PERSONAL AND PROFESSIONAL ENCOUNTERS WITH HAZARDS IN CONTEXT: THE CHALLENGE OF AMBIGUITY[1]

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Abstract

Changes in the problems addressed and the modes of interpretation employed by one hazard researcher during a lengthy professional career are identified and analyzed. These illustrate an ongoing dialogue between personal experience and professional engagement that moves towards broader framing of problems and increased synthesis of findings over time. This trend parallels the general evolution of interdisciplinary hazard research in recent decades. The emergence of ambiguity as a study problem that requires urgent attention is discussed against a background of burgeoning hazards and inadequate progress towards the reduction of losses, as well as an increasingly permeable boundary between the knowledge of experts and laypersons. Concepts of encounter and context are identified as promising rubrics under which researchers might undertake an expanded engagement with hazards and examples of topics on the author's current inquiry agenda are provided.

Key Words: Disaster; Decision-making, Knowledge; Experience; Interpretation; Chance; Synthesis; Geography

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[1] Based on a presentation at the 9th Magrann Symposium, Department of Geography, Rutgers University, March 2, 2016. This paper draws heavily on my personal experiences of hazard, but I am mindful of the major intellectual debts owed to a great many colleagues and students who shaped my understanding of hazards. In addition to the foundational contributions of Gilbert White, Bob Kates and Ian Burton I have been inspired by, and borrowed from, a wide range of other researchers. They include (in alphabetical order): David Alexander; Roger Balm; Greg Bankoff; Kent Barnes; Stephen Bender; Jorn Birkmann; Karl Butzer; Monalisa Chatterjee; Arthur Chiu; Chip Clarke; Craig Colten; Louise Comfort; Susan Cutter; Ian Davis; Marla Emery; Ken Foote; Maureen Fordham; Mickey Glantz; John Handmer; Jeanne Herb; Ken Hewitt; Jim Jeffers; Terry Jeggle; Roger Kasperson; Charles Kelly; Kevin Kenan; Jim Kendra; Howard Kunreuther; Allan Lavell; Mariana Leckner; Robin Leichenko; Ragnar Lofstedt; Andrew Maskrey; Rob Mason; Mark Mauriello; Melanie McDermott; John Miller; Tom Mitchell; Mark Monmonier; Joanne Nigg; Tony Oliver-Smith; Laura Olson; Karen O'Neill; Risa Palm; Christian Pfister; Roger Pilke Jr.; Rutherford H. Platt; Frank Popper; David Robinson; Claire Rubin; Bill Solecki; Richard Sylves; John Tiefenbacher; Juha Uitto; Peter Wacker; Marvin Waterstone; Jim Wescoat; Tom Wilbanks; Ben Wisner; Yuanchang Zheng; and Doracie Zoleta-Nantes.

Introduction

During a half century of study I have assessed the human dimensions of natural hazards and disasters from both personal and professional perspectives. This paper casts light on the interplay between these different realms of experience. It is organized around the concepts of **encounter** and **context**, two terms widely employed by hazard researchers and managers but rarely subject to analysis. Both of these expansive concepts deserve greater attention because they encourage self-awareness among investigators and illuminate the high degree to which hazards are multifaceted problems. By so doing they open up the discursive space to a larger co-constituency of experts and laypersons, which is a necessary precondition for devising successful ways of living with worsening events. (Mitchell 2017) Herein, examples of my personal encounters with contextualized hazards are provided and linked to broader scholarly discourse. The nature of intellectual inquiry is such that there is a high probability a researcher's outlook will change over time, hopefully in the direction of greater understanding and wiser decision making, though neither is a guaranteed outcome. It is important for those of us who are involved in the enterprise of hazard reduction to recognize such shifts and to explain why they may have occurred.

Encounters and Contexts

Encounters are unexpected engagements among people and risky environments that are potentially destabilizing for both. In this paper the focus is on human confrontations with extreme meteorological, hydrological and geological events, though other kinds of confrontations are also implied. Encounters with such events are socially mediated and deeply influenced by the contexts in which they occur. *Contexts* are frames of reference that accommodate and explain the interrelations of parts and wholes. Among others, contextual factors of time, space, place and culture strongly temper universalizing theories of hazard and modify prescriptions for action.

While this paper does not pretend to be an exhaustive treatment of encounter as an intellectual construct, use of the term is intended to underscore the provisional and often reflexive nature of responses to hazards that are prompted by the dynamic contexts in which they occur. Mixes of new experiences and unfamiliar challenges are typical of encounters with hazards and disasters, especially in the present increasingly mobile and disrupted world. To gain a more complete picture of human responses to hazard it is necessary to understand both encounters with extreme events and the contexts that frame those encounters; neither is of sovereign importance.

