

# Wagnerian Sands of the Desert

Variouslly described as singing, roaring, or booming, sand dunes around the world have been known to give operatic performances worthy of bringing the house down.

BY SHARON ELAINE THOMPSON

*Sand moves by saltation, a process likened by one scientist to a crowd of frogs all hopping in the same direction. The action gradually wears the surface of the sand grains smooth, a condition which may contribute to the booming. Death Valley, California.*

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**T**he sun was sinking in the west African afternoon when we plunged into a wild Land Rover ride across the dunes. Within moments we lost all sense of direction, regaining it only momentarily when we caught a glimpse of the sea, as we sped along the notorious Skeleton Coast of Namibia. When we finally stopped, it was at the top of a crescent-shaped behemoth. On the inside of the curve, the dune was a good 200 feet high and as close to vertical as a sand dune gets.

We gathered timidly at the edge of the precipice. But our guide, seemingly bent on suicide, sat down at the crest and started to slide down the dune face, the seat of his pants sending a small cascade of sand slithering to the bottom. Instantly the entire dune began to pulsate, groaning and grumbling, as if armies of Frank Herbert's sandworms from *Dune* were chewing their way to the surface. In a moment, all of us were laughing and scooting down the dune, the unearthly roar echoing in the natural amphitheater.

## Dune Diversity

Roaring, singing or booming dunes are not unique to the Namib Desert, although there is a large field of them there. They are found in many areas around the world: southern and northern Africa, Arabia, the Middle East, China, South America, Baja California, Hawaii, Nevada, and California. The sounds they make have been variously described as the sound of thunder, cannon, low-flying aircraft, wind in telegraph wires, drums, carts, cavalry, tambourines, foghorns, pipe organs, and zithers. Although the sound may be indescribable, it is nevertheless unforgettable.

## GEOLOGY

Over the years there have been a variety of explanations for the sounds. In Hawaii, where the dead were often buried in the sand dunes, the sounds in the sand were said to be the voices of the spirits. At Jebel Nakus on the Gulf of Suez in the Sinai Desert, it was believed the dunes were reverberating with the sounds of a *nakus*, or wooden gong, being struck in a temple buried beneath the sand.

In the Chinese province of Kansu, in caves near the town of Tun Huang, ancient documents were found dating to the seventh century Tang dynasty. These contained reports of a 500-foot-high sand hill that "at certain times gave forth strange noises." The sound was likened to that of rumbling carts or drums, and gave a nearby temple the name "Thunder Sound Temple." During festivals people would run up and down the hill, setting the sand to cascading and rumbling. No doubt, though, at other times the thundering coincided with earth tremors: Kansu is the center of China's earthquake activity.

As he passed through the Sinkiang- Kansu Desert west of Tun Huang on his way to China, Marco Polo heard strange tales that may have been triggered by the presence of the roaring dunes. In his "Travels" he reports stories of spirits who live in the desert and take malicious pleasure in calling to people, who, thus distracted, fall behind the caravans and are led out into the desert. Once lost these unfortunates "are persuaded they hear the march of a large cavalcade." Convinced their party is only over the next rise, they walk farther

and farther into the sands. "Almost passing belief" says Polo, "are the stories related of these spirits of the desert, which are said at times to fill the air with the sounds of all kinds of musical instruments, and also of drums and the clash of arms; obliging the travelers to close their line of march and to proceed in more compact order."

Closer to home, in both space and time, is Sand Mountain, 25 miles outside of Fallon, Nevada. The dune is 400 to 600 feet high, two to four miles long, and over a mile wide, depending on how the wind has been blowing. One Paiute story tells of a group of Indians camped near the base of the dune who fell asleep to the gentle hum of the sand hill.

According to an 1883 report on Sand Mountain, however, the sound was less like a lullaby and more like a Wagnerian opera belted out in an acoustically perfect hall. The article stated that lizards disturbing the face of the dune produced sounds so loud they were "heard at a distance of six to seven miles, and it is deafening to a person standing within a short distance of the sliding sand." Even today, with the sound drowned out by the buzz of dune buggies, observers say the rumbling can be heard on US Highway 50 about two miles away.

