Editorial

On the nature of man and disaster

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Abstract

Unique among animals, humans survive not by superb physical adaptation to our environment, but rather by intelligent, large-scale adaptation of the environment to our needs. We build houses with climate control systems that mimic the environment of sub-Saharan Africa. We safely live in environments where the temperature never rises above freezing and where the level of the sea is higher than the land we farm and build vast cities upon. We live in tropical rainforests teeming with hostile organisms, and atop arid, life-poor mountains and plains, at elevations in excess of 5000 m. As this editorial is written, a few of us live in space, circling the earth in an environment of hard vacuum, searing heat, and cryogenic cold. The sole endowment for our survival that evolution has bestowed upon us is reason and technologic civilization, which is its product. All human habitations, and all life on earth for that matter, are under continuous threat of some kind. Violent weather, earthquakes, volcanic eruptions, and even meteorite impacts represent threats of varying degrees of risk.

There is a tide in the affairs of men, which taken at the flood, leads on to fortune. Omitted, all the voyage of their life is bound in shallows and in miseries. On such a full sea are we now afloat. And we must take the current when it serves, or lose our ventures.

William Shakespeare
"Julius Caesar"

Introduction

Human response to risk can be either proactive or reactive. Proactive measures include avoiding known risks by not settling in or venturing into hazardous environments, and mitigating them by constructing dams, levees, and other protective infrastructure. Proactive mitigation also includes creating disaster warning systems, infrastructure to facilitate rapid evacuation, and emergency shelters in advance of need. Proactive measures are necessarily costly because they both consume and sequester resources for an indefinite period of time. This cost is particularly psychologically burdensome because it is impossible to predict with any certainty precisely when a threat will become a crisis or a disaster.

In contrast, reactive measures are much less expensive in the short term. Delivering emergency food, water, shelter, medical care, and post-disaster evacuation have the theoretical advantage of being deployable anywhere, ideally from just a few locations. The appeal of post-disaster response is that the overhead is low and the resources can be used reliably on a regular basis. Unfortunately, what is not factored into this approach is the vastly more expensive loss of property and lives that proactive mitigation would have prevented. The reasons for disasters such as Hurricane Katrina can only be understood by inquiring into the nature of technology and the human minds that wield it.

Timescales

There is an anthropologic perspective on the evolution of technology. One way to look at this progression is in terms of timescales. To begin, the 'trivial timescale' is bounded by day-to-day activities such as bathing, unstructured socializing, and going to work. Humans, and presumably most other vertebrates, all share this timescale. The second timescale is the 'personal timescale', which allows for planning and actions that occur over the time course of roughly two human generations (defined here as 44 years). Such planning includes selecting and mastering a livelihood, procreating and rearing children to adulthood, and setting aside resources to be used in old age and for the benefit of offspring. The personal timescale stretches the evolutionary limits of the average human mind. The vast majority of people are incapable of significant understanding or planning beyond the personal timescale; indeed, there is little evolutionary reason for human minds to function in timescales longer than this.

The third timescale is the 'historical timescale', which extends from the present to the beginning of human history. Very few of us spend any time in this timescale, and the emotional connection to events going back more than two human generations is slight. The fourth and most powerful timescale is the 'cosmic timescale', namely the period of time from the beginning to the end of the universe. Only a microscopic fraction of humanity has ever ventured into this timescale.

Galileo, Newton, and Einstein exemplify the power of thinking in the cosmic timescale. They have given us physics and its daughter sciences. These disciplines have facilitated the enormous and powerful technologies we now wield, from splitting the atom to our emerging mastery over the very fabric of life.

Disaster is largely an artifact in the transition from hunter-gatherer to town and urban dweller. Homo sapiens began their relentless advance across the face of the earth about 100,000 years ago [1]. Originally, hunter-gatherers moved, often cyclically, over comparatively large areas. Agriculture began to emerge about 12,000 years ago [2], the first human settlements 11,000 years ago, and the first cities only 7000 years ago [3]. From an evolutionary standpoint this is a trivial amount of time. The widespread application of the scientific method and development of the mathematics of statistics and probability occurred less than 400 years ago – an evolutionarily insignificant amount of time. Our entry as a species into the historical and cosmic timescales spawned both our reliance on technology and our vulnerability to disaster.

Accordingly, it is likely that disasters will always be part of human life for at least two reasons: human settlement has been undertaken in environments where the hazards are not completely understood; and known hazards are underestimated or ignored. History is replete with examples of both. However, our concern here is primarily with situations in which people abuse reason and technology and take extreme risk at great cost in terms of lives and property. Here, history is perhaps the best teacher, for it is rich in the story of why catastrophes like Katrina occur.