The concept of *encounter* has received little analytic scrutiny from hazards researchers though it is sometimes employed for purposes of exposition (Alesch et al 2001; Dasgupta, Siriner and Sarathi 2010; McCosker 2013; Gibbs and Warren 2014; Reser, Bradley and Ullul 2014) In contrast, historians and other social

scientists make extensive use of encounter as a point of entry to explanations of how certain groups legitimate and privilege their world views over those of competing others. (Livingston 1994; Withers 1999; Douglas 2014; Barua 2015; Beneito-Montagut 2015; Wilson 2015; Valentine and Harris 2016) This has major implications for hazards researchers because control of public discourse in, and about, situations of hazard is a major determinant of subsequent actions.[2] A few hazards scholars with interests in the application of scientific knowledge to public policy have probed the role of *context* in decision-making but that literature, too, is scanty[3]. (Mitchell, Devine and Jagger 1989; Mitchell 1999; Palm 1990; Cutter 1996; Collins 2008; Druckers, Frerks and Birkmann 2015). In contrast, encounter and context are widely accepted taken-for-granted concepts that routinely inform the work of emergency management professionals. (U.S. Department of Homeland Security 2013; Governor's Hurricane Conference 2017)

Victims, helpers and bystanders to specific events encounter hazards directly, whereas researchers usually encounter them indirectly as objects of study. For some humans a single encounter with an extreme event may dominate but individuals and groups typically take part in a sequence of encounters with different events at different times that together inform an evolving trajectory of experiences.[4] (Mitchell 2010) Individual and serial encounters have a powerful formative effect on expert and lay interpretations of hazard that, in turn, play important roles in shaping public policies.

Among social scientists it is customary to regard hazards as a *class* of related events, varying in magnitude and frequency but sufficiently similar to permit generalizations that are useful guides to action. Conversely, there is also value to treating each major hazard event as a unique occurrence, which – for some affected populations – it is. The history of natural hazards and disasters is peppered with references to specific events that became pivots of change for conceptualizing and policy-making. (e.g. the North Sea flood of February 1953; the Isewan typhoon, 1959; hurricane Katrina, 2005; Superstorm Sandy, 2012) (Bos, Ullberg and t'Hart 2005; Birkland 2006) Perhaps because great disasters are relatively infrequent, the most recent one often becomes the standard for planning responses to the next. (Wachtendorf and Kendra 2006; Ewing and Synolakis 2011) Yet the multiplicity of factors that affect risk, vulnerability, and resilience more or less ensures that no two hazards events will be the same, especially as experienced in human encounters.

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[2] An extensive body of literature on risk communications provides valuable insights about mechanisms that steer public discourse but usually does not address issues of privilege and legitimation. (Kasperson and Kasperson 2005)

[3] An appreciation of context is fundamental to being a good geographer or a good historian, something that is particularly visible in the work of ecologically, historically and culturally-oriented scholars and those who are interested in the process of synthesis. (Butzer 1982; National Research Council 1997; Atkins, Simmons and Robert 1998; Gober 2000; Janku, Schenk and Mauelshagen 2012)

[4] Processes of "improvisation" and "emergence" are related phenomena that signal the appearance of new responses. (Wachtendorf and Kendra 2006; Provitolo, Dubos-Palliard and Muller, 2011)

Differing experiences and interpretations by experts and laypeople greatly complicate the task of creating effective public policies for managing hazards. Though forensic research in the aftermath of disasters may help to sort out the varying interpretations it is usually too little and too late to make a difference to decisions about recovery and mitigation that otherwise tend to be strongly driven by expediency and already vested interests. (Burton 2010)

It is worthwhile noting that the conjunction of encounter and context raises questions that go beyond the scope of this paper but are nonetheless important to signal for future inquiry. Chief among these is the role of experience in decision-making about hazard. (Lindell 2013) Experiences are inscribed in humans by direct exposure to extreme events and indirectly by information acquired through formal education as well as folk wisdom, mass media reports and the accounts of others. It has also been conjectured that experiences may be acquired by exposure to *simulations* of real world events (e.g. virtual reality) (Mitchell 1997) Though often debated, the precise ways in which mental inscription takes place and the effects of what is remembered on different kinds of decisions and actions are still unclear. (Kates, 1976; Lowenthal and Prince 1976; Ittelson, Franck and O'Hanlon 1976; Mitchell 2000; Bos, Ullberg and t'Hart 2005; Tidball et al., 2010; Bohensky 2015) Findings by geographers and decision scientists suggest that humans, when recalling from memory, assess extreme natural events differently than at the time of their occurrence. (Slovic 2007; Kahneman 2011; Kunreuther, Slovi and Olsen 2014) Moreover, the contexts in which decisions are made are not necessarily the same as those in which events are experienced or when they are committed to memory. For example, during disaster recovery, actors, assumptions and timing are different for decisions about grand strategy compared with decisions about immediate operations or long term planning (Berger, Kousky and Zeckhauser 2008; Donovan and Oppenheimer 2014; Platt 2015) In other words, both for individuals and groups, encounter is a multi-phase and multifaceted process. Bearing these matters in mind, let us turn to specific examples of encounter drawn from the experience of this hazards researcher.

