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法国物理学家对沙漠声音展开研究

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It could almost be the chanting of Tibetan monks, a song beyond time, yet the setting is rigorous and clinical -- the laboratory of French physicist Stephane Douady, where a robot arm is pushing small, precisely measured amounts of sand down a plexiglass ring.

Douady is a leading expert in a very narrow field. He is investigating one of the most romantic yet maddening phenomena in the natural world: the "song of the dunes."

Travellers in the desert have long known that shifting sand can make an eerie noise, ranging from a bass boom to a baritone bark and a soprano whistle.

Writings in the Middle East from more than 1,500 years ago discuss this spine-tingling effect, as did Chinese authors from 1,200 years ago.

The sounds are "the song of the sands, the song of sirens who lure travellers to a waterless doom, the tolling of underground bells in sand-engulfed monasteries," said British scientist Ralph Bagnold in a 1941 book.

In Douady's lab at the Paris-VII University, a few cubic centimetres (cubic inches) of sand make a pleasant, low-frequency background noise. But in the real desert, the sound can reach 100 decibels, just 10 dB short of the pain threshold. Marco Polo compared the sound to the ominous pounding of war drums.

"Only a few dozen dunes in the world can sing," says Douady. The most vocal are those in China and in North and South America.

The noise occurs when the ridge of a sand dune builds up and eventually topples. This shear effect causes a mini-avalanche of sand in which millions of grains rub against each other as they fall.

But different materials and different conditions make different songs, says Douady.
Lab experiments show that synchronicity plays a vital role. Put simply, enough grains have to be flowing at the same rate in order to create and amplify the oscillation.

In turn, the factors behind synchronicity are wind speed, humidity -- most "singing dunes" are in warm, dry climates -- the size of the sand grain and the smoothness of its coating, too: a varnish-like deposit of clay and calcite.

The frequency range is remarkably high, from as low as 64 Hertz to as high as 2,500 Hz.

Research into dunes also has practical outlets. Douady's lab also replicates the desert on a 1/1,000 scale, creating dunes made from tiny ceramic balls and using water instead of wind, to see how the sand advances.

"In a day, you get an idea of how dunes can move over years, centuries even," says Douady.

Douady, whose research appears in a forthcoming issue of the journal Physical Review Letters, is far from being the white-coated lab nerd of cartoon stereotypes.

He is passionate about the desert, about poetry (the opening page of his website has a quote from the English romantic poet William Wordsworth) and is exploring ways in which the "song of the dunes" could be incorporated in art and music.

To most people it is just sand, and to many other scientists, it is just silica. For Douardy, it is a substance that is fluid, capable of order and disorder at the same time, and becoming more complex as the aeons pass.

"We are trying to understand chaos, and we are finding systems which gain in complexity with the passage of time."

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