Shake and Bake

A commentary on earthquakes and fire

Sacudir e assar

Um comentário sobre terremotos e incêndios

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Abstract This commentary on earthquakes and fire by Stephen J. Pyne focuses in notorious episodes as Lisbon 1755, San Francisco 1906, Tokyo 1923 as urban conflagrations in a scenario of "shake, then bake". Discussing the history of earthquakes, cities and fires, he concludes that "disastrous fires let history overwhelm geography; preventative measures let geography temper history". Pyne has written over 30 books, mostly on the history and management of wildland and rural fire, including big-screen surveys for the U.S., Canada, Australia, Europe (including Russia), and the world generally, and is completing a multi-volume fire history of the U.S. and its regions since 1960.
Keywords fire, earthquakes, urban fires, fire

Resumo Este comentário sobre terremotos e incêndios, por Stephen J. Pyne, privilegia episódios notórios como Lisboa (1755), São Francisco (1906), Toquio (1923) como conflagrações urbanas num cenário de

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"sacudir, então assar". Discutindo a história de terremotos, cidades e incêndios, ele conclui que "incêndios desastrosos levaram a história a sobrepujar a geografia; medidas prevendidas levaram a geografia a temperar a história". Pyne escreveu mais de 30 livros, a maioria sobre a história e manejo dos incêndios em áreas silvestres e rurais, incluindo grandes pesquisas panorâmicas sobre Estados Unidos, Canadá, Austrália, Europa (incluindo Rússia), e do mundo em geral, e está completando uma coleção sobre a história dos incêndios nas diversas regiões dos Estados Unidos de 1960 até os dias de hoje.
Palavras-chave incêndio, terremotos, incêndios urbanos, fogo

World War II marked the rediscovery of fire as a weapon, and its most spectacular usage was applied to cities. Thanks to aircraft it was possible to deliver incendiaries to urban centers. If the sky was dry, the day or night warm, the air unstable; if buildings could be slashed and split open first to expose combustibles; if bombs, rubble, or sheer number of ignitions could hobble or overwhelm firefighting operations, then fires could merge and incinerate whole city blocks. In fact, burning proved more deadly than bombs. A blast could blow a hole, a fire could propagate.

The modern use of the term firestorm was invented to describe the burning of Hamburg, Germany on 27 July 1943. It was reapplied to Dresden in 1945, then to a cavalcade of Japanese cities from Tokyo to Osaka. The horror ended when the atomic bombs brought firestorms to Hiroshima and Nagasaki. The most famous image of a mushroom cloud over Hiroshima was long misidentified as the pillar from the explosion when in fact it was the pyrocumulus from hundreds of merged fires kindled by the bomb. After the war, a Strategic Bombing Survey and the National Fire Protection Association both undertook inquiries into the mechanics of what appeared to be a new specter in urban conflagration.

In fact, the only true novelty was the bombing that preceded the burning. The past is littered with cities incinerated in similar ways but with earthquakes taking the place of military raids. The Tokyo that burned on 10 March 1945 was a city risen from the ashes of a Tokyo

burned in the aftermath of the 1923 earthquake. The slashing and disrupting that blockbuster bombs had wrecked on cities during the war, earthquakes had wrought previously. The fires followed. New technologies had created innovative ways to build cities, and then ignite them, but the big burns themselves were old news.

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The Earth is a fire planet. It has known terrestrial fire since plants first colonized continents; fossil charcoal dates back 420 million years. Likewise, humans are a fire creature. We have had the use of fire - have come to enjoy a species monopoly over it - for all of our existence. Because we could cook food, we got small guts and big heads. Because we learned to cook landscapes, we went to the top of the food chain. Now we have become a geologic force because we have begun to cook the planet.

But fire has limits. Not everything can burn, and not everything that burns can burn all the time. In nature fire appears in patterns, or regimes, underwritten by rhythms of wetting and drying and sparked by lightning. In built landscapes those patterns should, in principle, be under the control of people. We can choose what materials to use, how to arrange them, and what kind of ignition sources might abound among them. Still, we know that the built environment, too, burns. Rooms burn. Houses burn. Towns burn.

It sounds macabre to suggest that built landscapes also know fire regimes, but they do. If they are built out of combustible materials like wood and thatch, if they throng together in ways that allow a flame in one place to spread to other places, if they overflow with kindling flames, and if they can overwhelm the fire controlling forces residents can muster against them, then towns will burn, even very large towns, and they will burn in much the same way and at the same times as the surrounding countryside. Wooden buildings will burn like woods; common winds will drive flames.

There some parts of the world where urban fires are so abundant and counter-measures so feeble that a strategy of resilience argues for

rapid rebuilding after big burns rather than attempts to suppress serious starts before they mutate into conflagrations. But in most developed countries where industrialization has replaced freely combustible building materials like wood and thatch with steel, glass, stone, and brick, where candles and hearths are supplanted by electric lights and stoves, where cityscapes are designed to prevent fire spread, and where a fire-fighting system (typically based on fire engines) exists to catch fires while small, some other factor must operate to allow fires to propagate beyond their point of ignition. The most common means are war and earthquakes, followed by riots. What results is a perverse urban variant of slashing-and-burning.

