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Folklore and earthquakes: Native American oral traditions from Cascadia compared with written traditions from Japan

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Abstract: This article examines local myth and folklore related to earthquakes, landslides, and tsunamis in oral traditions from Cascadia (part of the northern Pacific coast of North America) and in written traditions from Japan, particularly in the Edo (present-day Tokyo) region. Local folklore corresponds closely to geological evidence and geological events in at least some cases, and the symbolic language of myth and folklore can be a useful supplement to conventional geological evidence for constructing an accurate historical record of geological activity. At a deep, archetypical level, Japan, Cascadia, and many of the world’s cultures appear to share similar themes in their conception of earthquakes. Although folklore from Cascadia is fragmentary, and the written record short, the evolution of Japanese earthquake folklore has been well documented over a long period of history and illustrates the interaction of folklore with dynamic social conditions.

Local cultures in regions of significant seismic activity around the world are rich in myths, legends, and other symbolic representations of earthquakes and their consequences. The study of local earthquake-related lore can shed useful light on local cultural traditions and values, human
psychology vis-à-vis the violent forces of nature, and other aspects of society and culture. This lore can also shed useful light on the geological record, sometimes even to the extent of suggesting major geological events that remain undiscovered by conventional scientific approaches. Common themes appear in stories from different cultures, and may help identify stories with geological information.

In this paper, we examine two types of earthquake lore from Cascadia and Japan. First, we discuss figurative stories from the Pacific Northwest coast of North America that appear to refer to earthquakes, tsunamis, permanent land level changes, or landslides. Geographically these stories describe events along two major fault zones; the Cascadia subduction zone (CSZ), which produced a magnitude 9 earthquake in 1700 (Satake et al. 2003), and the Seattle fault in Puget Sound which produced an earthquake of estimated magnitude 7.4 in approximately 900 AD (Bucknam et al. 1992). Secondly, we discuss non-geological evidence from Cascadia and Japan that researchers have used to date the CSZ earthquake of 1700. Next, we examine figurative conceptions of earthquake causality in Japanese folk culture, both circa 1700 and, in greater detail, during the period following the Edo (present-day Tokyo) earthquake of 1855.

This earthquake produced an outpouring of figurative namazu-e (catfish picture prints), which expressed a wide range of popular views on earthquake-related phenomena, both geological and social. Data from both Cascadia and Japan support our general argument that symbolic language can usefully describe geological events.

In addition to demonstrating a linkage between local earthquake lore and geological events in these two parts of the world, we propose some observations about similarities in this lore, with reference to other regions of the world. At a deep level, which we call the ‘archetypical level’, many apparently unconnected societies throughout the premodern world conceived of earthquakes in similar ways.

**Stories of earthquakes and related events from native societies in the Cascadia subduction zone**

**Geological knowledge of the Cascadia subduction zone**

The plate-boundary fault at the Cascadia subduction zone (CSZ) separates the oceanic Juan de Fuca plate from the continental North America plate (Fig. 1). It lies about 80 km offshore and extends roughly parallel to the coast from the middle of Vancouver Island to northern California. Although recognized...
as early as the mid-1960s, seismologists initially assumed that the CSZ was incapable of producing great (megathrust) earthquakes. It is seismically quiet, and no sizable earthquake has occurred on it since European settlement began. As the theory of plate tectonics matured, studies of subduction zones worldwide identified characteristics associated with megathrust earthquakes. These earthquakes are most common in areas where hot, young, buoyant crust is rapidly subducted (Heaton & Kanamori 1984). Although the rate of subduction in Cascadia is relatively slow, the subducted crust is among the youngest and hottest anywhere.

Field investigations in the 1980s of the coastal margins along the CSZ located geological evidence of abrupt land-level changes characteristic of megathrust earthquakes in ‘ghost forests’ of dead cedar trees in coastal estuaries in Washington and Oregon (e.g. Nelson et al. 1995). The cedars, originally above the limit of the tides, were killed when their roots were suddenly plunged into salt water. Beneath the surface of these same estuaries, soil cores reveal layered deposits showing a repeated cycle of slow uplift and rapid submergence. Preliminary age estimates based on radiocarbon dating (Nelson et al. 1995) and tree-ring studies suggested that the most recent earthquake happened about 300 years ago. A precise date, 26 January, 1700, was determined from Japanese historical documents (Satake et al. 2003), and confirmed by a close study of tree-ring patterns of ghost cedar roots (Yamaguchi et al. 1997). The magnitude estimate of 9.0, derived from the amplitude of the tsunami that reached Japan, implies rupture along the entire length of the CSZ (Satake et al. 2003). Figure 1 shows the geographic extent of the likely rupture area.

Native folklore from the Cascadia subduction zone

This section examines Native stories from along the Cascadia margin that are figurative and folkloric in style, and not amenable to dating with any precision. Some of these stories appear to be of fairly recent origin and possibly linked to the 1700 earthquake. It is seismically quiet, and no sizable earthquake has occurred on it since European settlement began. As the theory of plate tectonics matured, studies of subduction zones worldwide identified characteristics associated with megathrust earthquakes. These earthquakes are most common in areas where hot, young, buoyant crust is rapidly subducted (Heaton & Kanamori 1984). Although the rate of subduction in Cascadia is relatively slow, the subducted crust is among the youngest and hottest anywhere.

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Native oral traditions are sometimes structured as stories about the acts and personalities of supernatural beings, often in the guise of animals. Throughout Cascadia, stories were part of broader cultural contexts that also conveyed information through artifacts, dances, songs, and ceremonies, and personal and place names. Shaking imagery appears in stories about a variety of supernatural beings (McMillan & Hutchinson 2002), not surprising in an area with multiple cultures and multiple earthquake sources. Some stories are local, whereas others appear over a wider geographic range. Some stories have generic descriptions of shaking that could occur in any earthquake whereas others appear to describe specific effects, such as tsunamis or permanent ground level change along the coast, that might suggest a great subduction zone earthquake. We sought stories with widespread distribution along the Cascadia coast and imagery or descriptions of the effects that might be expected from a subduction zone earthquake.

The struggle between the Thunderbird and Whale is a story told by many groups from western Vancouver Island and northern Washington. One version, story 15b (see Fig. 1), includes a side comment that explicitly links earthquake and tsunami-like effects to the struggle and suggests an historical context:

My father (father of the medicine man who related this story to the writer) also told me that following the killing of this destroyer ... there was a great storm and hail and flashes of lightning in the darkened, blackened sky and a great and crashing ‘thunder-noise’ everywhere. He further stated that there were also a shaking, jumping up and trembling of the earth beneath, and a rolling up of the great waters. (Reagan 1934).
Thunderbird and Whale are beings of supernatural size and power. A story from Vancouver Island says that Thunderbird causes thunder by moving even a feather, and that he carries a large lake on his back from which water pours during thunderstorms (Carmichael 1922). The same story says that all creation rests on the back of a mammoth whale and tells of an occasion when Thunderbird drove his talons deep into the quivering flesh of Whale’s back, and Whale dived and dragged the struggling Thunderbird to the bottom of the ocean; imagery suggestive of ground shaking and ocean surges. In this story, three of the four original thunderbirds were drowned in this manner, and one remains alive. Other stories also have multiple whales or thunderbirds (Fig. 1, stories 1d, 15b, 22b; Reagan 1934, p. 25; Spott & Kroeber 1942, p. 227–232) that may refer to aftershocks.

Stories 5, 9, 14a and b, and 15a (see Fig. 1) further tie the story of a supernatural battle to the flood, with imagery that implies shaking—Thunderbird lifts the massive Whale into the air and drops it on the land surface. The flood description in story 15a is strikingly similar to story 10, which hints at a historic framework by placing the event ‘A long time ago... but not at a very remote period’.

The struggle between Thunderbird and Whale is unique to the Cascadia coast, and appears in stories from Vancouver Island to northern Oregon. From central Oregon south, Thunder or Whale figures appear individually in stories describing earthquake or tsunami themes. The central figures variously appear in the form of Thunder, Thunderbird or bird, and Whale, fish, or sea monster. In northern California, the Yurok tribe has an ‘Earthquake’ figure with ‘Thunder’ as his companion. Stories from Puget Sound and eastern Washington also use similar motifs in conjunction with descriptions of earthquake effects. Story 16, of the battle between the double-headed eagle and the water-monster, is about the creation of Agate Pass, a Puget Sound waterway far from the outer coast, but adjacent to the Seattle Fault, where a magnitude 7.4 earthquake caused a Puget Sound tsunami (Moore & Mohrig 1994) about 1100 years ago (Bucknam et al. 1992).