Youthful encounters with hazards

Apart from occasional mild snowstorms, my childhood in Northern Ireland was largely free of damaging events triggered by natural extremes. The earliest remembered such encounter was as a four year old, in July 1947, viewing a war-surplus military assault bridge that served as a temporary replacement for an ancient stone structure washed away by recent floods. (Meteorological Office 1949. p.31) Parents explained the circumstances of the old bridge's demise and the subsequent public response, also conveying the expectation that matters would eventually return to "normal", when a permanent replacement was constructed. For a long time thereafter we checked on progress towards that hoped-for state. Although, not recognized as such at the time, we were in effect making sense of the experience by applying a primitive Event-Effects-Consequences model of hazard. (Rossi et al 1983; Kates et al. 1985; Kasperson and Pijawka 1985)

A few other extreme natural events occurred during the subsequent decade including a severe storm in 1953 that inflicted widespread damage around the North Sea and drowned 133 people on a ferryboat crossing from Scotland to Ireland. (Hall 2013) Though the storm produced record-breaking damage elsewhere and eventually led to the massive Delta Project that closed off mouths of the River Rhine, I was most engaged by its consequences for the people of my hometown. On the day it occurred I was among the stadium crowd watching a professional soccer match and was greatly impressed by the flurry of activity that followed a public address message directing military and emergency services personnel among the spectators to return to their bases for deployment in an attempted rescue of passengers on the ferry. In later years I was to learn that mass media reporting of disasters has also tended to amplify the importance of local events over distant ones of similar (or greater) magnitude. (Kasperson and Kasperson 2005) However, the advent of widely available new electronic communications technologies appears to be diminishing this effect (Yan and Bissell 2015)

Gradually, there accumulated a basic layer of personal hazard experiences but they were disconnected from any larger explanatory system. To the limited extent that I possessed principles for understanding human responses to natural hazards they were culled from general education, including foundational texts about language, history, religion and social science. For example, high school lessons about ancient Greek culture supplied a number of helpful ideas, whose implications were only partially recognized and absorbed at the time. Among others, these included: (1) the inevitability of change in societies and environments (cf: Heraclitus of Ephesus); (2) the inherent imperfections of human knowledge about the external world (cf: Plato's cave); and (3) the temptation to downplay evidence that is at variance with widely accepted theories. (cf: the Procrustean bed). (Roochnik 2004) From these and other sources it gradually became clear that humans exist in the face of environmental uncertainties that often elicit hubris about our capacities for understanding and acting.

During undergraduate years in Northern Ireland, my acquaintance with floods, storms, droughts and the like was largely confined to textbooks and lectures; there were few direct encounters with natural hazard events. In University coursework, hazards were approached obliquely as marginal topics in the study of earth processes and as venues that displayed sociocultural practices. For example, under the tutelage of faculty geomorphologists I witnessed the results of an unusual bog burst that choked the Glendun valley with debris and learned to recognize the scars of old landslides on a coastal highway. (Colhoun, Common and Cruickshank 1965; Stephens 1997; Stewart 2014.) Among the many contributions of my major professor, Estyn Evans, to cultural geography, was the observation that folk housing in coastal areas of Ireland included tie down measures to protect roofs against high winds. (Evans 1957; Nolan, O'Reilly and Carthaigh 2015, p. 7) In the hands of a different kind of scholar this finding might have opened the door to systematic

analysis of human adjustments to natural risks but Evans' primary interests lay elsewhere.

Despite a paucity of extreme *natural* events in Ireland (Mitchell 2011), encounters with other kinds of disruptions, mostly social or technological, were readily available to serve as a basis for assessing environmental risks and hazards. For example, as a teenager cycling through the countryside, I came upon a train collision within minutes of its occurrence. (*Irish Times* 1959) The impact demolished an automobile that had been parked across the track, derailed several coaches and trapped the severely injured locomotive driver in his wrecked cab. Walking among the train passengers provided the first of several subsequent opportunities to witness the mixture of shock, disbelief and *purposive action* by victims that are typical of immediate human responses to rapidly occurring disasters. Looking back on such experiences, I now conclude that it is misleading to identify emergency services personnel as "first responders"; in most cases that title rightly belongs to those directly impacted by disasters, who are the initial agents of their own salvation.

