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Memory Saves Lives: Intergenerational Warnings Effectiveness – 13556

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ABSTRACT

The 2011Tōhoku earthquake and tsunami was a world-class natural disaster. It has been described as the most powerful earthquake ever in Japan, and as one of the most powerful earthquakes ever noted in the world. The toll in terms of human lives lost and property destruction was unimaginable. Even the word 'horrible' is inadequate to describe the suffering and misery that resulted.

Nations with nuclear power programs are engaged in, or at least planning to become engaged in, arranging to eventually dispose of their higher-level radioactive waste materials in deep geologic repositories. Geologic repositories are passive safety systems, and if undisturbed isolate these dangerous materials form the biosphere for extremely long times. The key words, however, are "if undisturbed." To assure that future generations do not inadvertently drill into repositories, national programs, and the international community (the Records, Knowledge & Memory (RK&M) preservation project of the Nuclear Energy Agency, for example), are proposing to place markers and/or monuments on closed repository sites that say "do not drill here, and this is why" in various sophisticated ways.

Such markers or monuments are attempts at providing passive institutional controls. The effectiveness of messages from past generations to a present generation may give an indication of how effective such passive institutional controls may be.

INTRODUCTION

It is the thesis of this paper that insight into the potential effectiveness of future-generation warnings may be gained by looking at the effectiveness of monuments erected by past generations in Japan to warn their future generations of the dangers of tsunamis. It is not a pleasant thing to look into the details of what happened in Japan in 2011. However, there were several places where the stone warnings from the past were taken very seriously.

There were other places, perhaps the majority of places, where trust in modern technology led to the ignoring of these warnings. The illustrative cases used in this paper have been drawn from the Internet. Each cited article's author was contacted, but no responses were received. The content cited in this paper was independently reviewed, verified to be unbiased, and confirmed to be credible (see Acknowledgements).

REACTIONS TO TSUNAMI WARNING MARKERS IN JAPAN

Two general responses seem to have occurred in today's Japan to the stone warnings created by their ancestors. The first response is from a newspaper interview that describes a community that actively kept alive the memory of a disaster from a thousand years ago [1]:

"Collective memory, as much as science and engineering, may save your life.

"A millennium ago, the residents of Murohama, knowing they were going to be inundated, had sought safety on the village's closest hill. But they had entered into a deadly trap. A second wave, which had reached the interior of the island through an inlet, was speeding over the rice paddies from the opposite direction. The waves collided at the hill and killed those who had taken refuge there. To signify their grief and to advise future generations, the survivors erected a shrine.

"Some 50 generations later, on March 11, 2011, the Murohama tsunami warning tower — which was supposed to sound an alarm — was silent, toppled by the temblor. Still, without the benefit of an official warning system supported by modern science, the locals relied on the lesson that had been transmitted generation to generation for 1,000 years. "We all know the story about the two tsunami waves that collided at the shrine," I was told.

"Instead of taking refuge on the closest hill, the one with the shrine, they took the time to get to high ground farther away. From the safety of their vantage point they saw two tsunami waves colliding at the hill with the shrine, as they did long ago. Tragically, not everyone made the right choice; I was told of at least one person who died.

"I know that science and engineering save lives. But in this instance neither did much to help. A message sent into the future 1,000 years ago did. Reaching out from the distant past, long-gone ancestors — and a deeply embedded story — saved their children."

Several other towns survived because of the warnings being kept actively in the population's memories. Examples include Aneyoshi, a featured village of survivors in an article in the New York Times by that paper's Tokyo Bureau Chief [2]:

"ANEYOSHI, Japan — The stone tablet has stood on this forested hillside since before they were born, but the villagers have faithfully obeyed the stark warning carved on its weathered face: "Do not build your homes below this point!"

"Residents say this injunction from their ancestors kept their tiny village of 11 households safely out of reach of the deadly tsunami last month that wiped out hundreds of miles of Japanese coast and rose to record heights near here. The waves stopped just 300 feet below the stone.