Although none of the Thunderbird/Whale stories are dateable, a few have vaguely historical time-frames. In addition to describing earthquake effects, Thunderbird and/or Whale stories have a general association with landscape-forming events, such as glacial moraines (Fig. 1, story 15b), icefalls (Reagan & Walters 1933), and landslides (Barbeau & Melvin 1943). Thunderbird also appears in stories about thunder, lightning, and rain. Thunderbird and Whale stories are part of a systematic oral tradition that used symbolism and mnemonic keys to condense and present information in a format that could be remembered and retold for generations. Native populations witnessed multiple cycles of CSZ earthquakes; geological evidence indicates at least seven in the last 3500 years (Atwater & Hemphill-Haley 1997). Artifacts depicting Thunderbird and Whale that long predate the 1700 earthquake have been recovered from coastal archeological sites (McMillan 2000). Knowledge of a repeating earthquake cycle may be implied in a story where the Thunderbird becomes a man and sends his Thunderbird costume back to the sky saying: ‘You will not keep on thundering, only sometimes you will sound when my later generations will go (die). You will speak once at a time when those who will change places with me will go (die)’ (Boas 1935, p. 65).

The Thunderbird/Whale motif is the central theme in carved and painted art of the outer coast and coastal fjords of Vancouver Island (Malin 1999) (Figs 2 & 3), where broad ocean openings...
funnel water into narrow waterways that run far inland. Port Alberni, at the landward terminus of Barkley Sound, 40 km from the ocean, experienced tsunami run-up about six times larger than sites on the open coast following the 1964 Alaska earthquake (Sokolowski Alaska Tsunami Warning Centre). Clague et al. (2000) have documented tsunami deposits from both the 1964 and 1700 earthquakes in Port Alberni and other fjord-like inlets on Vancouver Island. Alert Bay, between the northern end of Vancouver Island and the mainland, also has prominent Thunderbird and Whale artworks (Fig. 4) and story themes linking Thunderbird and flooding (Fig. 1, story 1a), and placing flooding at the time of the winter ceremonial (Fig. 1, story 1b).

Native stories, art, ceremonies, and naming preserve memories of Cascadia subduction zone earthquakes. Ancient, recurring imagery describes earthquake and tsunami effects and suggests awareness of repetitive cycles of world-altering events. Likewise, similarities in symbols and imagery along the length of Cascadia suggest commonly experienced events. We now take a closer look at earthquake-related lore from the Puget Sound area.

A’yahos, the AD 900 Seattle earthquake and earthquake lore from the Puget Sound area along the Seattle fault

The Seattle fault is a multi-stranded east–west striking reverse fault cutting across Puget Sound, through downtown Seattle, and across Lake Washington. Although geophysical evidence has long indicated a substantial offset in basement rocks beneath Puget Sound (Danes et al. 1965), no clear pattern of recent earthquake activity defining the fault has been observed. However, geological evidence of an earthquake around AD 900 (estimated magnitude 7.4) came to light in the early 1990s (Bucknam et al. 1992) and the Seattle fault is now recognized as a substantial hazard to the Seattle urban area.

The circa AD 900 earthquake caused 7 m of vertical uplift on the southern side, sent massive block landslides tumbling into Lake Washington, and created a tsunami in Puget Sound that left sand deposits on Southern Whidbey Island (Atwater & Moore 1992).

Two archaeological sites near Seattle attest to the effects of such events on local indigenous communities. Excavations at West Point, a promontory jutting out into Puget Sound north of downtown that was used as a fish- and shellfish-processing site since at least 4000 years before the present, show that the area dropped at least a metre during the quake. The point’s marshes were flooded with saltwater and a layer of sand covered the entire site. Over time, people returned to West Point and began using it as they had before the quake (Larson & Lewarch 1995). The earthquake also permanently transformed some areas. At the Duwamish No. 1 archaeological site, excavations show that the quake lifted up a low, wet area that had only been a minor camping and food-processing site and turned it into a higher, drier spot that eventually became home to a major permanent settlement with several longhouses (Campbell 1981;
Blukis Onat 1987). Natives passed down knowledge of these events in their oral tradition using descriptive metaphors based on their cultural concepts, often ascribing earth shaking to actions of supernatural beings.

In 1985, prior to published evidence of the AD 900 earthquake on the Seattle fault, an article in the Seattle Weekly (Buerge 1985) mentioned a Native American 'spirit boulder' associated with earthquakes and landslides located near the Fauntleroy ferry dock in west Seattle. The proximity of this location to the Seattle fault invited investigation and we discovered that the Fauntleroy Spirit boulder is associated with a supernatural being called a’yahos. Native stories often describe a’yahos in a way that could refer to earthquake effects, especially landslides. A’yahos is a shape-shifter, often appearing as an enormous serpent, sometimes double headed with blazing eyes and horns, or as a composite monster having the fore-quarters and head of a deer and the tail of a snake (Mohling 1957). A’yahos is a ‘Doctor’ spirit power; reserved for shamans. It is one of the most powerful personal spirit powers; malevolent and dangerous to encounter. A’yahos is associated with shaking and rushes of turbid water and comes simultaneously from land and sea (Smith unpublished notes). ‘At the spot where a’yahos came to a person the very earth was torn, landslides occurred and the trees became twisted and warped. Such spots were recognizable for years afterward.’ (Smith 1940)

Stories about a’yahos mention a number of specific places in the central Puget Sound, along the Hood Canal, and on the Strait of Juan de Fuca as far west as the Elwha River. A total of 13 a’yahos sites are mentioned in various stories (Fig. 5a, b), and these locales coincide with shallow faults around Puget Sound, including the Little River fault along the strait of Juan de Fuca, the Tacoma fault, and the Price Lake scarps (Haugerud et al. 2003). Five of the a’yahos story sites are located very close to the trace of the Seattle Fault (Fig. 5b). Four of the Seattle locales can be associated with landslides or reports of land-level changes that might have been caused by the AD 900 Seattle earthquake. Additional Native stories related to shaking, landsliding, or land-level change are associated with three of these sites.

A’yahos stories along the Seattle fault

The west Seattle a’yahos spirit boulder mentioned by Buerge (1985) is located on the beach immediately south of Fauntleroy Ferry Dock (Fig. 5b:1),

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**Fig. 5.** (a) Map of Puget Sound and eastern Olympic Peninsula. Boxed area indicates location of larger-scale map shown in Figure 5b. Dashed lines show locations of some shallow faults (after Haugerud et al. 2003); LR F, Little River fault; TF, Tacoma Fault; DDM FZ Darrington Devil’s Mtn fault zone; PL S, Price Lake Scarps; FC S Frigid Creek Scarps. Numbers in Figure 5a indicate sites outside the Seattle fault area associated with a’yahos stories. 1, Elwha River; 2, Dungeness River; 3, Dabob Bay; 4, Bald Point also known as Ayers Point; 5, Tahuya River; 6, Medicine Creek (Nisqually Delta); 7, American Lake; 8, Black Diamond Lake (1–5 from Elmendorf, 1993; 6 and 8 from Waterman 2001; 7 from Smith, 1940). (b) Larger-scale map showing the Seattle fault zone, a’yahos story localities (indicated by black circles), other stories that have apparent connection to earth shaking or landsliding (indicated by grey circles), and archaeological sites (white circles). 1, Fauntleroy; 2, Alki Point; 3, Lake Washington a’yahos site; 4, South Point, Mercer Island; 5, Madison Park; 6, Three Tree Point; 7, Agate Passage; 8, Bremerton; 9, Moore Point; 10, Portage Bay; 11, West Point; 12, Duwamish Site No. 1. LIDAR images of Fauntleroy (1) and Three Tree Point (6) are shown in Figure 6.
below what appears to be a very large landslide of undetermined age clearly visible in LIDAR images (Fig. 6a) but not shown on existing geological maps. Long term local residents Mory Skaret and Judy Pickens pointed out the boulder; Waterman (2001) indicated a location further south, near Brace Point. Stories of a’yahos spirit power are told about both the Fauntleroy boulder (Waterman 2001) and Alki Point (Smith unpublished notes), immediately to the north and uplifted during the AD 900 quake. Stories about Alki Point speak of shaking, rocks exploding, and the power coming from sea and land simultaneously (Smith unpublished notes).

The second place in Seattle associated with a’yahos is by the shore of Lake Washington (Fig. 5b: 3). According to elders who worked with T.T. Waterman, ‘On the lake shore opposite the north end of Mercer Island . . . an enormous supernatural monster . . . lived’ (Waterman 2001, p. 102). Large block landslides dated to AD 900 slid into Lake Washington from the southern end of Mercer Island and at Madison Park (Karlin & Abella 1992), about 2 km south and north, respectively, of the a’yahos site. In addition to the massive slides of AD 900 that bracket this site, a close-by landslide during the 1890s is said to have damaged buildings (McDonald 1956). It is possible that the 1890s landslide entered into the identification of this site with a’yahos. Landslides occur in many locations along the bluffs and steep slopes that line portions of the shores of Lake Washington and Puget Sound.

