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How does a tainter gate that is opened to above the 500-year flood headwater elevation become disengaged from the spillway while the dam is passing a discharge only slightly greater than a 10-year flood? On September 22, 2016, a 27-foot-wide, 14.25-foot-high steel tainter gate that was opened completely to pass flood flows somehow managed to become unseated from its trunnion pins, and was transported downstream by floodwaters. This unexpected event prompted a question shared by the owner, owner's engineer, regulators, and essentially everybody who learned of the incident: How did that happen? The answer began to develop when eyewitness photographs were posted on social media showing the interaction of a large tree present in the floodwaters. Lacking an eyewitness observation from downstream, or surveillance video that could have provided crucial insights to the event, the involved parties could not confidently explain how the gate became separated from the spillway bay. This paper traces the investigation to piece together the details of what occurred to dislodge the tainter gate. By considering evidence from eyewitness photos, damages sustained at the spillway bay, clues from the recovered gate, and modeling of gate deformations, the investigators developed a hypothesis regarding the sequence of events that occurred to result in loss of the tainter gate. Understanding the failure mechanism allows the owner to implement measures to prevent another tainter gate loss at Black River Falls, and allows the dam safety community to be mindful of a similar occurrence elsewhere.