"'They knew the horrors of tsunamis, so they erected that stone to warn us,' said Tamishige Kimura, 64, the village leader of Aneyoshi."

The article continues:

. . . “modern Japan, confident that advanced technology and higher seawalls would protect vulnerable areas, came to forget or ignore these ancient warnings, dooming it to repeat bitter experiences when the recent tsunami struck. . . .

“Hundreds of so-called tsunami stones, some more than six centuries old, dot the coast of Japan, silent testimony to the past destruction that these lethal waves have frequented upon this earthquake-prone nation. . . .

“Local scholars said only a handful of villages like Aneyoshi heeded these old warnings by keeping their houses safely on high ground. More commonly, the stones and other warnings were disregarded.

“Japan had neglected to teach its tsunami lore in schools. . . . the nation had put too much store instead in new tsunami walls and other modern concrete barriers, which the waves easily overwhelmed last month.”

Fig. 1. Example of a stone tsunami marker in Japan [3].

Figure 1 shows a stone warning monument by the village of Aneyoshi. The inscription reads: "High dwellings are the peace and harmony of our descendants," . . . "Remember the calamity of the great tsunamis. Do not build any homes below this point."[3]

An Associated Press article tells of the use of schools to keep memory alive, of place-names to keep memory alive, and discusses the longevity of disaster-memory in a family [3]:

“MIYAKO — Modern sea walls failed to protect coastal towns from Japan's destructive tsunami last month. But in the hamlet of Aneyoshi, a single centuries-old tablet saved the day. "High dwellings are the peace and harmony of our descendants," the stone slab reads. "Remember the

calamity of the great tsunamis. Do not build any homes below this point." It was advice the dozen or so households of Aneyoshi heeded, and their homes emerged unscathed from a disaster that flattened low-lying communities elsewhere and killed thousands along Japan's northeastern shore.

"Hundreds of such markers dot the coastline, some more than 600 years old. Collectively they form a crude warning system for Japan, whose long coasts along major fault lines have made it a repeated target of earthquakes and tsunamis over the centuries. . . .

"Many did escape, fleeing immediately after the quake. In some places, it was a matter of minutes. Others who tarried, perished. "People had this crucial knowledge, but they were busy with their lives and jobs, and many forgot," said Yotaru Hatamura, a scholar who has studied the tablets. . . .

"Earlier generations also left warnings in place names, calling one town "Octopus Grounds" for the sea life washed up by tsunamis and naming temples after the powerful waves, said Fumihiko Imamura, a professor in disaster planning at Tohoku University in Sendai, a tsunami-hit city.

"'It takes about three generations for people to forget. Those that experience the disaster themselves pass it to their children and their grandchildren, but then the memory fades,' he said.

"The tightly knit community of Aneyoshi, where people built homes above the marker, was an exception. 'Everybody here knows about the markers. We studied them in school,' said Yuto Kimura, 12, ... 'When the tsunami came, my mom got me from school and then the whole village climbed to higher ground.'"

Are there implications from the Japanese experience that may be useful in considering the potential effectiveness of warning markers and monuments to be placed on closed repositories?

POTENTIAL EFFECTIVENESS OF REPOSITORY MARKERS AND MONUMENTS

There is no valid comparison possible between the respective risks of a tsunami and a deep geologic repository. The former is a disaster of potentially horrific proportions in terms of wiping out human and other life and destroying property. The latter, if well sited, designed, and undisturbed, poses no credible threat to the well-being of human or other life.

Even if disturbed inadvertently by a driller, impacts may be acute for a small number of persons, but if it is allowed to be assumed that this future society is as aware of radioactivity as this current society is, then it can be assumed action will be taken to mitigate the contamination caused by the intrusion. Such an intrusion event with resulting contamination would likely serve as a renewal of any forgotten warnings for several, if not many, more generations.