The large blocks of land that slid into Lake Washington from Mercer Island’s South Point in AD 900 submerged intact with upright trees. As the lake rose and fell several feet during the course of the year owing to seasonal run-off in the lake basin, the trunks of these drowned trees were exposed. Native people avoided this place, which they called ‘stripping someone’s clothes off’. A man who came to strip the bark off the drowned trees protruding above the lake surface reportedly became crazy, because stripping the bark from the submerged trees was thought to be like stripping the clothes off the supernatural ‘earth beings’ who lived in the stumps of the drowned trees (Waterman 2001, pp. 108–110).

A third locality in greater Seattle is on the shore of Puget Sound, near Three Tree Point in Burien (Fig. 5b: 6), at a bluff where ‘a great snake lived inside, shoving the sand down when people disturbed him’ (Waterman 2001). James Rasmussen, of the Duwamish Tribe, identifies this snake as a’yahos. As at Fauntleroy, the locale at Three Tree Point features what appears to be a large, undated, and previously unmapped landslide, which is visible in LIDAR (Fig. 6b).

The fourth story comes from the Suquamish Tribe on the western side of Puget Sound (Fig. 5b: 7; Fig. 1:16). Oral traditions handed down by elders tell of the creation of Agate Passage (the waterway between the northern end of Bainbridge Island and the Kitsap Peninsula; located on the down-thrown side of the Seattle fault) following an underwater battle between a water serpent (not specifically identified as a’yahos) and a mythic bird. The battle resulted in ground shaking, churning of the waters, and widening of the channel.

Long ago, when this land was new, the area we know as Agate Pass was much smaller than today . . . There lived in this . . . body of water a . . . Giant Serpent.

The Double Headed Eagle flew over the pass and the Giant Serpent came up very angry. The two began to fight, and the earth shook and the water boiled . . . the people began to scream and cry until it was as loud as thunder.

Then, as if the earth was going to be swallowed by the waters, they began to boil and churn. Then, the Double Headed Eagle exploded out of the water and up into the sky with the body of the Giant Serpent in its claws. The Double Headed Eagle flew back into the mountain and behind him was left the wide pass . . . (Jefferson 2001).
The description of the widened channel could reflect permanent ground level change, and the sense of ground motion suggested by the story is accurate; Agate Passage is on the down-thrown northern side of the Seattle fault. However, geological evidence suggests that the AD 900 earthquake produced mainly uplift on the southern side, with the north side down only slightly; the correspondence between the story and reality is approximate rather than exact. We note, however, that some ‘drift’ seems reasonable in a story that may be a thousand years old and has been preserved through extreme cultural destruction. This story, set in an undated ‘long ago’, is strikingly similar to the stories from the outer coast of Cascadia that use the struggle of a supernatural bird and water-beast to refer to earthquakes on the Cascadia subduction zone (Ludwin et al. 2005a). The ‘long ago’ time frame suggests an origin more ancient than 1700.

A fifth place, on the Kitsap Peninsula near Bremerton (Fig. 5b: 8), is said to be another spot where shamanistic spirit-power could be acquired (Waterman 2001, pp. 206–207; Smith unpublished notes). Sam Wilson, born in 1861, and grandson of Chief Seattle told Marian Smith, ‘it comes from land and sea at same time’ (Smith unpublished notes). No obvious geological features were noted at this site, though it is situated between several strands of the Seattle fault. On the Puget Sound shore of Kitsap Peninsula just east of this locality, at Moore Point near Illahee State Park (Fig. 5b: 9), is a spot named ‘to have a chill’ or ‘to feel a tremor’ (Waterman 2001, pp. 206–207; Smith unpublished notes). Sam Wilson, born in 1861, and grandson of Chief Seattle told Marian Smith, ‘it comes from land and sea at same time’ (Smith unpublished notes).

Native ‘Doctor’ or shaman power was a particularly strong form of spirit power. Throughout the region, individuals sought personal spirit powers to guide their lives and bring them luck and skill. A’yahos was one of the most powerful of these personal spirit powers, though it was also malevolent, dangerous, and possibly fatal to encounter (Smith 1940). A’yahos ‘Doctor’ spirit power was one of only two powers (a’yahos and stádik’’a) reserved exclusively for shaman, and descriptions of both these shamanistic powers include shaking or land-sliding imagery (Elmendorf 1993; Smith unpublished notes; Smith 1940; Waterman 2001). Shaman were believed to hold the power to cure certain illnesses, and also the power to cause illness and even death (Suttles & Lane 1990). The name of James Zackuse, a Duwamish Indian Doctor who lived in Seattle on Lake Union’s Portage Bay during the late nineteenth and early twentieth centuries, translates to ‘trembling face’; rooted in ‘dzakw’, the Puget Lowland Native word for earthquake (Miller & Blukas Onat 2004, pp. 78–85).

Shaking also appeared as an important element in Puget Sound Salish ceremony, when ritual objects filled with spirit power and became self-animated (Miller 1999, p. 133; Elmendorf 1993, p. 192–198; Haeberlin & Gunther 1930, p. 79). An early white settler noted a specific connection between ceremony and earthquake shaking as early as 1893:

During the past thirty-three years I have on many occasions endeavored to gather from the oldest and most intelligent Indians something of their earlier recollections; for instance, as to when the heaviest earthquake occurred. They said that one was said to have occurred a great many years before any white man had ever been seen here, when mam-oook ta-mah-na-wis was carried on by hundreds. This is the same performance they go through when they are making medicine men, and consists of shouting, singing, beating on drums and sticks and apparently trying to make as much noise as they can. (Seattle Post-Intelligencer 1893)

Salish earthquake stories from outside Puget Sound also draw a connection between ceremony and shaking (Fig. 1, stories 8 and 22b; Ludwin et al. 2005b).

Earthquake lore from Puget Sound in the context of regional earthquake motifs

Although the a’yahos name appears to be specific to central Puget Sound, the double-headed serpent is widely known and depicted in NW cultures, and may have been similarly linked to earth changes. The Quileute, a non-Salish group living on the NW Washington Coast, have artifacts depicting a two-headed horned snake with the forelegs of a deer. Although not clearly linked to a’yahos, stories describe it as a vicious guardian spirit (Powell & Jensen 1976). Another two-headed snake, the Sisiutl, is a figure well known from stories and ceremonial artifacts of northern Vancouver Island.

Whales or water-monsters (which may represent the subterranean world in the same way that snakes do) appear in many Pacific Northwest coastal stories that describe ground shaking and/or tsunami-like floods, probably related to earthquakes on the Cascadia subduction zone (Ludwin et al. 2005a). Whales per se are not prominent in stories from the Seattle fault area, though the water-serpent of Agate Pass is analogous to a whale. However, in southern Puget Sound where damaging earthquakes centred deep underground are relatively common (occurring in 1949, 1965, and 2001), several stories mention whales trapped inland and thrashing their way out, sometimes through underground channels (Ballard 1929). Thunder, also common in coastal stories of
shaking and flooding, appears occasionally in stories from Puget Sound (Ludwin et al. 2005b). Figure 7 shows two versions of a Salish ceremonial dance mask and costume linked to earthquakes (Lévi-Strauss 1979), whirlwind (American Museum of Natural History catalog), and thunder (Jenness 1955). The Sxwayxwey (also Swai’xwe and many alternate spellings) masks sometimes include a two-headed snake (Jenness 1955). The mask’s origin is relatively recent, probably sometime after 1500 (Ludwin et al. 2005a), and is described in a number of Salish stories that use shaking imagery and/or descriptions, though often quite figurative (Lévi-Strauss 1979). The Sxwayxwey has been incorporated into the ceremonies and oral traditions of non-Salish groups living at the north end of Vancouver Island (Lévi-Strauss 1979), where mythic-style stories of its origin explicitly relate the mask to earthquakes.

In a northern Vancouver Island ritual (Boas 1897) the Sxwayxwey represents earth shaking. A mythic story (Fig. 1, story 1d) tells of the Sxwayxwey mask obtained at night in the winter ceremonial house of Red Cod, where rumbling sounds and earth shaking are caused by fish thrashing about on the floor. Additional sources identify the Sxwayxwey as originating in recent historical time and place its geographical origin near the town of Hope (Codere 1948; Duff 1955; Carlson 2006; Lévi-Strauss 1979) on the British Columbia mainland. The Sxwayxwey is related to earthquakes over its entire geographic range (Lévi-Strauss 1979), although the shaking element is not prominent in mainland stories. Mention of the Sxwayxwey also occurs in connection with thunder and whirlwind (American Museum of Natural History Catalog; Jenness 1955; Fig. 1, story 2).