In summary, early childhood interpretation of hazards involved gradual removal of the self from the center of the explanation to the periphery and the introduction of competing perspectives that reflected increasing awareness of more remote events represented in the mass media and the educational curriculum. Later, direct and indirect experience of a handful of extreme natural events, building fires, episodes of violence associated with a campaign mounted by political dissidents in the Irish Republican Army (1956-62), and transportation accidents, all provided grist for the mill and served as templates for understanding threatening departures from normality. This laid the groundwork for my adult acceptance that human agency is not confined to "man-made" hazards but might contribute to apparently "natural" ones as well.

Adult encounters in the USA and beyond

In 1965 I came to the United States as a graduate student intending to study urban geography and planning. While embarked on that course, hazards kept popping up in unexpected contexts. The first was a *chance* encounter days after arriving in the country. A fellow passenger on the train taking me into the U.S. interior was on his way back to a Gulf Coast home that he believed had been damaged by hurricane Betsy (September 1965). He passed the time not just by expressing anxiety about the destruction he might find but also by offering a pessimistic assessment of his prospects for receiving relief aid. He alleged that poor African-American victims would get preferential treatment over people like him, a white man, thereby signaling his perception of an invidious relationship between racial identity and loss susceptibility. It would be several decades more, not until the advent of Hurricane Katrina (2005), before formal social and race-centered explanations of disaster fully emerged in the professional literature. (Cutter 2006; Hartman and Squires 2008; Cannon 2011).

Chance has been an important concept in statistical studies of hazard events, and various systems for "taming" chance, especially by means of probability statistical procedures, have contributed to the development of hazard prediction systems and insurance as a risk spreading mechanism. (Hacking 1990; Bernstein 1998) But hazards scholars have also acknowledged that entirely unpredictable events (i.e. surprises) also occur, introducing unforeseen considerations into decision making and often confounding existing systems for managing hazard. (Kates and Clark 1996) The conceptions of hazards as estimable repeat events and hazards as unique unrepeatable ones are antithetical; they may be best thought of as parallel tracks toward understanding. At least two surprises have influenced my personal and professional development.

First, in January 1967, my plans for doctoral education were radically reoriented when an unexpected blizzard shut down Chicago on the day I had stopped off to scout the possibility of enrolling at the University of Chicago as a geography Ph.D. student. The only faculty member who made it in to the deeply snowbound Department of Geography that morning was Gilbert White, the discipline's major exponent of hazards studies. (Hinshaw 2006) We had a lengthy conversation that reinvigorated my nascent interest in hazards and left me thoroughly convinced that here was a field with an unbeatable suite of merits – intellectual challenge, social usefulness, and emotional engagement - overseen by a remarkable mentor. I had not arrived in Chicago with the intention of embracing hazards research as a career but departed firmly committed to that plan.

The second notable chance encounter occurred a decade later when the commercial aircraft on which I was traveling to attend a (hazards-focused) conference crashed during takeoff in Denver. (National Transportation Safety Board 1977) Not only did this event provide a very intimate window into human thought and behavior under conditions of extreme stress, it also illuminated the existence of gaps between planned responses to hazard and actual behavior as reflected by various shortfalls in the emergency management system. When the opportunity arose, I became an enthusiastic participant in quick-response study teams established under the aegis of the National Academy of Sciences, Committee on Natural Disasters. These field investigations revealed the value of direct participant observation of ongoing hazards, underscored the potential for abrupt disjunctive events, and increased my awareness of cognitive dissonance as an important consideration in the interpretation of hazard events.[5] (Dzialek 2013; Beasley 2016)

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[5] Cognitive dissonance theory argues that humans typically change their assessments of conflicted situations by various mental routines, in order to manage tensions that might otherwise paralyze decision-making. But the presence of enduring contradictions, like fear of destruction and willingness to reside in places that are recognized as both highly risky and highly desirable, shows that many people accommodate these tensions rather than resolving them.

