in July 1989. Surplus funds available at the conclusion of the 28th ICG were transferred to the GSA Foundation with the stipulation that income from the fund be used to support the attendance of young geoscientists at future IGICs, until such time as the United States again hosts an IGC. Travel grants will consist of economy airfare to and from China. To be eligible, an applicant must be a resident or citizen of the United States (includes students); must have a birth date after August 13, 1956; and must have an abstract accepted in the program of the 30th IGC. Official applications for funds are available from the Grants Administrator, GSA Headquarters, 1300 Penrose Place, P.O. Box 9140, Boulder, CO 80301. Along with the form, applicants must include a copy of the abstract that was submitted to the 30th IGC. Applications must be supported by two letters from current or recent supervisors; students may use faculty members. Qualifying applications and letters of support must be postmarked no later than 15 September 1995. Applicants will be notified of results early in 1996.

GSA TODAY, September 1995

170
Spokane Flood continued from p. 170

trains at lower levels which in no way connect with the dissected plateau positions. He says “out-by” way of Mica, California Creek, and North Fork. We believe you did. Also my impression of atonamonts.3 Thanks he may find some evidence of ground ice on some of the scabs of the Spokane Valley above the city. May leave a student here to hunt for it. I am willing he should. He goes after Pardee hard on one point. The fact is, of course, that the deposits are more the likely of flood origin than of glacial origin. Bretz rather than of glacial ice. That is—I do not regard them as conclusive evidence of glaciation. On the other hand the deposits are indirectly if not directly, related to glaciation and may have been formed by streams that gouged out the channels and basins under an ice cover as you suggest.

Though Pardee may not have advocated the catastrophic origin of the scablands, Bretz was not his first proponent. McMacken (1957) attributed a “Flood Theory” to a teacher at Lewis and Clark High School, Alonzo P. Troth, who apparently never published his hypothesis.

PARDEE’S REVELATION

Whatever the origins of the cataclysmic flooding hypothesis, Pardee played a major role in the resolution of the Spokane Flood controversy. His contribution came in rather dramatic fashion at a 1940 meeting of the American Association for the Advancement of Science in Seattle, Washington. Howard Meyerhoff (1978, written communication), who attended that meeting, recalls a key moment in the pardee-Pardee affair. Pardee was a dramatic speaker and certainly knew how to get the audience’s attention.

Pardee walked into the room with a box of handouts,.Boldly he announced: “I have come here this afternoon to announce a revelation. I have found the origins of the Spokane Flood in the Channeled Scabland. The principal feature of the deposits that suggested glacial action is the presence of large boulders, some of them of foreign origin. In intelligence of the fact that they have been made available since 1922, however, I have concluded that these deposits are more likely to be of flood origin than of glacial origin. Bretz rather than of glacial ice. That is—I do not regard them as conclusive evidence of glaciation. On the other hand the deposits are indirectly if not directly, related to glaciation and may have been formed by streams that gouged out the channels and basins under an ice cover as you suggest.

Pardee’s revelation caused a stir, but most of the attendees were skeptical. They wanted more evidence. Pardee knew that he needed to provide more data to support his hypothesis. He promised to do so in a future publication.

Pardee’s revelation was a turning point in the debate over the origins of the scablands. It set the stage for the ongoing debate between advocates of the catastrophic and the non-catastrophic theories. Pardee’s revelation was a catalyst for further research and discussion, leading to a better understanding of the Spokane Flood controversy.
that Bretz (1923a) had introduced, but rejected after further study. Flint (1938) proposed that the normal process of channel aggradation by proglacial outwash streams was followed by dissection to leave remnants of a fill that locally resembled bar forms.

Subsequent papers at the 1940 meeting reiterated various hypotheses for the origin of the Channeled Scabland. E. T. Hodge (1940) presented his scenario involving glacial erosion in the scablands associated with complex damming and diversions by river ice. J. S. Allison (1940) presented a synopsis of Flint’s fill hypothesis and contrasted it with Gilbert’s ice-jam theory. In a later paper Allison (1941) pointed to key shortcomings in the Flint hypothesis. The eighth speaker in the session was Joseph Thomas Pardee, who rose to speak on “Ripple Marks(?) in Glacial Lake Missoula.” The modest title and the low-key delivery were deceiving. Pardee quietly described the “ripple marks” at Camas Prairie (Fig. 2), an intermontane basin in northwestern Montana. He described them as “extraordinary,” heights of up to 15 m and spacings of as much as 150 m (Pardee, 1940). His written discussion (Pardee, 1942) also had an understated title, “Unusual Currents in Lake Missoula.” His work, dating back to before Bretz’s studies, clearly demonstrated that Lake Missoula was the source of catastrophic floods through the Channeled Scabland. He noted that about 2000 km² of water were held in the lake. Moreover, the glacial dam impounding this lake had clearly failed suddenly, with a resultant rapid draining of the lake. Evidence for this failure included severely scoured constrictions in the lake basin, huge bars of current-transported debris (Fig. 3), and the giant current ripple marks. However, Pardee (1942) did not state the connection to the Channeled Scabland. Perhaps he generously left that point to Bretz.