One striking story from the northern end of Vancouver Island (Head-Winter-Dancer: Boas & Hunt 1905) mentions the acquisition of the Sxwayxwey mask in combination with earthquake- and landslide-related figures and imagery from multiple northwest cultures in an epic tale about the founding of the great houses of the Kwakwaka’wakw (Kwakiutl) people. In Head-Winter-Dancer, Thunderbird and his wife descend from the sky at a mountain called Split-in-Two. They become human, taking the names Head-Winter Dancer and Winter Dance Woman, and bear sons who travel around Vancouver Island gathering crests and founding great houses. When their youngest son is born, they hear a sound like rocks rolling down and find a double-headed serpent in their salmon-trap (Fig. 8). They wash the new baby in the blood of the double-headed serpent and he is transformed into Stone-Body, a name similar to Stone-Ribs—an earthquake-related being in Haida stories from British Columbia’s Queen Charlotte Islands (Swanton 1905, pp. 190–210). Stone-Body cries out in the voice of the Dzonoqwa (a supernatural being linked to earthquakes and to the Sxwayxwey (Levi-Strauss 1979) and it is divulged that Dzonoqwa had come to Winter Dance Woman and Stone-Body is his son. Stone-Body grows up rapidly and travels in a self-propelled death-bringing, double-headed serpent canoe, acquiring crests from the communities he visits. He obtains the earthquake-related Sxwayxwey mask from the Salish to the sound of thunder. Stone-Body gives his older brother

Fig. 7. Salish Swai’xwe masks associated with shaking, whirlwind, thunder and the two-headed snake (Jenness 1955). The two open-mouthed protuberances above the forehead likely represent snakes. (a) Mask from mainland British Columbia, collection of American Museum of Natural History; 16/9222A. (b) Mask from Vancouver Island, photo by Edward Curtis (2001).
Cannibal the additional names Rolling-Down, Great-Mountain, Rock-Slide and Coming Down. The two-headed Sisutl of the Kwakwaka’wakw is similar in form to the two-headed supernatural serpents a’yahos of Puget Sound, and its blood transforms the child of the Thunderbird/Dzonoqwa into the earthquake-related figure Stone-Body. The inclusion of multiple earthquake-related mythic figures (Thunderbird, Dzonoqwa, Stone-Body, Sxwayxwey, Sisiutl) in a story about the foundation of the great houses of the Kwakwaka’wakw suggests that earthquakes deeply affected their culture. The use of earthquake imagery from the adjoining Salish and Haida cultures suggests earthquake events that were felt across tribal boundaries.

Non-geological evidence for the Cascadia subduction zone earthquake of 1700 from Cascadia and Japan

The precise dating of the Cascadia subduction zone earthquake of 1700 is an example of how local lore and other non-geological evidence can enhance conventional geological knowledge. The 1700 earthquake was initially dated through Japanese historical documents, and the date was confirmed independently through Native American oral traditions and dendrochronology.

Nine Native stories from the Cascadia coast (Fig. 1, stories 1c, 3, 4, 6, 7, 13, 17, 27 and 28) have sufficient information for estimating a date range since an event associated with shaking and/or flooding (two stories with both, three with shaking only, and four with flooding only). Two stories, told between 1860 and 1964, tell of a grandparent who saw a survivor of the flood, and one of a great-grandparent who survived it. Figure 9 tabulates the accounts, and gives date ranges. Date range minima and maxima are 1400 and 1825. All estimates span the interval between 1690 and 1715, and the average value of the midpoints of the date ranges is 1690. Discarding the earliest and latest midpoints yields an average midpoint date of 1701. This finding is remarkably consistent with the 1700 date of the most recent CSZ earthquake determined from Japanese historical documents.

The date estimates based solely on descriptions of floods could possibly be reports of tele-tsunamis (i.e. those arriving from distant earthquakes). Alaskan and South American earthquakes produced notable tsunamis on the Cascadia coast in the twentieth century (Lander et al. 1993). Although we do not know the history of Alaskan earthquakes around 1700, tsunamis from South American earthquakes were recorded in Japan in 1730, 1751 and 1780 (Watanabe 1998). Japanese earthquakes have not produced significant tsunamis in Cascadia since at least 1806 (Lander et al. 1993), but locally generated tsunamis damaged the Japanese coast in 1611, 1707, and 1771 (Watanabe 1998).

Cascadia Native stories that can be used to date the 1700 earthquake are mostly straightforward descriptions of flooding and/or shaking. Of these stories, the clearest and most complete is from the outer coast of Vancouver Island, recorded by Chief Louis Nookmis following the 1964 Alaskan earthquake. It describes a night-time earthquake quickly followed by a tsunami that destroyed the Pachena Bay people:

They had practically no way or time to try to save themselves. I think it was at nighttime that the land shook... I think a big wave smashed into the beach. The Pachena Bay people were lost... But they who lived at Mals’as, ‘House-Up-Against-Hill’ the wave did not reach because they were on high ground... Because of that they came out alive. They did not drift out to sea with the others. (Fig. 1, story 7, Arima et al. 1991)

Robert Dennis, Chief Councilor of the Huu-ay-aht First Nation and descendent of Chief...
Louis Nookmis, has discovered previously unpublished information that allows us to estimate a date at between 1640 and 1740. This new information comes from a comprehensive transcription and translation of the 1964 recordings undertaken by the Huu-ay-aht First Nation.

A second datable story that includes flooding and shaking elements is from the northern margin of the Olympic Peninsula in northwestern Washington. It combines information from three independent sources (Fig. 1, stories 11–13) to yield a tale indicating winter flooding with accompanying strong shaking. A tradition that cannot be dated but vividly describes strong night-time shaking, from a group on the inner coast of Vancouver Island, supplements the datable stories:

In the days before the white man there was a great earthquake. It began about the middle of one night... threw down... houses and brought great masses of rock down from the mountains. One village was completely buried beneath a landslide. It was a very terrible experience; the people could neither stand nor sit for the extreme motion of the earth. (Fig. 1, story 8, Hill-Tout 1978).

The remaining stories that can be dated describe saltwater flooding events. Archaeological evidence indicates that some Native villages on the British Columbia, Washington, and Oregon coasts experienced subsidence, were flooded by tsunamis, and
abandoned following the 1700 earthquake and tsunami (Minor & Grant 1996; Hutchinson & McMillan 1997; Losey 2002; Cole et al. 1996), supporting the possibility that flooding stories may reflect this event.

As we mentioned earlier, Japanese textual data were instrumental in precisely dating the CSZ earthquake of 1700. The exact date and approximate time of this earthquake (9 pm on 26 January 1700) were determined from a variety of Japanese historical documents such as domain (han) records, merchant records, and the records of village headmen that reported the arrival of a tsunami with no reports of associated shaking (Satake et al. 2003). In addition to recording the 1700 earthquake, Japan has a rich folklore related to earthquakes and written and graphic documentation that allows us to observe how that folklore developed and interacted with other aspects of Japanese culture. Earthquake imagery in Japanese folklore has distinct similarities to Cascadia imagery, and we explore this, particularly through the example of 1855 Ansei earthquake, which was followed for a few months by a brief but abundant output of "namazu-e" (catfish picture-prints) that combined earlier earthquake folklore with incisive observations on both earthquake effects and current events.

Halway to the present and halfway around the world—The 1855 Ansei earthquake in Japanese folk images

Japanese documents used to date the 1700 earthquake focus on straightforward descriptions of areas flooded by the 1700 tsunami and resultant damage and do not touch upon the origin of the event. However, Japan lies in an area of especially vigorous seismic activity and it is not surprising that we can find abundant earthquake-related data expressed both as written records describing the effects of specific events and in folk culture ideas about their cause. The long written history available in Japan enables us to track changing conceptions of earthquakes and offers an interesting comparison to the earthquake stories from the oral traditions of Cascadia. For example dragons and other serpent-like creatures associated with water were prominent in Chinese and Japanese folk beliefs concerning earthquakes. Figure 10 shows a broadsheet entitled ‘The cause of earthquakes and tsunamis’ published c. 1650. In Japan, the serpent figure gradually gave way to that of a giant catfish (namazu), a belief that parallels the many shaking-related whale stories found in the Pacific Northwest (Ludwin et al. 2005a).