In the interim, once embarked on graduate study in Chicago, the number and variety of encounters with hazard events and environments quickly mounted up.[6] Among others they included: study trips to places that experienced high levels of natural risk and the researchers who studied them (e.g. Southern Louisiana); a summer spent interviewing water system managers about flooding and drought issues in municipalities scattered around the country (e.g. Atlanta, Omaha, Waterloo, Muskegon); and last but not least, a doctoral dissertation that involved interviews with residents of five east coast USA communities affected by shore and beach erosion. (Mitchell 1974)

These and other encounters were approached with the distinctive set of questions and investigative tools that has come to be identified with the "Chicago school" of hazard research. (Penning-Rowsell 1999) Under Gilbert White, students were encouraged to select practical problems faced by hazard managers as points of departure for their inquiries rather than grounding them in ideas primarily drawn from academic theory. The perceptions, actions and experience of ordinary laypeople at risk provided much of the evidence employed to answer two main strategic questions that guided inquiry: "How do humans *make choices* among available responses to the *perceived* risks and hazards of *uncertain* environments?" and "how can better *information* about risks and responses improve decision-making in support of reducing losses?" (Burton, Kates and White 1974) Work in this paradigm was highly productive and findings had a good deal to do with the creation and improvement of various policy measures including, among others, the National Flood Insurance Program[7] and the eventual founding of a science of sustainability. (Cohen 2006) Later, at the urging of scholars with interests in the area of disasters and development, two additional questions were added to the broad hazards research agenda: "Why are hazardous places disproportionately occupied by *marginal groups* with limited access to resources for protection? How do societal institutions reproduce conditions of hazard?" (Hewitt 1983; Wisner et al 1994) Most of my early investigations fitted comfortably into this extended research tradition and White's emphasis on expanding the range of choice available to humans has been enduringly influential. (Mitchell 2008b)

Once graduated and hired as a newly minted university professor, my opportunities for encounters with hazards multiplied further. In succeeding decades the great majority of encounters were with coastal storms and riverine floods but there were important exceptions for other kinds of events including technological risks (e.g. nuclear radiation) and social hazards (e.g. terrorism).

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[6] This underscores an important difference between the information perspectives of experts and laypeople. Experts (e.g. researchers) deliberately employ focused searches for selective evidence whereas laypersons draw on heterogeneous bodies of (their own) unbidden experience.

[7] In the case of the NFIP, White and his co-workers eventually came to question the way in which some of these research findings and recommendations were implemented. Failure to tie flood insurance premiums to risk levels was one prominent example, that appears to have encouraged - rather than dissuaded, increased occupation of hazardous floodplains. Recent efforts to reform the NFIP, half a century after its creation, may be moving to correct this deficiency.

(Cutter, Brosius, Barnes and Mitchell 1979; Mitchell 1979; Mitchell 1983; Mitchell et al 2001; Mitchell 2003a and 2003b) Membership on study committees of the National Academy of Sciences exposed me to other disciplinary perspectives on hazard and facilitated field investigations that gave insights into the management of mudflow hazards on the edge of metropolitan Los Angeles as well as nationwide issues of multi-hazard management. (Campbell et al 1982; Mitchell et al 1983) The Academy also encouraged the notion that properly executed science might provide sound guidance on the making of public policy that is independent of political, economic, judicial and bureaucratic influences. (Jasanoff 1990) Work with "quick response" study teams provided rare access to stricken communities in the immediate aftermath of specific damaging events. Among others, were places affected by three Pacific and Atlantic hurricanes (Iwa, Iniki, Diane) and one extra-tropical storm of record-breaking proportions in the United Kingdom. (Mitchell, Devine and Jagger 1989; Mitchell 1994) Lessons learned included the many ways in which buildings and structures can fail during extreme events and the value of securing perishable information about human responses before it becomes contaminated by post-disaster experience. These are matters about which the first hand knowledge of laypersons who undergo disasters can be invaluable as a counterweight to – overly truncated and reductionist - expert conceptions around which public policies are frequently constructed. (Mitchell, O'Neill, McDermott and Leckner 2016)

Studies in non-USA communities affected by other kinds of hazards added further breadth (Minamata, Japan; Tangshan, China) by demonstrating that scientific knowledge is not a frictionless commodity, especially when the transfer of experience among places with different vernacular and scientific cultures is being undertaken. (Mitchell 1996; Mitchell 2008a) Although there is much to be gained by exchanging knowledge about hazard reduction practices that have worked well in some contexts, scholars should be under no illusions that this is an easy process that will produce similar results in new settings. (Sorensen 2000; Bijker 2007) To add greater temporal depth, I began a continuing program of visiting the sites of historic disasters to investigate residual long-term effects. (e.g. Johnstown, Centralia, Galveston, Texas City, Bar Harbor, San Francisco, Santa Barbara, Pueblo, Hilo, Napier, Florence, Lisbon) These reexaminations show that, although natural disasters may be instrumental in effecting large-scale physical transformations of impacted communities and landscapes, those experiences are – at best - only selectively and incompletely celebrated, memorialized or otherwise known to subsequent generations. (Foote 2003) Moreover, local experiences and adjustments that might have broad applicability are not passed on to populations elsewhere that might have made use of them. (Mitchell 2008a) Failure to teach succeeding populations about experiences of recovery and regeneration deprives society of positive historical lessons and saps confidence in the human potential to successfully confront future challenges. (Mitchell 2016a) Historical studies have offered one other advantage; they often illuminate the process of long-term recovery (i.e. years to decades), one of the least explored aspects of research on disasters. Thereby attention is directed to *shifts* in risk assessment and transformations in the framing of hazard problems

as new issues arise with the passage of time and different interest groups develop around them. (Mitchell 2006; Mitchell 2010; Mitchell, O'Neill, McDermott and Leckner 2016)