Japan's 2011 experience is very sad, but illustrates the difficulty of keeping a collective memory alive from generation to generation even in the case of a horrifying event. By comparison, a repository intrusion event with some releases that are cleaned up, and a few persons who are treated for acute exposure, would be a rather benign event.

In addition, there is no precedent of a disaster-memory to use to drive the importance of the topic deep into the minds of the citizenry.

Japan's rural culture seems to have very stable, multi-generation residence times for families in the small towns discussed in the stories cited. This would likely not be true in large cities in Japan, or in many countries elsewhere in the world where population transience is the norm. A transient population would not have the oral history tradition within several family generations as alluded to in the cited accounts. Therefore, even keeping a disaster memory alive for three generations in larger communities with more population transience would be difficult.

A strange place name that causes one to ask 'why' is a novel approach to keeping local memory alive. Using schools to teach children, rather than, or in addition to, relying on families to pass on traditions, is perhaps an effective way to pass information into the future.

It is obvious to anyone living in an area that can be reached by, or has been reached by, a tsunami would be anxious to pay attention to warnings and heed them. However, it seems to be part of the human condition to be blasé about unseen, and especially unexpected, risks in the face of daily life and its ever-present and -demanding challenges.

Perhaps the one lesson to be taken from the Japanese experience is that there is no reason to assume that future generations will care at all, monuments or not, about the presence of a repository that has never reached out and hurt anyone. It is heartening that in several places memory of disaster was kept alive for anywhere from several generations to a thousand years, but that has to be balanced with the fact that in many more places the population trusted in modern technology to protect them, in spite of being aware of warnings. The general safety level experienced by most residents in advanced nations also gives them a potentially false sense of well-being and security that makes disaster unthinkable.

The one sure way to make at least the local population care and maintain awareness about a repository site is to make the site important, locally. This can be done by linking the site with the local economy (a museum, perhaps) or making it an otherwise attractive place for locals to come for recreation among the warning signs (a novel touch for a park or sports complex on the site).

In southern France and in several locales in Spain, Roman aqueducts still stand. They have been maintained for almost 2,000 years because they supplied vital water to towns. In very recent times they have been replaced by wells and pumps, but they are still carefully maintained because they bring tourists. This suggests that to be remembered and maintained, a facility has to be locally important.

The DOE has a large number of sites formerly utilized for its nuclear research and testing programs. Many have been decommissioned, decontaminated, and remediated to the extent practicable and transferred to the DOE Office of Legacy Management for post-closure care. Some, however, cannot be released for unlimited use because of on-site waste disposal cells or landfills or subsurface soil and groundwater contamination. To lighten the burden on the DOE in controlling land use on these properties, the Legacy Management office has worked with local stakeholders and governments to allow use of the sites that would not pose a health or environmental risk. Examples include sites that are being used for sports parks and walking and

running trails, as wildlife habitat, and for renewable energy generation. There are administrative institutional controls in place that prevent certain types of land use at these sites that could create a health risk. However, making the sites locally desirable and important, and thus keeping them continually in a use that prevents incompatible land use, may be just as important as legal controls on land use, so long as the basic infrastructural features of the local community remains intact.

Perhaps less energy and investment should go to building massive markers, and more creativity and investment should be channelled into making the location more useful, in an attractive way, to the local community.

The Japanese markers lesson is sobering. As every parent and grandparent knows, you have no control over the future. Some kids listen, some don't. Most feel they are more knowledgeable, more aware, and more sophisticated than their progenitors. Hence they discount tales spun from experience. You can build the markers and monuments, at huge expense, and yet be ineffective. You could build a dog-park, baseball field, and running track, and assure that as long as people need exercise or dogs need to poop, your property will be protected from intruders. You can even deed that rather inexpensive but nice infrastructure to the local community government and not have to worry about maintaining it. Or you can build a museum/educational facility on the site and turn it over to the regional government with some long-term grant support. Usefulness may be more important than the size of, or messages on, monuments.