The link between earthquakes and giant catfish developed gradually over several centuries from native Japanese folk beliefs with some influence of Chinese ideas. The basic view was that a giant namazu lived in the subterranean waters below the Kashima Shrine in Hitachi Province (present-day Ibaraki Prefecture, slightly north of Tokyo). A large boulder called the foundation stone (kaname-ishi) pinned the namazu down and kept it largely immobile. The weight of the foundation stone itself, however, was insufficient to suppress the namazu’s movements, and the system depended on the Kashima deity (Kashima daimyōjin, often known simply as Kashima) pressing down on the stone. During the tenth month of each year Kashima had to leave his post and travel south to Ise to attend a meeting of the major Japanese deities. In his absence, Kashima would leave the local deity Ebisu in charge of pressing down on the foundation stone. Whether owing to negligence by Kashima himself or to Ebisu’s inability to perform the namazu suppression tasks, earthquakes took place when the lack of pressure on the foundation stone allowed the giant namazu to wiggle around under the earth. The severity of shaking depended on the extent of the namazu’s movements.

Fig. 10. ‘Earthquakes and Tsunamis Explained’, c. mid-seventeenth century. On the outer edges of the circled dragon are written the months of the year. What appears to be a small sword is just above and touching the dragon’s head. Below this sword is written ‘kaname-ishi’, (foundation stone). Inside the dragon are the ‘the 60 plus islands of Japan and the various foreign countries’. The last line of text inside the dragon explains that all of these places should be regarded as existing above the dragon. In other words, the dragon resides under the earth. Normally, it is pinned down and made immobile by the deity of the Kashima Shrine, who presses down on a boulder (the foundation stone), which presses down on the dragon’s head. The deity’s sword is a substitute for the boulder. Sometimes, however, the deity does or is otherwise distracted, and he lets up on the boulder. The dragon is thus able to wiggle around under the earth, which causes earthquakes (from Miyata & Takada 1995, p. 54).
This basic understanding of the namazu-based cause of earthquakes was subject to many variations because it was enmeshed in the broader network of Japanese folk religion. Cornelis Ouwehand’s detailed, structuralist study of namazu images situates their themes within the broader matrix of folk religion (Ouwehand 1964). One twist on the basic motif was that Kashima often worked in close association with the thunder deity and sometimes other local deities of Edo. Namazu-e sometimes depicted Kashima, Ebisu, and the thunder deity as being jointly responsible for the devastation of a major earthquake. Also, most early nineteenth-century Japanese people associated earthquakes with water. The namazu, of course, was a water-dwelling creature and the thunder deity manifests himself in storms. Indeed, most popular newspaper accounts of earthquakes also mention the presence of thunderstorms associated with them (e.g. Kitahara 1999, pp. 32–33, 36–37).

Although the namazu-based explanation of earthquakes had become widely known throughout Japan by the early nineteenth century, it was not the only way of describing the mechanism of earthquakes. The Ansei kenmonroku (Accounts of the Ansei [1854–1859] era) contains a typical alternative, based on a widely known view of cosmic transformation whereby the five primary agents of yin and yang—fire, metal, wood, earth, water—interacted to create the material world and to embody the forces that govern it. With respect to earthquakes, normally water (purely yin) overcomes fire (purely yang). Furthermore, water is the agent normally holding sway in the subterranean environment. Earthquakes result from the occasions when fire overcomes water underground, thus reversing the normal state of affairs. A broadsheet issued just after the Ansei earthquake of 1855 explained its cause in terms of both yin and yang forces and the movements of namazu, but it called the namazu-based explanation an ‘unsophisticated theory’. (Wakamizu 2003, pp. 16–17). Popular newspapers often started their accounts of earthquakes with a simple, brief statement of yin and yang forces being out of balance. For example, the text of an account of the Ise earthquake (14th day, 6th month, 1854) explains that a clash of yin and yang forces resulted in thunder in the skies and shaking of the earth. An account of an earthquake in Odawara (2nd day, 2nd month, 1853) employs verbatim the same explanation (Kitahara 1999, pp. 32–33).

The key point here is that in nineteenth-century Japan, multiple theories of earthquake causality co-existed. Most of these theories postulated an imbalance in the cosmic forces, expressed in terms of the five agents (gogyo) of yin and yang or the subterranean movement of a giant creature. This creature was most commonly a namazu, but might also be a dragon, a turtle, a whale or even an oversized worm (jishin mushi). Scholars tended to talk about earthquakes in terms of abstract cosmic forces and ordinary people tended to invoke images of giant animals wiggling around under the earth. Despite these differences, the two general modes of conceiving and explaining earthquakes were not necessarily mutually exclusive. Both approaches saw earthquakes as the result of temporary aberrations in the delicate balance of power in and around the earth.

One namazu-e explicitly combines these two approaches to understanding earthquakes (Fig. 11). It depicts three members of the construction trades (identified by clothing and tools) around a namazu dressed in human clothes. The foundation stone floats in the air and gold coins are scattered around it, about to rain down on the three tradesmen. All seem to be enjoying their newfound good fortune. The redistribution of wealth was a theme in namazu-e, as carpenters, plasterers, roofers, and other specialists in the building trades prospered in the wake of the earthquake. On the clothing of each tradesman and the namazu are the characters for one of the five agents of yin and yang: wood 木, fire 火, earth 土, and water 水 (the namazu). The gold coins function as the final agent, metal 金 (also means gold). In addition to depicting a situation in which the five agents have returned to a state of balance, each agent stands for an important part of the immediate post-earthquake experience. Wood represents the houses and other structures, fire stands for the fires that raged for days, the watery namazu caused the earthquake in the first place, which dislodged metal (money) from the coffers of the rich and put it into the hands of labourers. The text accompanying the image reinforces the theme of the five agents. This print combines scholarly explanations of earthquakes and folk explanations in a way that the residents of Edo could have ‘read’ in either relatively simple or sophisticated manners without contradiction (Wakamizu 2003, pp. 68–70; Miyata & Takada 1995, p. 304).

The precise origins of the link between namazu and earthquakes in Japan are unclear. It is possible that the general idea of a giant fish supporting the earth came to Japan from China as part of popular Buddhist beliefs. Kojima points out that several Buddhist temples in China feature an image of the Bodhisattva Guanyin standing atop a giant fish that roughly resembles the Japanese namazu (Kojima 1995, pp. 188–189). Some degree of Chinese influence undoubtedly facilitated the development in Japan of both the idea that namazu cause earthquakes and the view of earthquakes as resulting from an imbalance or aberration.
in the forces of yin and yang. Nevertheless, the close link between namazu (or anything similar) and earthquakes never developed in China.

Perhaps the most significant Chinese influence on Japanese views of earthquakes came from the ancient idea of heaven’s mandate (tianming). In this view, which could accommodate both abstract and anthropomorphic conceptions of the cosmic forces, heaven (the cosmos) bestows on rulers a mandate to govern based on their moral fitness. Earthquakes, floods, famine, epidemics, and other natural calamities were signs of heaven’s displeasure. This idea became the bedrock of classical Chinese political theory. It was also influential in Japan, especially in the notion that the cosmic forces periodically rectify a social order gone awry (yonaoshi, ‘world rectification’). Earthquakes were a major tool for bringing about such rectification, and in this sense, they were not random occurrences. The print described above in which the earthquake redistributes wealth reflects this way of thinking. Earthquakes, therefore, necessarily had political significance in premodern Japan, and commentary on them could easily become commentary on the state of society and government.

The namazu-e (catfish picture prints):
Japanese responses to the Ansei earthquake

For Japan, a particularly well documented example of how folk beliefs intersected with contemporary political and social culture is the Ansei earthquake of 1855. On the second day of the tenth month (November 11 in the solar calendar), a magnitude 6.9 earthquake with a shallow focus shook Edo (present-day Tokyo) and a wide surrounding area. Aftershocks continued for the next nine days. Estimates of the number killed in the greater Edo area range from 7000 to 10 000 (4000–5000 for the downtown area), but the precise figure is uncertain. This death toll amounted to roughly 1 in 170 Edo residents, and shaking and subsequent fires destroyed 1 in 3 non-military houses and other structures (Inagaki 1995, p. 64). The injured were especially numerous, and fires burned for days throughout the city.

A remarkable coincidence between geology, geography, and politics magnified the psychological impact of this earthquake in such a way as to make it appear as a direct attack on the heart of the bakufu, Japan’s military government based in Edo. The distribution and severity of damage was not uniform. Some areas suffered severe devastation and loss of life, whereas other parts of the city came through the ordeal with nearly all buildings and people shaken but intact. The damage was less a function of proximity to the epicentre than it was a function of topography and soil conditions. The Yamanote Tablelands, an extension of the Musashino Plateau, wound their way through parts of the heart of Edo, constituting modest upland areas. These upland areas were not
always obvious because of erosion and past filling with soil or debris of low-lying areas. In 1590, when Tokugawa Ieyasu (1542–1616) made the fishing village of Edo his base of operations, human engineers and construction workers began to reclaim the marshy flats around Edo Castle. This process accelerated rapidly during the early seventeenth century, after Edo became the de facto political capital of Japan. Edo Castle itself was on natural high ground, but much of the prime land around the castle had been part of a river drainage basin of Edo Bay a mere two or three centuries earlier.

