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Blow-Up

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- *Volcanoes: Crucibles of Change* by Richard Fisher, Grant Heiken and Jeffrey Hulen Princeton, 344 pp, £25.00, July 1997, ISBN 0 691 01213 X

On 21 August 1986, Hadari, a peasant farmer in the highlands of the Cameroon, was woken by a rumbling sound. Startled, he observed vapours pour from the edge of the nearby volcanic Lake Nyos, to form a miasmic cloud which silently spilled over the edge of the lake and sought lower ground, like a heavy morning mist. By the following day seventeen hundred people lay dead in the valley villages of Subum, Cha and Nyos. The corpses of their cattle lay strewn about, surrounded by the motionless bodies of the flies that had plagued them in life. Nothing that needed to breathe survived. What Hadari had witnessed was a volcanic eruption consisting only of the heavy gas carbon dioxide, a gas that smothered the villagers as it flowed down to the low ground. Survivors described a sensation of weakness in the legs, an unendurable lassitude. They felt weighed down, exhausted unto death: a subtle eruption all the more horrible for its stealth.

We usually think of volcanic eruptions as more blatant events: the literally petrified inhabitants of Pompeii seared by hot ashes, at once killed and immortalised, frozen for ever in the act of gasping for breath or pushing away the fearsome incandescence.
But *Volcanoes* makes it clear that this is only one choice from a menu of destruction, on which the Nyos disaster is certainly the most arcane. Some eruptions are almost benign. The fires of Hawaii erupt regularly above hot spots that remain in the same site for millions of years, as the Earth's crust glides above them, creating islands, or plastering new lava onto old flows. The lava extrudes as a liquid rather like boiling toffee, and spills down in a manner which would be described as orderly only by a volcanologist. Smaller flows can sometimes be turned aside to spill harmlessly into the sea. The basalt cools into dark, grotesque shapes like twisted rope or solidified rapids, instant monuments created from the smoothly flowing *pahoehoe* lava. Blocky, jumbled lava is known as *aa*, so providing Scrabble players with the ultimate crowner.

There is a type volcano: it is on the island of Vulcano in the Aeolian Islands, and its intermittent rumblings and eruptions were once interpreted as the sounds of Vulcan's forge. In classical times the festival of Vulcanalia was held on 23 August to appease the unpredictable and temperamental god. His bad temper was seldom mollified. Santorini blew up 3600 years ago, a catastrophe that produced a caldera six kilometres in diameter and split the northern part of the island into three. This eruption may well have fatally weakened Minoan civilisation, thereby diverting the course of European history. The idea for Plato's vanished island of Atlantis could have derived from this destruction, an idea that seems to be more indestructible than pumice, for even today the search for it extracts funds from the gullible.

Construction and destruction often go together. On 20 February 1943, a small fissure opened in a field in Mexico, and a new volcano appeared where there had been none before. During the next nine years, Paricutín produced 700 million cubic metres of lava and a billion cubic

metres of volcanic ash. A fertile valley was blighted, plants and animals sickened and died – those of a religious cast of mind saw it as a visitation on the sinful.

Catastrophe is perversely attractive. As I read the statistics spewed out like *pahoehoe* lava in this book, it occurred to me that we may be drawn to these disturbances as instances of Armageddon. It is, after all, hellfire itself that bubbles up from magma chambers, destroying everything it touches. The most devastating catastrophes are produced by pyroclastic surges (more graphically described by the French term *nuées ardentes*), incandescent clouds of glassy ash which bustle along at astonishing speeds blasting everything in their path – no one can outrun them, and they are even capable of flowing uphill for a short distance. Such an 'ardent cloud' devastated the town of St Pierre in Martinique during the eruption of Mont Pelé on 8 May 1902. Fisher and Co show photographs of an archetypal French provincial street, one of a thousand rues Victor Hugo, obliterated by the disaster. Hiroshima is the nearest we surfacedwellers have yet come to duplicating the destruction wrought by magma. Even so, we have failed to manufacture an equivalent of the ghastly *lahars*: the suffocating mudslides which follow when ashfalls are soaked by rain; like some lethal grey porridge they push through houses – inexorable slurries, unstoppable. They can rise again, and flow downhill to wreak havoc, years after an eruption has otherwise subsided.