Not all encountered hazards occur in confrontations with natural extremes. As the professional experience of scholars accumulates we are often asked to undertake the delicate and risky task of advising others about appropriate public policies and practices. One such encounter had a major impact on my thinking about hazard during the 1980s and 1990s, and especially about, the appropriateness of scientific research institutions as launching platforms for the reduction of societal problems. In the present era when we have become accustomed to the leadership of the Intergovernmental Panel on Climate Change (IPCC) in support of enlightened policy making for the alleviation of climate change risks, it is salutary to recall the much less effective effort to mount a global program for the reduction of natural disaster losses that was eventually undertaken between 1990 and 1999.

The US National Academy of Sciences prepared the groundwork for an International Decade of Disaster Reduction (IDNDR) by creating an Ad Hoc committee to explore the feasibility of such a venture and to scope its initial lineaments. I was privileged to serve as Chair of that committee and to oversee preparation of a draft report to the Academy leadership. Our report made recommendations for a collaborative program that would focus on making better use of existing available scientific information by interest groups that were in a position to effect change. The report was never published and its recommendations were ignored in favor of a different set of recommendations from a formally created Academy Committee. That group proposed a more conventional program of basic and applied scientific research aimed at creating new hazard knowledge and new hazard-monitoring and research technologies. My published critique of the formal report was not optimistic about its prospects for success. (Mitchell 1988)

Nonetheless, the proposed Decade (1990-1999) went ahead under the sponsorship of the United Nations but ran into serious difficulties and had to be radically restructured in 1994, largely along lines advocated, or implied by, the initial draft report. (Hannigan 2012) While making some progress, the Decade never lived up to its initial promise. This experience underlined the dangers of relying too heavily on the guidance of the producers of scientific knowledge to achieve hazard reduction goals and not enough on inputs from those who use, or might use, such knowledge in real world applications. The importance of partnerships between knowledge producers and knowledge users is now more widely accepted (Mitchell 2006), though later developments suggest that the relationship between expert knowledge and lay knowledge is undergoing transformations that may require even more dramatic reformulations of future hazard reduction initiatives. (Mitchell, O'Neill, McDermott and Leckner 2016)

An Epiphany

About half way through my tenure at Rutgers University – in 1991-92 to be exact – I spent a year as a Faculty Fellow at what was then called the Center for the Critical Analysis of Contemporary Culture, now the Center for Cultural Analysis. < http://cca.rutgers.edu> It was a stimulating experience, though not one that I was very comfortable with at the time. But it did allow me to build on a series of "what if" experiments that I had employed in England while investigating the great 1987 windstorm (Mitchell, Devine and Jagger 1989) and it gave license to develop a different approach to studying hazards, an approach that added ideas from the humanities to my training in the natural and social sciences.

A few years later this approach crystallized while my wife and I were driving on Interstate 5 in southern California heading towards the city of Tijuana, Mexico. Just as we came upon a yellow and black warning sign that portrayed a group of adults and children in flight[8] we were listening to a radio report about the deaths of illegal migrants caught in the desert further east during an unexpected snowstorm. (See *Los Angeles Times* 2002 for a retrospective summary of similar events.) The juxtaposition of the two streams of information was striking. Here were a group of victims of an extreme event that were at the same time also being portrayed as hazards to motorists. Switching back and forth between the two notions was a feat of mental gymnastics because it shifted the frames of reference, the assumptions that went them and the prescriptions for action. Both were valid views of reality, though quite different in their implications. It was an illustration of F. Scott Fitzgerald's comment about intelligence as "… the ability to hold two opposed ideas in mind at the same time and still retain the ability to function" and a reaffirmation of Walt Whitman's observation about acceptance of contradictions.[9]

A couple of days later the initial notion was reinforced and extended at the San Diego History Center in Balboa Park. We had gone to see an exhibit on the role of droughts and floods in the city's history and noticed at one point that the building was distinctly vibrating. It was situated more or less under the landing approach to Lindberg field and the apparent cause of the vibrations was not an earthquake, as first feared, but a low flying passenger jet. The approach into Lindberg field is one of the more difficult in the United States in part because the land surface drops away unevenly under the descending aircraft and there are high buildings near the end of the main runway. Furthermore, the History Center was vibrating in part because of its construction as a temporary exhibit at a major 1915 Exposition held to celebrate the opening of the Panama Canal. The original wood, stucco and chicken wire frame was subsequently patched up when local leaders took a fancy to its Spanish-inspired architecture and wanted to keep it, but the present day building still shows evidence

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[8] Known simply as "The Immigration Sign" < https://en.wikipedia.org/wiki/Immigration_sign> it has now become an iconic, frequently parodied, image.