When the earthquake struck, it shook the whole city, but structures on the firm foundation of the uplands generally fared better. The severe damage occurred in low-lying areas, especially areas of land reclaimed from marshes and waterways. As fate would have it, the most prominent neighbourhood of samurai residences, home to the bakufu’s closest supporters among the domain lords, leading bakufu officials, and several key bakufu offices, was located at a place that during the sixteenth century had been the Hibiya Inlet of Edo Bay. The earthquake devastated this neighbourhood, as if it had targeted the government for destruction. One residential zone further out from the castle, the area adjacent to the elite neighbourhood, was home to commoners. Built on a firm foundation, it suffered only moderate damage and stood in stark contrast to the elite neighbourhood’s collapse. In the eyes of commoners and elite alike, the cosmic forces made a strong statement that night (Noguchi 1997, pp. 73–108).

As if to add insult to injury, there was one more odd twist to the earthquake damage. In the commoner neighbourhood of Kitachi-ku, for example, not one main building collapsed. Nearly all the serious injuries from this neighbourhood were the result of falling roof tiles or eaves from collapsed storehouses, built as separate structures from the main buildings. Many other neighbourhoods reported the same pattern, and all visual evidence points to storehouses sustaining much worse damage than any other type of structure. These rigid, heavy, mud walled, tile-roofed storehouses tended to vibrate at the same frequency as the high-frequency seismic waves generated by the shallow-focus earthquake. The irony is that the bakufu ordered this rigid, heavy storehouse design in 1842 as a fire-prevention measure (Noguchi 1997, pp. 118–120). In this way too, the earthquake seemed to be paying especially close attention to the government in its destruction.

Within two days of the initial shaking, printers set up makeshift facilities in the relatively less damaged areas and began to produce namazu-e for sale through street vendors. Namazu-e sold briskly for approximately two months before government authorities outlawed their production and burned the printing blocks. These symbolically rich prints are a record of the Ansei earthquake, and they served as a medium through which the common people of Edo could interpret the event (Abe 2000, pp. 26–28, 46). Therefore, namazu-e are an excellent case study in the use of historical documents and symbolic language to complement conventional geological evidence in reconstructing the history of geological events. These prints also provide insight into the cosmological, social, and political meaning that many nineteenth-century Japanese ascribed to major earthquakes. More generally, the views of earthquakes manifest in namazu-e may be part of a global set of local responses to earthquakes that share broad themes in common such as the notion of a chthonic fish/dragon/snake-like creature as the immediate cause of the earthquake or a connection between earthquakes and thunder. The following section examines namazu-e with respect to their value as earthquake records, documentation of social responses to earthquakes, and possible commonality of themes with symbolic representations of earthquakes elsewhere in the world.

**Correspondence between namazu-e and earthquake-related events**

The most common types of namazu-e to appear immediately after the initial shaking were talismanic prints that people could hang in their houses in the hope of warding off further damage. Aside from the fires, aftershocks were also serious concerns for the residents of Edo. Many of these talismanic namazu-e depict the Kashima deity, often with the assistance of the thunder deity or others, decisively pinning down a giant namazu with a sword or the foundation stone. In some variations, the namazu vigorously apologize, sometimes in writing, for the destruction wrought by their reckless movements. Frequently, groups of smaller namazu, usually representing aftershocks, surround a giant namazu. The purchase and display of an image depicting the Kashima deity having regained firm control over the various namazu was, of course, wishful thinking. Kitani points out that namazu-e functioned as a mental health aid for those caught up in severe circumstances largely beyond their control. By dealing with fear, suggesting a degree of reassurance, and expressing emotions such as anger and disgust, often leavened with irreverent humour, popular prints helped residents of Edo cope with what today we might call post traumatic stress disorder (Kitani 1995b, 1999).

One of these talismanic images, entitled *Jishin o-mamori* (earthquake protection: Fig. 12) is
especially interesting. It features a giant namazu—half catfish, half dragon—pinned firmly to the ground by the Kashima deity’s sword through its head, which the thunder deity is pounding with his mallet. The upper left corner features an iconographic image of the Ursa Major (Great Bear or Big Dipper) constellation and the word ‘Kashima’ rendered in the peculiar ‘spirit writing’ of Daoist talismans. The text explains the various problems the namazu have caused and ends with a statement of protection for the integrity of houses. There are four smaller namazu in front of the giant namazu, all bowing down vigorously and abjectly before the quelling power of the two deities. At first glance, these four smaller namazu may seem to be aftershocks. Normally, however, aftershocks appear in these prints as a larger group of small namazu. In this case, the four small namazu each wear robes with characters for place names on their backs: Kyōto, Shinshū, Odawara, and Ise (Wakamizu 2003, pp. 85–86; Miyata & Takada 1995, p. 262). These place names correspond to major earthquakes from the relatively recent past. They attest to a widespread knowledge of recent earthquakes among Japan’s urban population, even those that took place in other regions of the country. Indeed, the text of many popular newspaper accounts mentions recent earthquakes, either in passing or comparatively, when discussing the Ansei earthquake in 1855. Let us examine some of the details symbolized by each of these small namazu.

The ‘Kyōto’ namazu stands for an 1830 earthquake of about magnitude 6.5 shook the old imperial capital of Kyōto causing about 280 deaths, 1300 injuries, and an unusually large number of aftershocks (Usami 2003, pp. 131–132). Because Kyōto rarely experienced earthquakes of any significance, this otherwise rather modest seismic event became an occasion for worry, especially because it occurred almost in concert with the promulgation of a new era name, Tempō. Matsuzaki Kōdō, for example, a Confucian scholar living near Edo, took anxious notice of both the Kyoto earthquake and the unseasonable blooming of cherry trees. Writing in his diary a day after the Tempō era started, he said that ‘Our ruler is virtuous, and our habits upright . . . so there should be no reason for any disasters . . . All we can do is pray for the Heavenly Protection of yesterday’s new era name’ (Bolitho 1989, p. 117).

‘Shinshū’ is another term for Shinano, present-day Nagano Prefecture, which was the site of the magnitude 7.4 Zenkōji earthquake of 1847 that resulted in at least 10 000 deaths by most accounts. According to one newspaper account from the time:

In the third month of 1847 on the 24th day around 10pm, a large earthquake struck Shinano. Unfortunately, that month the Zenkō Temple (Zenkōji) was displaying a Buddhist statue, and so people from all around had crowded in to see it. A large crowd was milling around, which exacerbated the panic when the earthquake struck. Many of them were pinned down by or crushed beneath collapsing houses. Moreover, fire flew from the collapsed houses in an instant, and before long, the district in front of the temple gate was a sea of flames. Aftershocks sounding like thunder continued without cease, there being more than 80 throughout the night. A fissure appeared in the earth from which flowed mud and sand. A cliff overhanging the north fork of the
Sai River collapsed, which caused massive flooding. Disasters two or three deep caused, it is said, the deaths of 30,000. Prior to the earthquake, the temple put up a notice board of regulations for viewing the Buddhist image in front of its gate. It disappeared in the night, as did a second one. After putting up a third one, a guard was posted around the clock. Reflecting on this matter, people claimed that it must have been a way that the main Buddha of the temple tried to warn the people of an impending earthquake (Nishimaki 1978, p. 126).

Mention of the Zenkōji earthquake was common in popular accounts of subsequent earthquakes and occurred especially frequently in images and documents connected with the Ansei earthquake.

Odawara is a city slightly to the south of Edo, which experienced a major earthquake of unknown magnitude on the 3rd day of the second month, 1853. According to one newspaper account, houses ‘collapsed like chess pieces’. A corner of Odawara castle collapsed, and the shaking and subsequent fires killed 3780 (Nishimaki 1978, p. 140; Kitahara 1999, p. 32).

Finally, the ‘Ise’ namazu represents an earthquake that occurred on the 14th day of the 6th month, 1854. It shook Iga-Ueno in present-day Mie Prefecture and the Ise and Kenoe areas in present-day Shiga Prefecture. It caused widespread property damage, destroying over 20,000 homes, and was widely reported in the popular press of the major urban areas (Kitahara 1999, p. 33).

There was at least one more talismanic namazu-e of similar iconographic design featuring the same four smaller namazu representing the same past earthquakes (Miyata & Takada 1995, p. 262). More common were textual references to past earthquakes. Namazu-e often mentioned or discussed one or more of these previous earthquakes, thereby linking them with the Ansei earthquake. The popular urban press and inter-city news networks preserved the memory of recent earthquakes in the Japanese islands even among those who did not experience them directly. This point is significant because, as we will see, many urban Japanese came to regard the Ansei earthquake as part of a series of ‘world rectification’ (yonaoshi) events.