In the summer of 1952, Bretz, then nearly 70 years old, returned for his last session of fieldwork in the Channeled Scabland. The purpose was to investigate new data that had been obtained in surveys for the Bureau of Reclamation’s Columbia Basin project. H. T. U. Smith accompanied him, acting in the field as “skeptic for all identifications.” His written communication (Bretz et al., 1956, p. 761). George E. Neff of the Bureau of Reclamation pointed out many new exposures of flood sediments. Bretz reported the 1952 field season with a wealth of new data. The U.S. Bureau of Reclamation had been especially generous in supplying maps, aerial photographs, and sedimentological information. Bretz wrote the extensive report over the next year. In that paper (Bretz et al., 1956), the most convincing evidence for cataclysmic flooding proved to be the presence of giant current ripples on bar surfaces (Fig. 4). These showed clearly that bars 30 m high were completely inundated by phreatomagmatic flows of water. Numerous examples of giant current ripples were found on the same bars that Flint had interpreted as normal river terraces. Such features could have been produced only by the flow velocities associated with truly catastrophic discharges.

J. T. Pardee may have been wrong about the 1922 interpretation of scabland flood bars, but his 1940 description of giant current ripples proved to be the key point for convincing skeptics of the cataclysmic flood hypothesis. His first paper on glacial Lake Missoula was published in 1910, only one year after he began his 32 year career with the U.S. Geological Survey. His last paper on the subject appeared in 1942, the year after his official retirement from government service on May 30, 1941. His recognition of the giant current ripples of Lake Missoula was followed by the documentation of 15 scabland ripple fields by Bretz et al. (1956) and nearly 100 by Baker and Nummedal (1978) (Fig. 4). The hydraulic characteristics of the cataclysmic flows have proven to be physically consistent with the various geomorphological field evidence (e.g., O’Connor and Baker, 1992). Unresolved issues remain as to the number of flood events, and timing of the late-glacial floods (Baker and Bunke, 1985; Waist, 1985), which have been named for Lake Missoula (Bretz, 1969), the source that was so well documented by Joseph Thomas Pardee.

DISCUSSION

The Spokane Flood controversy has been cited as an illustration of the role of hypotheses in geoscience. Emphasis in previous work centered on the role of the “outrageous hypothesis” (Davis, 1926) proposed by Bretz. Formal scientific publications provided the major source for description of the controversy. However, correspondence among the participants reveals a more complex and human character to the controversy. Hypotheses in geology have a profoundly human dimension. Though often associated with single individuals, usually the authors of key scientific papers, hypotheses may emerge from exchanges with colleagues over controversial explanations. The multiple working hypotheses described by Gilbert (1886) and Chamberlin (1890) are worked out among the members of a scientific community. Similarly, the eventual acceptance of a controversial explanation by that community is also a human process. The Spokane Flood controversy provides an excellent example of the social dimension for achieving reliable scientific knowledge.

ACKNOWLEDGMENTS

I thank Brian K. McDonald for sharing the results of his archival research into correspondence relating to the Spokane Flood controversy. Conversations with the late J Harlen Bretz provided the stimulus for my original research into the history of the controversy.

REFERENCES CITED


Spokane Flood continued on p. 173

Figure 2. Giant current ripples at Camas Prairie, north of Plains, Montana. The ripples are composed of foreset-bedded gravel and consist of ridges up to 15 m high, spaced as much as 200 m apart. They cover approximately 10 km² of northern Camas Prairie.

Figure 3. Giant flood bar at the mouth of a small tributary to the Flathead River valley near Perma, Montana. Described as “quilt fills” by Pardee (1942), the deposit is an eddy bar (Baker, 1973) formed during the rapid draining of glacial Lake Missoula. The low terrace in the foreground consists of lacustrine silt emplaced by the reformation of glacial Lake Missoula after its cataclysmic draining phase.