There were spectacular sunsets after the atom bomb, just as there were after Krakatoa, west of Java, blew apart in 1883. (A film was made in the Sixties called *Krakatoa, East of Java*, an error which delighted many critics, and may well have provided more entertainment than the film itself.) Darkening of the skies by disseminated volcanic dust was probably responsible for the cold winters in past centuries that regularly allowed traders to set up booths on the frozen Thames. The reach of a major volcanic eruption is global; the Biblical 'darkness covered the Earth, and gross darkness the people' could be describing the dead skies that follow a major eruption, and were a premonition of crop failure and of the fruit withering on the vine. Ice cores in Greenland record the ash from eruptions which happened on the other side of the globe.

Eruptions often have a political dimension. Fisher and Co describe in detail the dillyings and dallyings that preceded the eruption of Mt St Helens in the Cascade Range on 18 May 1980. Roadblocks were set up and moved forward, only to be moved back again; warnings were ignored; Skamamia County officials had difficulty persuading the public of the dangers. When the side of the mountain blew apart, 77 people died. Politicians are uneasy with catastrophe: a lifetime spent feigning control is gainsaid by the invisible movement of molten rock deep within the earth. As I write, the Caribbean island of Montserrat is in mid-eruption. The lava dome is continuing to grow – it may yet heave up into an astonishing explosion as the internal pressure generated by hot magma demands release. The Tar River Estate House, once an elegant colonial building, has been virtually erased by a pyroclastic surge. In July there were volcanic bombs landing on the capital, Plymouth, which has now been abandoned. Yet there has been wrangling about the need to move the population; people have been reluctant to leave their houses and their chickens; messages seem to have been confused.

To the readers of this book the scenario will be familiar. One can imagine the inhabitants of Pompeii worrying about property prices seconds before they and their properties were obliterated. Yet scurrying about in the background of the Montserrat eruption are teams of scientists trying to outguess fickle Vulcan (the suitably-named Professor Sparks leads the team) and providing what they hope is reliable information. They know the signs. Colleagues have died trying to acquire some experience of the symptoms that presage catastrophe: the

ground rising; liquid rock moving below the surface of the Earth, as detected on a seismometer; a sudden change in the chemical composition of the steamy vapours released from fissures. Their assessments are a matter of life and death, and I can imagine the intensity of their daily discussions. Every observation counts, but they may sometimes give contradictory indications. Yet the scientists can only advise – the politicians must issue the orders.

It is an interesting paradox that from the aftermath of destruction springs fertility. Volcanic soils are famous for their fecundity – a recompense perhaps for devastation. In Hawaii the restoration of the soil may take less than a century. Pliny the Elder was an admiral of the Roman fleet who perished during the eruption of Vesuvius in AD79. He remarked of the fertile Campanian plains: 'in spring the fields, having had an interval of rest, produce a rose with a far sweeter scent than the garden rose, so far is the earth never tired of giving birth.' The term 'Plinian' indeed is still applied to a columnar kind of eruptive cloud, but that is a celebration of the Elder's nephew – Pliny the Younger – whose first-hand accounts of the fatal eruption may entitle him to be called the father of volcanology.

Volcanic destruction is also counterbalanced by the transport of mineral richness to the surface. Where volcanic fluids percolate through the Earth's crust they carry with them a cargo of treasure: gold, silver, copper, molybdenum, lead, zinc are all dissolved in the volatile mixtures. The volcano is like a refiner's fire, or the retort of the alchemist, progressively distilling the dull stuff of the crust until it yields concentrated wealth. Volcanoes do naturally what Marie Curie did artificially when she extracted small quantities of radium from tonnes of pitchblende. The booty lies along thin mineral veins around the ancient volcanic centres.