[9] "Do I contradict myself? Very well, then I contradict myself. I am large. I contain multitudes" (*Leaves of Grass* 1891-92)

of this fantasy beginning, not least a degree of fragility in the face of external shocks. (Amero 2016) So here there was a convergence of evidence about place-related hazards of the past (floods, droughts), the present (aircraft mishaps), the future (earthquake) and a time that hovered somewhere between then and now (building vulnerability); in short, simultaneous multiple contexts of hazard.[10]

These and similar encounters with contradictions of hazard that converge in time and space turned my attention to a new set of questions that still preoccupy me. It became obvious that humans receive many different kinds of incommensurable information about hazards that scientists have traditionally segmented and treated as specialized topics in separate subfields of study. What if instead we focused on the messy bundles of questions that are faced in real life, the ones that pose the most difficult tests of our existing theories and methods? I'm referring specifically here to situations characterized by ambiguity.

Ambiguity in hazard assessment and management

Ambiguity is a word that comes from the Latin *ambigere* meaning "to wander". Ambiguous situations are those that have more than one meaning or have unstable meanings. Some economists have employed the term narrowly in reference to situations where decision-makers are adverse to uncertainty borne of incompatible information and they have devised logical procedures to get around these limitations (Heal and Millner 2015); this paper takes a different tack by emphasizing the pervasiveness and fluidity of ambiguity as well as the unwillingness of humans to forego bifurcated thinking. In this respect it shares similarities with recent proposals by Australian interdisciplinary scientists of climate change for a broader engagement with persistent ambiguities. (Fleming and Howden 2016)

There are many kinds of ambiguity; contradictions and paradoxes among them. Ambiguities are embedded in human cultures, societies, institutions and individuals, wherein they serve important functions and are often signaled linguistically. For example, humor, advertising and the construction of symbolic identities are all premised on notions of ambiguity. Thus, allegorical jokes about hazard, such as "the lady and the tiger," are staples of academic conferences and gain their discursive power from multiple meanings, unexpected juxtapositions of terms and sudden shifts in perspective[11]. (Johnson 2015) Advertising often turns conventional images of hazard on their head to achieve goals far different from

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[10] For a discussion that situates simultaneity within the spatial discourse of Geography and links it to the concept of chance, see Massey 2005.

[11] Although there are many variations, the basic story has recently been summarized by Keith Johnson (2015). Its core is a dilemma posed by an absolute ruler to a captive. This involves choosing to open one of two (or more) mysterious doors behind which can be found either a great reward (the lady) or sudden death (the tiger). The story can be adapted, for different audiences, to show how rational choice processes may lead to surprising outcomes.

those of hazard reduction; therein hazardous phenomena are employed to sell luxury goods to consumers who are encouraged to associate them with qualities such as dynamism, grandeur, rarity and irresistible power, not the confused, destructive and untidy circumstances that typically characterize real world disasters. Artists and literary figures too use hazard imagery for symbolic purposes, perhaps to encourage people to question assumptions and judgments that are normally taken-for-granted. For example, a brass plate embedded in a literary walk outside the Sydney Opera House features Dorothea Mackellar's approving lines about droughts, famine, fire, flooding rains, terror (and beauty) in a poetic tribute to Australia's national identity that makes a virtue out of what, for many, would be negative connotations. (Mackellar 1911)

Ambiguities also permeate the universe of hazards management; reported from field study sites and commented on by hazard managers and hazard theorists. One prominent example that has gained public attention is society's reliance on climate science to provide the main basis for climate policies at a time when public trust in science is increasingly being called into question by many who influence, or are responsible for taking, decisions to reduce climate risks. (Pew Research Center 2016; Matthews 2016) Half a dozen other examples are illustrative of the wide range of hazard-related ambiguities that exists. First, humans are often drawn to places where undesirable risk processes enhance residential or recreational desirability (e.g. crustal instability; steep slopes; dynamic coasts and other waterfront sites). Second, protective regulations can be self-defeating if they rob vulnerable populations of the learning experiences from which knowledge about risk is acquired or if they encourage risk-taking by (mistakenly) nurturing an illusion of complete safety (i.e. "moral hazard"). Third, privacy protections that are intended to shield vulnerable populations (e.g. undocumented migrants) from surveillance by officialdom or the mass media may hinder the building of institutional memories among helping organizations, thereby depriving them of data that are essential to effective long-range mitigation efforts. Fourth, organizations that preserve and protect heritage sites typically showcase static architectural, historical and aesthetic values while neglecting the judicious risk-sensitive decision-making processes that permitted those places to survive. (Mitchell 2016a) Finally, we are trained to focus on how humans *learn* but we also need to take account of the propensity to *forget* (Mitchell 2000), a process that frequently renders what had once been comprehensible, now confused. In short, we are surrounded by ambiguities and cannot escape them. Perhaps the most profound ambiguity that brackets our existence on Earth is: "How can imperfect humans best engage a variable planet that is simultaneously limiting, enabling and indifferent?"