Figure 4. Giant current ripples at Spirit Lake, Idaho. The partial forest cover indicates the immense scale of these bed forms.

Figure 5. Floods in the Channeled Scabland, between the COLUMBIA RIVER and the NEHEMIAH RIVER, illustrate the major source for the Spokane Flood controversy. These floods, with a volume of water in excess of 10,000 cubic km, are described by Gilbert (1886) and Chamberlin (1890) as the most powerful natural events in recent history.
Estates continued from p. 169

by Ruby and Mary. He provided impor-
tant evidence through the study of the Grund Coulee and Hungry Horsedamns, and he played a major role in the discovery of phosphate deposits. his paper USGS Bulletin 842 (see REFERENCES list) is considered to be an authoritative and thorough compila-
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Penrose Conference Scheduled

Tectonic Evolution of the Gulf of California and its Margins
April 16–21, 1996

A GSA Penrose Conference, “Tec-
tonics of the Gulf of Califor-
ia and its Margins,” scheduled for April 16–21, 1996, in Loreto, Baja California Sur, Mexico. Loreto, a small fishing and tour town, with direct air service from Los Angeles, is located within the Gulf extensional province on the Gulf of California. The conveners of the conference are Paul Umhoefer, Joann Stock, and Arturo Martín. This conference will focus on the tectonic development of the Gulf of California region during the past 15–20 m.y. The Gulf of California is one of two examples on Earth of active oblique-plate boundaries. The Gulf of California and the San Andreas fault system, received much attention during the early days of plate tectonics due to their simplicity and the kinematic consis-
tency of the transform model. As a geologically young and currently active plate boundary, the Gulf of California has been the subject of considerable investment by many geoscientists. Because it is an active and accessible plate boundary, it is the focus of a growing number of tectonic geomorphology, stratigraphy and seismotectonic studies.

The objectives of this Penrose Con-
ference are to assess the state of knowl-
edge of the Gulf of California region, investigate areas and topics of greatest potential future research, and stimulate collaboration on future research proj-
ects in both earth and ocean sciences. In order to assess the tectonics of the Gulf of California and its margins, the conference will cover all aspects of the subject, including relation to the San Andreas fault, plate motions, marine geology and geophysics, seismotectonics, magnatism, structural geology, tec-
tonics, basin analysis, tectonics and paleontology, geodynamics and model-
ing of rifts, and comparison to other young rifts. The geographic range of the conference encompasses the marine realm of the Gulf of California and its mouth and the onshore mar-
gins in Jalisco, Sinaloa, and Sonora on the east, the Salton Trough in Califor-
nia in the February 1975 Geology: ... the conference will be limited to inves-
tigation of where and when to hold the next Gulf of California conference. Hopefully, this will work out in Mexico, particularly in light of the need to establish better liaison with Mexican scientists. ... we couldn’t have said it better.

The conference will be limited to about 70 participants. The conference fee has not yet been established, but we hope that it can be less than $750. The fee will include ground transportation from/to the Loreto airport, registration, field trips, lodging, and double-occupancy hotel accommodations. Limited support is available for some graduate students, and we are attempting to obtain partial support for Mexican geoscientists and some partici-
pants from outside North America.

APPLICATION DEADLINE IS NOVEMBER 1995. Prospective participants should send a letter of application to Paul Umhoefer. The letter should describe briefly your research related to the objectives and plan of the conference, and your professional role and address, if avail-
able. The conference is designed to involve all of the participants in either keynotes, short oral talks, poster presentations, or active discus-
sion. Thus, in your letter of applica-
tion, please state whether you would like to be considered for a title for your prospective short talk or poster. After the applications are received, formal invitations will be sent out in December 1995. Please direct any questions to:
Paul Umhoefer, Department of Geology, Box 4099, Northern Arizona University, Flagstaff, AZ 86011. Phone: (602) 523-9220, E-mail: jumhoefer@nas.nau.edu; Arturo Martín, Departamento de Geología, CICESE, P.O. Box 434843, San Diego, CA 92143-4843, (015-52 from U.S.) 617-44-05 ext. 2425, fax (015-52 from U.S.) 617-44-04 ext. 2425; E-mail: amartin@cicese.mx.

REFERENCES CITED

Kelly, Mary Pardee, 1963, Memorial to Joseph T. Pardee, published in the GSA Bulletin (see REFERENCES list).


O’Connor, J. E. and Baker, R. V., 1992, Magno-


Pardee, J. T., 1910, The Channeled Scabland. The Contri-