Volcanoes is a compendium of facts and observations, compellingly and concisely explained. It sometimes reads like a Guinness Book of Eruptions, as statistic is laid on statistic: how many billions of tonnes of debris and what manner of explosion and in what order – a catalogue of cinders and sulphur. For every disaster there is an enumeration of the dead. Something about the amazing instability of the volcanic environment demands such numbers of superlatives. In 1779, Captain Cook made landfall on the Pacific island of Iwo Jima – nowadays the beach on which he drew up his dory is 40 metres above sea level. Imagine if South-East England were such a geological rocket: it would not be many centuries before St Paul's Cathedral began growing its own glacier.

Fisher and Co are modest about their own part in the eruptions they describe, yet they must be aficionados of destruction, connoisseurs of catastrophe. What left me perplexed was not to do with volcanoes, but with volcanologists – why do they do it? Volcanoes are certainly the most inhospitable, and quite possibly the most dangerous places on Earth. I have known two volcanologists who died in pursuit of their obsession – that does not happen very often to astronomers or particle physicists. Something compels these volcano-lovers to scale abrasive slopes of pumice, often in appalling heat, while breathing in the unbearably irritating fumes of sulphur dioxide – true brimstone – that emanate from vents and fissures. They are armed with little more than measuring instruments and bags for gathering samples. Two Russian volcanologists described here took measurements while riding a raft of crust on top of a molten flow in full spate. They leapt to safety only when their conveyance began to break up. It may be, as is often said, that Russian scientists tend to the lunatic, but even the most cautious volcanologist can get into trouble. It really is a heroic endeavour. Yet there is little in these pages to indicate what drives the compulsion to study explosive holes in the ground. In the days when Freud was respectable we might have sought a motive in sexual fascination.

There is certainly much priapic imagery in the description of eruptions, with their engorgement of magma chambers, gaseous emissions, and magma domes rising as the pressure builds up. Eruption could be described as the detumescence of the Earth itself. But the sheer power of the processes at work may be a greater attraction.

Richard Fisher's signature appears on many of the illustrations. He must have visited these crucibles of steam and lava. It would have been good to know more about what it is like to be inside a living volcano, to hear the sounds of fumaroles popping, or feel the texture of basaltic or rhyolitic rocks on the barren slopes. It would have been interesting to learn how the colours change at night, whether animals lurk amid the scoria and cinders, whether the investigators have themselves experienced fear – and, if so, whether the reaction to it was rational or irrational. The problem with much popular science writing by scientists is that a passion for explanation often leaves out the explanation of the passion. Scientists are trained to write in the passive voice: any expression of emotion is excised by the editors of the scientific journals – and inhibition becomes a habit that is hard to break. Indeed, the supremacy of the fact is unchallenged. What that means in a book of this kind is that the most vivid descriptions of eruptions are those of bystanders, or sea captains like Pliny senior, or, occasionally, writers who also happen to be observers. Of course, the statistics of eruption are so amazing that merely to list them is dramatic. But the facts would have come into focus if we had had a description of what it is like to camp with volcanologists, and what they gossiped about in the dim glow of a distant pond of lava. What is it like to bathe in a hot spring? And is the quest for an understanding of deep tectonism as altruistic as it is presented here, or are there races to be first to a new discovery in volcanology – even at the cost of being foolhardy – as there are in so many other branches of science?

If the authors were asked to describe their own reasons for studying volcanoes they would say that what they most wanted to do was to make predictions of volcanic activity more accurate. And it's true that Vulcan's ill-tempered sallies can now very often be dodged. The textbook example is the eruption of Mt Pinatubo in the Philippines in 1991. Task forces of seismologists and vulcanologists monitored everything that could be monitored, detected the tell-tale swelling of the ground, the increasing frequency of shocks. They studied the flows from previous eruptions to identify vulnerable areas: lava flows, like serial killers, often use the same modus operandi. The task forces liaised with the authorities, and the authorities actually took their advice. It all worked rather well, and human casualties were avoided. This happened thanks to the labours of dozens of data-gatherers like the authors of this book. I would be surprised if they got the nod they deserved after the event. We can only hope that the same measured response will save all the people of Montserrat.