The major themes of the namazu-e of 1855 and the sequence of the appearance of these themes tracked the physical, psychological, and social courses of the earthquake and its aftermath. Immediately after the initial shaking, the emphasis in namazu-e was on the destruction. Commentary on the destruction assumed at least four different forms. One form was a relatively straightforward reporting of the damage via images of collapsing buildings, fires, dead and injured people, and so forth. A second type of early namazu-e criticized the Kashima deity and the deities associated with him for their negligence. Some of these prints depict the deity as trying without success to restrain the namazu and others are more irreverent, depicting the deity or deities as lazy or negligent (Fig. 13). A few prints even go so far as to demote Kashima and elevate Amaterasu (the solar deity associated with the imperial family) as the main hope for a return of stability (Abe 2000). Nevertheless, because the local deities were the only forces likely to restrain the namazu in the future, the most numerous form of namazu-e were talismanic images such as the one discussed previously (Fig. 12). In other words, the residents of Edo experienced both anger toward the deities and a desire to beg them for assistance, and early namazu-e embodied both attitudes, albeit rarely on a single page. Another variety of early namazu-e depicts the residents of Edo themselves as suppressing the namazu, often quite violently. In addition to the obvious emotion of anger, these prints also depict the wishful thinking whereby ordinary people might have some control over the raging forces of nature (Fig. 14).

As the fires subsided along with the fear of aftershocks, the work of recovery and rebuilding began. During this phase, a second wave of namazu-e began to emerge, many of which featured the theme of world rectification (yonaoshi). We have already examined one case of this type of image (Fig. 11). As agents of world rectification, the destructive power of the namazu served a worthy end. During the 1850s, many denizens of Edo increasingly came to see the bakufu as ineffective and corrupt. The early nineteenth century was a time of frequent crop failures, famine, strange weather patterns, urban riots, and mass religious pilgrimages—often started by rumours of supernatural phenomena—whose participants sometimes developed into unruly mobs. Some of the urban riots were the result of the hoarding of basic commodities by unscrupulous merchants in an effort to create artificially high prices. In short, there were many reasons for ordinary urban dwellers to regard their world as needing radical rectification and thus teetering on the edge of one or more major heaven-sent calamities.

As we have seen, the uneven severity of destruction due to variations in topography, soil conditions, and construction type caused the earthquake to appear as a direct attack on the government. Nevertheless, there was collateral damage in the form of death, injury, and destruction to the innocent. In some examples of the second wave of prints, the namazu seem genuinely to regret the damage suffered by the innocent. In prints produced after the extent of devastation had become clear, namazu often expressed second thoughts or regret after seeing the effects of their deeds. One way to depict this point was to show smaller namazu...
vigorously criticizing a giant namazu, whose movements caused excessive shaking. Another was to depict namazu assisting earthquake victims in various ways (Fig. 15). Other prints featured anthropomorphic world-rectifying namazu.

The most common depiction of world-rectifying namazu shows them re-distributing wealth. For example, they force the rich to vomit or excrete money (Fig. 16). Consider the effects of a major earthquake on different social groups. Of course, the shaking itself and the resulting fires would be dangerous and terrifying for anyone in society regardless of status or circumstances. The aftershocks would probably cause even more damage over the course of the next day or several days. Relief efforts, salvage operations, the hauling away of rubble, and rebuilding would begin soon after the aftershocks subsided. Labour, both skilled and unskilled, would be in great demand during this recovery period. Nearly anyone willing to work would be able to find work at an elevated wage, at least for a while. The wealthy, whose expensive homes and businesses would need repair or rebuilding, would have to pay these high wages to the labourers. Of course, the homes of the labourers, too, might need rebuilding, but they would have been able to afford it. Official wage rates for various types of labourers rose between sixteen and seventy percent in the wake of the earthquake, but actual wages for carpenters, plasterers, and other skilled tradesmen roughly quintupled during the period of peak demand (Noguchi 1997, pp. 202–203).

Most of the population of Edo and other large cities made their living through unskilled labour, through skilled craftwork, or by operating small shops (including street vendors). Many of these occupations would have profited nicely from the post-quake recovery work. Therefore, for many urban dwellers, earthquakes, although terrifying and destructive, were also a boon for personal and family finances. It would have been like money pouring out from the heavens and into their hands—a common image in many second-wave namazu-e (e.g. Fig. 16). Not all occupations, however, benefited from the earthquake. Some namazu-e criticized the tendency of carpenters, plasterers, and other skilled tradesmen roughly quintupled during the period of peak demand (Noguchi 1997, pp. 202–203).

More broadly, there was a strong sense that earthquakes, as destructive as they are in the short term, provide an impetus for society to regain its social and financial health. The thinking here extrapolates from prevailing theories about human health. For a person to be physically healthy, the most important consideration is that the flow of blood and vital essence (ki—the major concern of acupuncture)
be vigorous and unimpeded. Japanese in the early
nineteenth century typically regarded disease as
the result of a blockage in the flow of these fluids.
Economists and social commentators of the time
frequently likened the flow of wealth, especially
metallic currency, through society to be the major
factor in social health. In this sense, the activity of
merchants was normally a good thing because
they were the main agents of the exchange, and
thus circulation, of goods and wealth. Successful
merchants, however, often amassed great stores of
wealth and sometimes hoarded goods in an effort
to raise prices by creating an artificial shortage.
Thus, major earthquakes would literally shake
things up and put the stagnating goods and wealth
back into circulation, especially into the hands of
ordinary people. In this sense earthquakes were
like medicine for an ailing society (Fig. 18).

The theme of world renewal in the namazu-e went beyond economic redistribution. A close
reading of the prints reveals a connection with the
major political events of those times, specifically
the arrival in Edo of Matthew Perry of the United
States in 1853 and 1854 to negotiate a formal diplo-
matic treaty with Japan. Depictions of Perry and the
Americans in the popular press were generally
unflattering. Some accounts, however, regarded
Perry’s arrival as a world rectifying event to shake
up Japan’s complacent rulers in the bakufu and
the warrior class (samurai) in general. The occur-
rence of major earthquakes (1853, 1854, and
1855) within a short time of Perry’s arrival fit per-
fectly into this world rectification scheme. Some
namazu-e therefore made veiled connections
between Perry and the Ansei earthquake. Because
direct commentary on political events of this mag-
nitude would have been dangerous, the printmakers
employed plays on words and symbols to conceal
political commentary.

In one well-known print, a giant namazu appears
to have partially morphed into a whale spouting
money, but not from a blowhole (Fig. 19).
Instead, the money comes from precisely the place where a smoke stack would be located on the steam ships of the time. Furthermore, the entire appearance of the *namazu* resembles that of one of Perry’s ‘black ships’. The text of an accompanying song written on the print includes a play on words that links ‘great country’ with ‘big black’ and a popular deity of wealth whose name is literally Big Black (Kitani 1995a, pp. 56–61). At least some Japanese at the time of the Ansei earthquake explicitly linked prosperity, world rectification, Perry’s expedition, and the earthquake. The *namazu-e* functioned as sophisticated commentary on geological, social, and political events.

**Discussion**

The allegorical tales from Cascadia describing flooding, shaking, and other earthquake-related phenomena and the *namazu-e* of Japan exist at the nexus of social and geological reality. Depending on circumstances, symbolic language of this sort is capable of indicating: 1) the existence of major seismic activity in the past (and thus potentially in the future); 2) the time and location of specific earthquakes and tsunamis; 3) the approximate intensity of specific earthquakes; 4) local understanding of the cause(s) of earthquakes; and 5) the socio-political significance of earthquakes. Non-geological evidence such as local written records, monuments, place names, folklore, and non-Western elite intellectual theories of earthquake mechanisms also have the potential to supplement conventional geological evidence for understanding past seismic activity and its effects. In short, symbolic language and other non-geological evidence deserve the serious attention of Earth scientists. The relative infrequency of extraordinarily damaging earthquakes and their wide social impacts argue for inclusion and study of all relevant records.

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**Fig. 15.** ‘The sympathy of the world-rectifying *namazu*’ (*Yo-naoshi namazu no nasake*). This print is typical of those suggesting that the *namazu* feel remorse for the high levels of damage they have caused in their capacity of agents of world rectification. Here they help rescue earthquake victims. In other prints, they might be dispensing medical care to the wounded.

