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At the Edge of the Crater
The Incredible Fascination of Volcanoes

Translated by Allison Brown

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Golden Traces in front of the Milky Way:

On the Fascination of Volcanoes

The climb was more arduous than we had imagined. We had already spent two days hiking with our heavy backpacks through the tropical rainforest on the Indonesian island of Java. The incline was gradual but constant. In the early afternoon we finally reached the point where the lush green of the rainforest came to an abrupt end. Ahead of us was a steep cone of black and brown volcanic ash. It was so high that from the bottom we couldn't see the peak. "That's the way up," said Professor Kirbani, pointing to one of the many grooves in the furrowed slope. Sitting down on an uprooted tree trunk, he added that the crater was about 1,500 feet above us. The rest of us took a break as well and then we started the ascent. The ash was wet and slippery. At first we all laughed at the fact that we would take two or three steps uphill and then keep sliding back down. The deep tread on the soles of our heavy hiking boots just couldn't get a grip on the steep slope. As a result we slowly but surely started feeling frustrated and exhausted. We couldn't bear even to look at our porters, carrying all the gear for our expedition. In worn-out old rubber boots or even sandals they were moving up the ash cone at almost twice our pace, despite the load they were carrying.

After almost three hours of tedious climbing, the slope gradually flattened out, and shortly before sunset we finally reached the summit plateau. Here there were no stones or solid rock, and in a predominantly Muslim country there was of course no cross marking the top. The summit was nothing but fine, granular ash in all shades from dark brown to gray to the deepest black. Looking back, we could see the green of the rainforest below us. And on ahead the blue of the Indian Ocean was shining in the distance. Directly in front of us there was a huge gaping hole that opened up toward the ocean, that is, to the south. Vapors were rising from the base of the hole. Now and then a muffled bang could be heard and a small cloud of smoke would rise up. We had finally reached our goal, and were standing at the edge of the crater.

We were a group of six volcano researchers from Germany, Indonesia, and the United States, accompanied by about twenty local porters. The edge of the crater on which we were standing belonged to Mount Semeru, one of the most active volcanoes in the Indonesian-Malay Archipelago. In our backpacks were sleeping bags, clothing, and tents. The porters carried the seismometers, cables, batteries, laptops, food, and drinking water that we would need to the top of the 12,060-foot high volcano. We wanted to spend a few days up on the

summit plateau and along the rim of the crater, feeling the pulse of the volcano. We brought seismometers since these instruments for measuring seismic motion are as important for volcanologists as a stethoscope or an EKG machine is for a doctor. Just as a physician can determine if a patient is sick or healthy by analyzing the frequency, strength, and rhythm of the heartbeat, volcanologists can find out a lot about the state and condition of a volcano by examining volcanic earthquakes. Professor Kirbani, a geophysicist from the University of Yogyakarta in central Java, had suggested that we conduct our measurements on Mount Semeru. He said it is almost always active and far less dangerous than many other volcanoes in Indonesia.



p. 11: In the early morning light: Mount Bromo (foreground) and Semeru (with an eruption cloud in the background), two volcanoes on the Indonesian island of Java.

Lava destroys the rice cultivation

The tropical islands of Indonesia are truly a paradise for volcano researchers. There are more than 13,000 islands in the country—stretching out between Sumatra in the west and the island of New Guinea in the east—and 76 volcanoes that have been active in the period of recorded history. Eighty percent of them, or sixty, have erupted in the last hundred years. Some of the world's worst volcano disasters occurred in Indonesia, such as the powerful eruption of Krakatoa in 1883 and the devastating eruption of Tambora (see chapter 7) in 1815, which altered the global climate. Also the island of Bali, which is very popular among tourists, experienced a catastrophic eruption in 1963, in which almost 2,000 people died. At that time the Gunung Agung volcano spewed out hot lava that flowed over the fertile rice terraces.

Before climbing Mount Semeru with the scientists, I had already seen a number of Indonesia's volcanoes close up. I had spent the night on Krakatoa, climbed Merapi (which is above Yogyakarta) several times, and had swum in the crater lake of Kelut, in water warmed by hot springs. On Bali I had admired both Gunung Agung and Batur, and on the neighboring island of Lombok I had climbed Mount Rinjani. On the Dieng volcanic plateau I had bathed in springs with high carbon dioxide content. But nowhere else in Indonesia did I hike through a landscape as unique as what I found in the environs of Semeru.

We had set out from the large city of Surabaya and first drove to the town of Malang. From there we took a number of smaller streets, dirt roads, and jeep tracks to a guesthouse at the Tengger Caldera, a huge hole in the landscape. The crater is almost triangular in shape and several miles across. It is more than 300 feet deep with rather steep walls. The flat floor of this depression is completely filled with light ash. Indonesians call it *Lautan Pasir*, sea of sand. There are several cinder cones that rise out of its midst, including the very active, sulfur-spewing Mount Bromo.

This landscape is the home of the Tengger people, a small Hindu minority in the largely Muslim country. The people here are stoic in their dealings with the small volcanic eruptions in their neighborhood. I have seen them calmly continuing to work in their fields while Bromo was hissing in the background. Some walked their bikes through the sand sea while the volcano was erupting. Other Tengger would simply open up an umbrella to keep the volcanic ash from falling on their heads.