AN EXAMPLE OF A MARKED, SURFACE-DECONTAMINATED DISPOSAL SITE[1]

While an employee of Argonne National Laboratory in the early 1980s, the lead author chanced upon a nearby marker (Figure 2).

This marker is on a remediated site owned by a local jurisdiction and monitored by the DOE. The site is 20 miles from Chicago, Illinois. This is a site where the first and second US nuclear reactors were developed and tested. The site is in the Palos Forest Preserve, which is part of the Cook County Forest Preserve District. Forest Preserves are publicly accessible.

Note that someone has gone to the trouble of knocking the word "no" out of the text, making the warning more ominous than intended.

The primary contaminants of concern in groundwater and surface water are tritium and strontium-90. The Forest Preserve District prohibits drilling and excavating on all its lands, effecting a working land-use restriction that reduces the likelihood that buried waste would be exposed through human intrusion.

The only currently plausible exposure pathway is where groundwater surfaces at a seep, and where an intermittent stream flows several months each spring. Potential exposures to contaminated groundwater and surface water are of low frequency and short duration. Observed

[1] Information in this section, and its figures, were obtained from the "Fact Sheet" linked on this page: http://www.lm.doe.gov/SiteA_PlotM/Documents.aspx

levels of contamination do not endanger the health or safety of the public visiting the site, using the picnic area, or living in the vicinity.

Fig. 2: Warning marker in Palos Forest Preserve near Chicago.

Although the land is owned and managed by the Forest Preserve District of Cook County, Illinois, the DOE is responsible for the subsurface radioactivity. DOE's Office of Legacy Management manages this site according to a site-specific Long-Term Surveillance and Maintenance Plan. DOE conducts annual inspections of the site to evaluate the condition of surface features, such as site vegetation and any onsite and adjacent offsite erosion. DOE also periodically evaluates the groundwater and surface water monitoring program carried out by Argonne National Laboratory.

A second site marker has been placed on the site to give a historical context (Figure 3). As long as current civilization and its local institutions survive, this land will remain protected from intrusions into its subsurface. As long as these stone monuments survive, this place will be protected from inadvertent intrusion.

If someone reads these signs and intrudes anyway, it is an advertent intrusion, and the intruders bear all responsibility, not the generation which placed these warnings here. If someone, in an act of vandalism, makes these warnings unreadable, the responsibility rests with the vandal, not

with the generation that erected the marker. Current generations can influence, but not control, future human actions.

Fig. 3: Informational marker in Palos Forest Preserve near Chicago, Illinois.

CONCLUSIONS

Current generations are ethically obligated to warn future generations about risks they are leaving behind. In terms of formerly utilized deep geologic repositories, to the extent practicable, local jurisdictions, which are likely to remain in some working form even through major national changes, ought to be involved in providing long-term land-use protection.

To an extent practicable, national authorities need to aid local jurisdictions in making the site a local and regionally useful place so as to maintain public awareness and invoke locally mandated land use controls. National authorities ought to also provide technical services to aid in a periodic assessment of changes in the risk potentially posed by the sealed facility.

Finally, the repository implementer needs to erect long-lasting warning monuments that are factual and warn of, but do not exaggerate, intrusion risks.

Warning markers work best in concert with local interest in maintaining current recreational or educational land uses. Markers need to be long-lasting. Yet their costs should not impoverish a current generation to warn of a potential risk that may not even be likely to be encountered in some far-away future generation. Current generations are real persons, living here, now, and ought not be adversely affected in terms of lifestyle, health, or basic comfort in favour of a few

hypothetical members of far-future generations who may encounter what today would be a manageable risk.

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We relied on: http://factsanddetails.com/japan.php?itemid=2227&catid=26&subcatid=160, a website by T. HAYS. Citations in this paper used the original sources cited by HAYS to reduce the risk of citation error.

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