**Fig. 16.** ‘The outward-bound ship of the wealthy’ (*Kane-mochi-tachi no defune*). This *namazu-e* is a typical illustration of the world-rectifying *namazu* helping to return society to economic health by forcing the money horded by the wealthy to return to circulation. From the point of view of workers in the construction trades and many other types of labourers, the higher wages and extra work caused by the earthquake was like money pouring from the heavens.

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Although the data from Cascadia and Japan are sufficient to support the contention that non-geological evidence might play a constructive role in creating a complete record of seismic activity, they also suggest intriguing possibilities about human perceptions and understanding of earthquakes. Plate tectonics were not understood to be the cause of earthquakes until the mid-twentieth century, and all prior considerations of earthquake causes were speculative. Human nature demands an explanation for events experienced over extensive areas and that cause damage, fatalities, and permanent land-level changes. Through the ages, people documented earthquake effects and speculated about their causes (all early theories ultimately proving incorrect), both in folklore from seismogenic areas and in the writings of scientific thinkers including Aristotle, DaVinci, Darwin, Lyell, Humboldt, Kant, and Mallet (Oeser 1996–2001). Early attempts at scientific explanation sometimes found it useful to compare earth
tremors to human illnesses such as loss of circulation or ague (Oeser 1996–2001). Some scientists still find it useful to consider the Earth as a living body. The Gaia hypothesis, proposed by James Lovelock (1972), is capable of stimulating integrative thinking and lively debate about large-scale ecological phenomena. Similarly, speculations and descriptions found in earthquake folklore can serve as a springboard for contemplating earthquake effects at particular geographic sites.

Comparing the earthquake-related lore of Cascadia with the namazu-e of Japan, we find similar motifs and notions of causal mechanisms. In both areas, for example, a chthonic, serpentine creature of great power, associated with water and living under the earth or ocean, is the immediate cause of earthquakes. Although the Japanese namazu is typically a type of catfish, it was a development from earlier notions of subterranean dragons. Similar notions are found throughout the world. Legends from Sumatra attribute earthquakes to a horned water serpent that struggles to shake off the land above him (Dixon 1916; Frazier 1918). Piccardi (2001) has reported that the lairs of chthonic dragons in Greek mythology are located directly above active faults, as is Scotland’s Loch Ness monster. Although not all mythical or folk theories of earthquakes view the causal mechanism of earthquakes as the movement of a fish, serpentine, or reptilian creature within or beneath the earth or waters, this theme seems to be common to diverse cultures throughout the world.

Another widely distributed theme regarding earthquakes is the connection between earthquakes and thunder. In the Japanese case, we find the close association of the Kashima deity and the thunder deity. In the southern part of Cascadia, thunder appears in human form and frequently appears as the companion of Earthquake. Along the middle and northern Cascadia coast, the Thunderbird appears in numerous stories describing marine flooding and ground shaking. In European thought, thunder is closely associated with earthquakes in the Bible (King James version: Isaiah 29:6; Revelation 16:18; 11:13, 19), in sermons (Wesley 1750), and in c. 1750 scientific thought (Franklyn 1750; Stukely 1749–1750; Bina 1751 & 1758). In India, texts from the eleventh to sixth century BC say that ‘once upon a time mountains could fly and move. Thus they were frequently falling on the earth causing earthquakes continuously. At the request of the earth, the Creator ordered Indra (thunder) to cut the wings of the mountains so that the earth became stable.’ (Iyengar 1999).

Moving beyond images of the mechanical causes of earthquakes, we find that many cultures throughout the world regarded earthquakes as purposeful...
events, not random occurrences. More specifically, there was a pronounced tendency for local populations to regard earthquakes as divine punishments. The Japanese notion of world-rectification, although not solely punitive, includes the idea that earthquakes punish those who have harmed society such as merchants who hoard wealth or a corrupt and ineffective government.

In European thought, unspecified sin was said to cause earthquakes, with piety put forth as a cure. The sermon of the British minister Charles Wesley (1750) makes this clear ‘Earthquakes are set forth by the inspired writers as God’s proper judicial act, or the punishment of sin: Sin is the cause, earthquakes the effect, of his anger.’ Stories from Cascadia and Alaska include examples of earthquakes following misdeeds such as cruelty to animals (Fig. 1, story 1c), greed (Fig. 1, story 23), unbridled lust (Adamson 1934, p 216–217) and incest (Krause 1956, p. 183–184).

From the above examples, it is likely that at a deep level many or most of the world’s premodern societies regarded earthquakes in a similar way. The earth shook because of the movements of a water-dwelling fish, whale, snake, dragon, or reptile within the earth or beneath the water. This shaking process was connected with the phenomenon of thunder, and the shaking was, at least in part, a world-altering retribution visited on earthly inhabitants by the cosmic forces. The alteration of the world included destruction of the existing social and material equilibrium, destructive and constructive changes in physical landforms, and opportunities for some to advance in social or material status while the fortunes of others declined.

The Japanese case is noteworthy in that the namazu figures comment extensively on both the destructive and constructive aspects of earthquakes. As we have seen, images produced soon after the main earthquake, at a time when aftershocks continued to shake the ground, stressed the destructive power of the namazu. Once the most hazardous aspects of the earthquake had passed, then the emphasis shifted to opportunity for labourers and other members of the general population who stood to benefit economically from the reconstruction. More broadly, the earthquake represented opportunity for social renewal. On balance, especially looking at it in hindsight, ordinary Japanese tended to view the Ansei earthquake of 1855 as more of an opportunity than a hazard. The namazu image was sufficiently complex that it could accommodate a range of earthquake-related phenomena. Furthermore, many other Japanese supernatural creatures, such as the oni (demon) and tengu (goblin) have a similar quality. They are fearsome, powerful, and often destructive. On the other hand, they can also be beneficial in certain circumstances (Smits 2002; Shimizu 2003, p. 136).

In the case of Cascadia, evidence for considering earthquakes to have a constructive aspect is sparser, and the cultural context distinct. Rather than relatively centralized and highly stratified governance, as in Japan, there were numerous distinct and relatively isolated tribal groups with generally more fluid social hierarchies. Although reports of death and destruction are present in many stories (and indeed, are one of the factors that helps us to identify them as earthquake- or tsunami-related), various tales from Cascadia do attest to human flexibility in response to earthquakes. A story from Vancouver Island tells how, following the 1700 tsunami, remnants of a tribe that had been largely obliterated offered tribal leadership to a newcomer arriving after the event (Fig. 1, story 6). Another account from the same area tells how, after the 1700 tsunami washed away the people of Pachena Bay, property rights passed to a group related by marriage (Fig. 1, story 7). Another story, from the northwest tip of Washington, tells of extreme hunger when the tide refused to go out (Peterson 1976), a possible reference to shellfish beds subsided below the low-tide level. Starvation was averted when the Thunderbird brought a whale to shore. Stories from northern California report improved fishing at sites where the earth subsided and was inundated (Fig. 1, stories 31b and 32). Like the Japanese, the Yurok of northern California saw earthquakes as an indication of an unbalanced world, and held annual midwinter world-renewal ceremonies with a Jumping or Deerskin Dance intended to stave off earthquakes and other impending catastrophes and restore balance to the world (Kroeber 1976).

Although earthquake-related figures in Cascadia are generally treated with great respect and sometimes fear, a few stories present a comical aspect to the Thunder figure, characterizing him as a hostile father-in-law who sets dangerous challenges for his human son-in-law, including bringing two fighting stones, called White Agate and Blue Rock, into the house. The son-in-law has special powers that protect him, and manages to turn the danger around to injure the father-in-law (e.g. Adamson 1934); the warring rocks tear Thunder’s house to pieces.

Large earthquakes create a geographically distributed set of shared and individual experiences that are amenable to a broad range of human analysis and interpretation. Although individual fortunes or even cultures rise or fall, the stories of the survivors persist. Listening to and integrating local stories into our consideration of what an earthquake means anchors us in our geographic and historic setting in multiple and thought-provoking ways. Earthquakes belong to communities, and their
popular representations are worthy of a place alongside the persuasive explanations of science.

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References


PETERSON, H. 1976. Songs and stories from Neah Bay [sound recording], told by Helen Peterson of the Makah tribe. Canyon Records, Phoenix, AZ.


SMITH, M. W. (unpublished notes) interview with Seattle’s grandson Sam Wilson, b. 1861 [Information collected in the 1930s], handwritten notes, originals held by Royal Anthropological Institute, 50 Fitzroy Street, London, WIP 5HS U.K. Viewed on Microfilm at B.C. Provincial Archives (RBCM); microfilm A1738, Reel 3 Box 5, Reference MS 268:5:4 Nos. 1–18.


SWAN, J. G. 1870. The Indians of Cape Flattery. Contributions to Knowledge, Smithsonian Institution, Washington, D.C.