From the edge of the huge crater we had a stupendous view of Semeru, which was much higher, rising up in the background. About every half hour a new cloud of smoke

collected above its peak. That meant there had been another eruption inside the crater, during which the volcano spewed out gas and vapors. There, said Kirbani, who had studied in Germany and like many Indonesians went by only one name, were the most “beautiful” volcanic earthquakes.

The pulse of a volcano

Earthquakes are in fact not only the pulse of a volcano, they also hold many of the fire mountains’ secrets. Some types of quakes reveal information about what is happening in the volcanic vent and the underlying magma chamber. The gases that are released and the flowing magma generate sounds that cannot be heard by human ears, but they can be registered with seismometers. The sounds are formed through complex processes within the volcano; scientists compare them to the air stream in an organ pipe, the bang and whoosh when a bottle of champagne is opened, or a so-called water hammer, the banging you hear if air is caught in a water pipe. Wolfgang Brüstle, the German organizer of our expedition, said that perhaps we would actually come across these audible earthquakes on Semeru.

So we hired some Tengger porters and set off for the Mahameru, which is what the locals call Semeru. We had several days of hiking ahead of us, through volcanic ash and then again through the rainforest.

There is something mysterious about volcanoes. They can erupt at any time, but despite all the research that has been done we do not really know what is going on inside them. They are puzzling since we have only rudimentary knowledge of their inner mechanisms. This unknown aspect is certainly one reason why so-called fire mountains exert an incredible attractive force on many people, including a lot of scientists.

The volcanologists at Indonesia’s volcanological survey told us that right now the number of earthquakes is rather low. They said that they didn’t reckon with a serious eruption. On the other hand, every volcanologist knows that something unexpected can always happen (see next chapter). Despite all the monitoring and observation, even today active volcanoes remain unpredictable. Whenever you climb onto a volcano you are taking a certain risk. For many adventurers, this inherent danger is definitely also what makes climbing onto an active volcano enticing and exciting. It can give people butterflies in their stomachs much like bungee jumping from a great height.

There is also a third phenomenon that magically draws people to volcanoes. There is something mystical about them, something intangible, which we cannot fathom in our everyday lives. A bubbling sea of lava—that might be how we imagine the subterranean hellfire. A flow of glowing lava, when the innards of the earth come up to the surface, since the molten rock comes out directly from depths of three to six miles. A volcano also represents the elemental force of nature. No other force on earth is as powerful as that of a volcano. In a serious eruption it can blast away its entire peak. In only a few minutes it can pulverize millions of tons of rock into ash and hot gas and shoot it twelve or more miles high into the atmosphere. Out of respect for the dead at Hiroshima and Nagasaki one doesn't really want to say this, but the explosion of an atom bomb is just a small bang compared to the eruption of one of the large volcanoes on earth. Such an eruption involves so much energy that it goes beyond the imagination even of physicists. If it could be converted into a form that could be used by human beings, a serious volcanic eruption would be capable of supplying enough heating and electricity for all residences and factories in the world, plus enough to run all the vehicles on earth—for several years!

Smoking volcanoes threaten megacities

The overwhelming power that is contained in a volcanic eruption, however, cannot be channeled, much less tamed. Instead, it is brute force. But this is precisely why we need to understand what is going on in a volcano. The mysterious appeal, the risk, and the romantic, mystical magnetism are just one side of volcanoes. On the slopes of many volcanoes and in their direct proximity, large metropolises and megacities have meanwhile developed, whose populations are directly endangered by eruptions. When the smog is not so bad it is possible to see the smoking Popocatepetl from Mexico City, and 18 million people live in the immediate environs. Manila, Quito, Seattle, and many other cities with populations in the millions are in the direct path of active volcanoes. Scientists have to calculate the risk and monitor the activity state, in order to warn the population in time and thus save lives.

As we set up our tents on the summit plateau of Semeru, we were not thinking of either risk or danger. After the long hike we were all dog-tired and we pretty much crawled right into our sleeping bags. It was not long before I fell into a deep sleep. I don't remember how long I slept but at some point I was awakened by noises. Something was pelting down onto the wall

of the tent. At first I thought it was raining. Then I remembered that we specifically timed the expedition to coincide with the dry season. It was not rain—and suddenly I realized what was pattering on my rain fly. It could only be volcanic ash. I had barely finished that thought when an adrenaline rush raced through my limbs. If it was raining volcanic ash, then Semeru must have erupted—and we were still sleeping cool as anything at the edge of the crater? In no time I had crawled out of my sleeping bag and tore open the zipper of my tent. What I saw just about took my breath away: millions of glowing pieces of ash were shooting out of the Semeru crater high above its edge. Like tracer ammunition they left a red-gold trace in front of the panorama of the heavens of the Milky Way. Below me the mighty, glowing force of the earth's interior was hissing and above me were the infinite expanses of the galaxies.

I would have liked to spend hours watching the glowing particles of ash that night, if Semeru had not calmed down and gone to sleep shortly after I had awakened. So I too crawled back into my sleeping back. Not until the light of the rising sun the next morning did I notice that the hot particles of ash had burned dozens of holes into the walls of my tent.



p. 14: The glowing pieces of ash look like tracer ammunition when they shoot out of a crater in the middle of the night, like here at Yasur on the Pacific island of Vanuatu.