Both war, particularly aerial warfare, and earthquakes break up blocks of fuels into forms more amenable to flame and break down the ability to contain those flames. Bombs can rupture water mains and cut off telephone lines, craters and rubble can halt the flow of engines and brigades, and the sheer number of fire starts can overwhelm forces or cause them to disperse. Before aerial bombardment, many of the most famous urban fires burned because they were first shaken to pieces.

Shake, then bake. The scenario characterizes three of the most notorious of urban conflagrations. The worst, if measured by how comprehensively it affected its society, was surely Lisbon. On November 1, All Saints Day, 1755 the city managed to attract all the demons of the Apocalypse. Tremors were followed by a tsunami followed by fires which reportedly burned for five days. Perhaps 85% of the city lay in ruins. San Francisco, California shook early in the morning of 18 April 1906. The resulting fires burned through its largely wooden cityscape for three days, following terrain and winds, much as though it were a wildland fire; they destroyed 500 city blocks. Fortunately the Earth's crust ruptured on land, sparing the city a tidal wave. The Great Kanto earthquake of 1 September 1923, considered the worst natural disaster to strike Japan to that time, shook the sea floor some 30 miles from Tokyo. The land buckled and bounced, immense seas washed over the shoreline and plains, and fires ravaged what remained of Tokyo and Yokohama.

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Cities don't need earthquakes to burn. Rome burned without a tremor in 45 AD; and London, in 1666. A colonizing United States had cities burn so often (without preceding tremors) that they were accepted much as great floods or blizzards were, as an act of nature if not a judgment of Providence. Conquered cities were frequently put to the torch as well as to the sword (or in Moscow's case, residents indulged in scorched earth practices by burning their own wooded town). In all these examples, in keeping with their character as a built environment, the blazes were directly or indirectly started by humans. Occasionally lightning would migrate from trees to barns or steeples, and from there to structures, but there are no known city fires started by bolts from the heavens.

Earthquakes lie well outside human causation, which perhaps makes their trauma more frightening. The very Earth, the most sensibly solid feature of the world, shakes and wobbles into a *terra infirma*. It is possible to erect a city on the assumption that, from time to time, the land will swell like an ocean in storm, and Tokyo has, but Lisbon and San Francisco had not understood the hazard until it happened. Fire seized the opportunities presented to it. Interestingly, many commentators at the time chose to focus on the fire, which people could at least pretend to control, than on the quake, which they could not.

Understand that fire is an interactive phenomenon: it synthesizes its surroundings. Its power derives from its capacity to propagate. A shattered cityscape can free many flames from confinement in candles, lamps, and stoves; it exposes combustibles that are otherwise walled off; it may break water mains and cripple the ability of a firefighting apparatus to respond. Within minutes a constellation of tame fires can become an explosion of feral fire.

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Major cities in developed countries don't burn as they previously did before industrialization. With regard to fire, they show remarkable internal stability, in part because they house less open flame, relying on power generated by machines outside the city limits. They rarely burn at all unless some outside force shakes up the built landscape to the point it can carry flame, or more accurately many flames, because saturation ignition helps overwhelm institutions for firefighting. This can happen with earthquakes, but most metropoli don't straddle fault zones. Or it can happen with modern war in which bombs substitute for tremors. Or it can occur amid riots that can kindle many starts and interfere with suppression efforts. (In fact, there are studies suggesting that a riot will last as long as its fires, that the fires become rallying points and social timers.)

There is one curious exception. In recent decades, automobile-powered urban sprawl is flinging houses, fragments of urban landscape, into flammable countryside. All industrial cities in fire-prone settings are feeling the effects - Sydney and Melbourne, Provence and Tras o'montes, Valparaiso and Santiago, Cape Town and Fort McMurray, Los Angeles and San Diego. Industrial combustion encourages development into bush or wildland, while equally prodding the once-rural landscapes into economic decay and revanchist brush. The loss of an actively managed rural countryside is underwriting a new regimen of urban wildfire. It's a peculiar pyric pathology for an industrialization that has otherwise found alternatives to open burning.

Fires that burst into such cities are, in reality, less tsunamis of flame than locust swarms of embers. They can find abundant points of ignition in structures and ignite scores of structures and so overwhelm urban fire services. The core of urban fire protection is a design that makes fires difficult to start and more difficult to spread. The urban-fringe fire overcomes that inertia. Here fires can ignite and spread faster than urban fire departments can respond. They can bake without preliminary shaking.

Earthquakes, cities, fires - all will continue, each with its own logic. From time to time their separate narratives will entangle with potentially catastrophic consequences. When such moments will happen is

impossible to forecast. But it has long been known that for both fire and quake the identification of place matters more than of time. Quake-prone and fire-prone sites can undertake mitigate measures in advance of catastrophe. Disastrous fires let history overwhelm geography; preventative measures let geography temper history.