Pompeii

Nearly 2000 years ago, in 79 AD Pompeii was a thriving Roman port city on the Bay of Naples. Pompeii and the surrounding communities of Herculaneum, Stabiae, Oplontis, Sora, Tora, Taurania, Cossa, and Leucopetra were of roughly the same character and economic importance to Rome as are New Orleans, Biloxi, Gulfport, Mobile, Bay St. Louis, and Slidell to the USA.

Pompeii had been continuously inhabited since it was founded in the 6th century BC. In 62 AD an earthquake of large magnitude devastated the city. The damage from the earthquake was so extensive that 14 years later reconstruction was still underway, although most of the residential and business structures had been rebuilt – apparently on a grander scale than before. Early August in the year 79 AD the wells in Pompeii ran dry. As August wore on small earthquakes began to rattle the city. Finally, on the afternoon of 24 August at about 13:00 hours Mount Vesuvius erupted. The eruption of Vesuvius darkened the sky and blanketed the city in ash. Pompeii, much like New Orleans, was largely evacuated, and like in New Orleans only about 10% of the population (2000 souls) remained in the city for the final cataclysm. This is remarkable because this eruption of Vesuvius was the first time in recorded history that a vertical eruption of this magnitude and its accompanying pyroclastic flow were documented (by Pliny the Younger [4]).

By the evening of the 24th two additional eruptive surges had covered the city in 2.5 m of fine ash. This had exactly the same effect on the remaining population as did the flooding of New Orleans; it was as impossible to move through the ash to escape via either land or sea. The residents who remained were trapped. Between 07:00 and 08:00 hours on the morning of the 25th, the fourth and fifth eruptive surges occurred and these were lethal to both the city and its inhabitants [5]. These surges moved at a rate of 200–300 km/hour, tearing off roofs, fragmenting lighter structures, and transiently raising the ambient temperature to over 200°C [6].

Conclusion

So, what is the relevance of Pompeii to our contemporary response to risks and hazards of similar magnitude? Vesuvius last erupted in 1944, at which time there was significant loss of life and property. Since that time the area has been densely repopulated, and the town of San Sebastiano was rebuilt on its former site directly atop the lava flow that destroyed it in 1944! Currently there are 3 million people living in an area of high risk and approximately 600,000 living in the 'zona rosa', virtually in the same geographic area occupied by Pompeii, Herculaneum, and their sister communities [7]. The logistics of the timely evacuation of 3 million people with little or no warning, living at a density greater than that of the inhabitants of Hong Kong, are incomprehensible. At this time, engineering to protect the population at risk should Vesuvius experience another catastrophic eruption does not exist. Because of the impossibility of timely evacuation in the event of a sudden eruption, those who choose to live and work in the shadow of the volcano today are more likely to lose their lives than were the inhabitants of Pompeii nearly 2000 years ago. This is a classic example of people choosing to continue occupying hazardous zones where effective proactive risk mitigation is not technologically possible.

There is hope. Proactive, protective technology exists that can reduce the threat of disaster along the Gulf Coast and presumably other areas to a negligible or acceptable level and is in use around the world. The multibillion dollar Deltawerk seawalls constructed in The Netherlands [8] and the Thames Barrier in London [9] are examples of the kind of engineering that could protect New Orleans and other at-risk US cities from future hurricane storm surges. Radically improved building codes that mandate structural resistance to high winds and flying debris, such as those implemented in Florida after Hurricane Andrew, would greatly reduce the loss of homes and businesses, even in the face of category 4 hurricanes.

Technologic civilization is now both global and integrated. A retrovirus infecting a few individuals in a remote corner of Africa can bloom into a relentless worldwide epidemic [10]. A disaster half a world away can cripple or potentially even destroy our increasingly unified technologic civilization. As a species we must make the jump from the trivial and personal timescales to the historical and cosmic ones, or we shall perish. Eleven thousand years ago we made the incredible jump from hunter-gatherers to agricultural town dwellers. The wisdom of this decision is challenged with each failure in foresight that leads on to disaster. From the moment we began to seek our fortune in the realm of the historical and cosmic timescales, we embarked on the ultimate voyage. To quote Shakespeare once again, 'On such a full sea are we now afloat. And we must take the current when it serves, or lose our ventures.'

What will be our choice – on to fortunes or bound in shallows and miseries?

Competing interests

The author(s) declare that they have no competing interests.

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