

were incompletely resolved rings and, with his discovery of Saturn's Titan, added another moon to the cosmos. The number of known satellites grew to eight in the late seventeenth century with the observations of Giovanni Domenico Cassini, another professor of mathematics and seasoned courtier. Together with the six planets then known, Cassini said, the eight satellites made a total of 14 — honouring his royal patron, the Sun King, Louis XIV of France.

By associating planets and moons with flattery of his patron, Cassini continued a game begun by Galileo, who named the four companions of Jupiter the Medici stars. Galileo's discovery and identification of these satellites, and his deduction of accurate values for their periods, were great technical achievements. He recognized that a table of the satellites' eclipses could support a method for finding longitude at sea. He offered to sell the method to the King of Spain and the Estates of Holland, but the technique proved impractical and the terms too dear.

Although technical difficulties undercut the exploitation of the Medici stars for navigation, their application to cosmology was easy. Of all the discoveries that Galileo announced 400 years ago, they provided the strongest argument yet against the geocentric world view. The Jovian system obviously was not centred on the Earth, and Jupiter's ability to retain its satellites during its orbit showed that Earth might move without losing its Moon.

Sidereus nuncius can mean either celestial message or celestial messenger. Galileo intended it to mean 'message' when he applied to the Venetian censors in 1610 for permission to publish his book. Most translators, however, follow Kepler in rendering the meaning of *nuncius* as 'messenger'. In this they have captured the way in which Galileo came to regard himself. His quixotic self-identification as a messenger from heaven or agent of the stars gave him the psychological strength to make *Sidereus nuncius* more than a report of marvels. Whereas Columbus added a new hemisphere to an existing one, Galileo announced his celestial message to his contemporaries as a demand for the replacement of the cosy Christian cosmos by an uncomfortable new world. ■

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EARTH SCIENCE

Fire from the depths

Powerful volcanoes remind us of the fragile boundary between Earth's crust and mantle, finds **Laura Spinney**.

The eruption of the Icelandic volcano Eyjafjallajökull this April, and the month-long havoc it caused in the skies over Europe, was a salutary lesson in how susceptible our global, interconnected society is to natural perturbations. This saga and other spectacular eruptions are explored in the exhibition *Supervolcano* at the Natural History Museum in Geneva, Switzerland.

The highlight is the display of photographs by Geneva's volcanology society. These self-confessed volcano addicts travel the world to record the beauty and devastating impacts of the latest eruptions. The images attest to the many ways that volcanoes can kill you — through flying debris, burns, asphyxiation or being struck by the lightning generated within the columns of charged particles they eject.

Interactive installations convey the volcanic experience. Visitors can feel seismic tremors, listen to a mud volcano and walk through a reconstructed lava tunnel. The destructive power of volcanic ash is revealed in a mock-up of a crushed office: it is the weight of settled ash that causes buildings to cave in.

Other displays explore the wider societal risks of massive eruptions and their historical influence. Eyjafjallajökull was a relatively modest geological event, but volcanologists fear that it might trigger a far more dangerous neighbouring volcano, Katla, now under high surveillance. If Katla blows, the fallout could put April's upset in the shade.

The 1783–84 eruption of Laki, another Icelandic volcano, might have contributed to the French Revolution a few years later.

Laki's toxic cloud polluted the atmosphere, lowered temperatures and caused famines across the Northern Hemisphere.

Even more destructive are supervolcanoes — eruptions with the maximum score of eight on the Volcanic Explosivity Index, measured according to the volume of material ejected, among other factors. Eyjafjallajökull qualified as a four. The eighteenth-century Laki eruption and the

Supervolcano
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1991 eruption of Mount Pinatubo in the Philippines — which spewed out 10 cubic kilometres of debris — both scored a six.

No known supervolcanoes are currently active, although the imploded remains of one lie in Yellowstone National Park in Wyoming. From the size of its caldera, researchers think that it dumped ash across much of the continent about 640,000 years ago. Toba in Sumatra was one of the last supervolcanoes to erupt, 75,000 years ago. Forty kilometres away is Mount Sinabung, which erupted last month after a long period of inactivity. It too is being monitored closely.

This timely exhibition reminds us of our vulnerability to volcanoes; we inhabit Earth's cool, thin crust, but more than 99% of the planet smoulders at temperatures above 1,000°C. ■

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Eyjafjallajökull's billowing ash triggered lightning when particles were charged by friction.

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