What is to be done?

Together with uncertainty and complexity, ambiguity raises very difficult problems for hazard analysts. (Renn, Klinke and van Asselt. 2011) But our understanding of ambiguity lags well behind what we know about uncertainty and complexity. It is now time to mount a more comprehensive investigation of hazard

ambiguity. In my opinion this will be accomplished best by opening up the hazards research arena to a wider range of perspectives, assumptions and information sources than have been employed heretofore. Ambiguities are often a byproduct of differences of positionality and incompatibilities among different ways of knowing. (Ip and Wu 2015; Henderson 2011) Successfully coping with hazards in the face of such ambiguities requires explicitly identifying them and devising tools to accommodate them in decision-making processes. This will involve elevating the salience of presently neglected types of knowledge that reside in the arts and humanities and among vernacular populations that confront hazards directly. Not simply as interesting add-ons to existing decision making systems but as independent and important driving forces in their own right. The benefits of so doing are not restricted to expanding knowledge in support of decision-making. Giving standing to alternative knowledge systems can also can help to greatly expand the presently weak public constituency for hazards management, a task that has been postponed for too long by researchers, educators and hazards managers. (Mitchell 2017)

The foregoing proposal would take researchers into uncharted intellectual territory so there is a need for robust orienting concepts. In these circumstances encounter and context are promising candidates for inclusion, not least because they are relational concepts that are compatible with the process of knowledge synthesis that has been such a distinguishing feature of contemporary research on mega-problems like global environmental change and other so-called grand challenges. (IPCC 2012; 2014; National Research Council 2001; 2005; 2016) It is already clear that the 21st century is generating hazards that are more numerous, varied, damaging and unprecedented than heretofore and that the pace of efforts to reduce them is falling behind. (Mitchell 2017) With no anticipated letup in the speed of environmental and societal changes, new hazard contexts will continue to emerge, setting the stage for a spate of new encounters that will likely, in turn, become the drivers of new public policies. As those who have worked in active circumstances of hazard or ongoing disasters know, encounters generate experience that is an important component of knowledge but context usually sets the parameters of interpretation. (Hyndman 2001) Moreover, comparative case studies are essential to provide a check against naïve acceptance of field evidence that may be unrepresentative or otherwise misleading. (Brookfield 1999)

My own research agenda reflects these assumptions. I am currently exploring the potential contributions of professional groups that have either not played large roles in the formulation of hazard policies (e.g. historic preservationists) or have worked largely in isolation from other fields of expertise (e.g. public health professionals). (Mitchell 2016a) I am also seeking to encourage the use of innovative new tools like Health Impact Assessment that are designed to merge knowledge contributions derived from hazard-focused encounters between laypersons and experts. (Mitchell 2016b) I would like to see the extension of hazard theory beyond ideas about the vulnerability of people and structures to include the vulnerability of essential societal functions like learning, performance, creativity

and regulation – all of which can be compromised or enhanced by exposure to hazards, with unanticipated consequences. I would also like to see more attention to aesthetic and emotional dimensions of hazard as represented in the work of artists, poets and novelists and others who create and modify notions of hazard that pervade popular culture with unknown but likely profound effects.[12] The possible agenda is long and will evolve still further.

Environmental hazards are one of the world's enduring problems. They have always been present, documented in the footprints of early hominids crossing volcanic ash in East Africa, featuring in some of the first known religious shrines and at the center of epic tales of creation and destruction from Gilgamesh to Atlantis. New hazards emerge and old ones wane as societies introduce new technologies, rearrange the uses of environmental resources and discover different ways of buffering ourselves against risks and vulnerabilities. But the central problem remains: how to achieve an acceptable fit between society and environment in the face of threats that arise from the joint actions of restless Humanity and fluctuating Nature. The reinvention of hazard research is a continuing challenge for us all.

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[12] Some initial forays in this direction have appeared in the new journal *Geohumanities* but more are needed. (Tangney 2015; Vickery 2015; Kawano et al 2016; Philipps 2016)

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