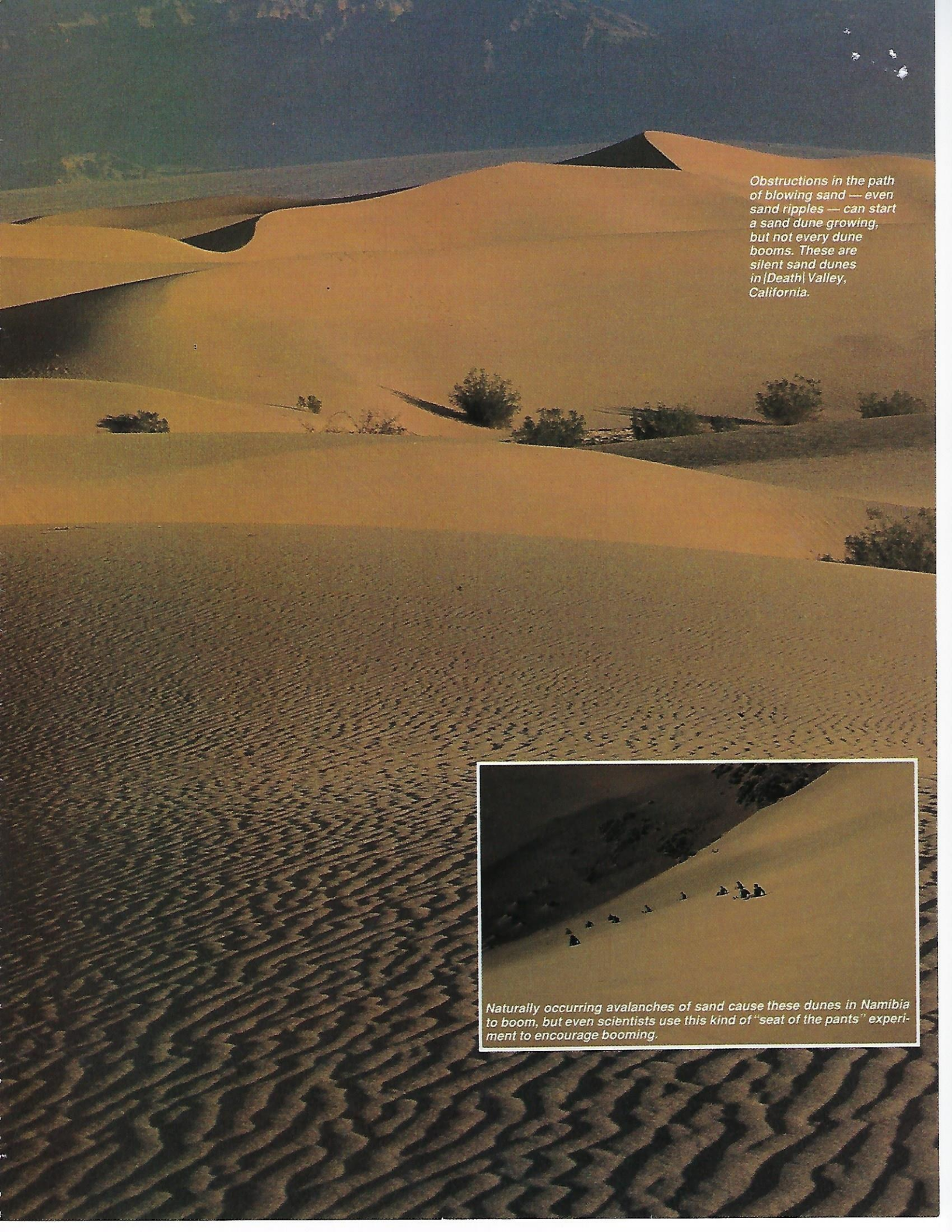
Scientists have taped and analyzed the sounds of booming dunes and found that, although the roaring starts at one frequency, within a few seconds another, lower frequency rumble begins, amplifying the lower parts of the first wavelengths of sound. In addition, ground vibrations of a similar frequency intensify the sound waves. The sound lasts, gradually diminishing, until the last of the sliding sand has settled.

Singing dunes are usually found in deserts, so Death Valley would seem to be a perfect place for them. Yet only one dune group in the area, the Eureka Sand Dunes National Natural Landmark north of the Monument, is known to roar. Geologist Dennis Trexler, with the Division of Earth Sciences at the University of Nevada, was one of the first to describe booming there. He believes the dune complex may be the highest in California at 680 feet. It is 3.3 miles long and 1.5 miles wide.

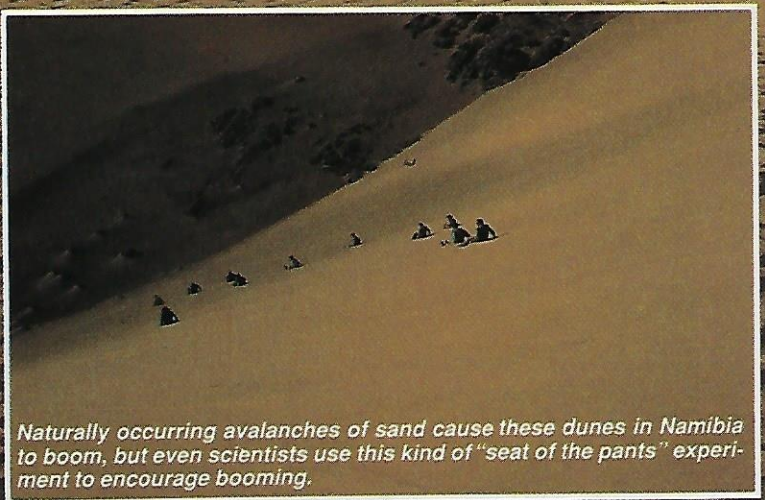
Of the 30-odd known booming dune locations, all but one are composed primarily of quartz sand and are in arid deserts. The



As the Land Rover's wheels go over the crest of the dune, small avalanches set the hill of sand moaning, fortunately masking the author's own moan of terror. Skeleton Coast, Namibia.



Obstructions in the path of blowing sand — even sand ripples — can start a sand dune growing, but not every dune booms. These are silent sand dunes in Death Valley, California.



Naturally occurring avalanches of sand cause these dunes in Namibia to boom, but even scientists use this kind of “seat of the pants” experiment to encourage booming.

## GEOLOGY

exception is Barking Sands near Mana on the Hawaiian island of Kauai. There the dunes are made up of calcium carbonate, presumably from the shells and coral that are washed onto shore. The Hawaiian sands are also unique because they reportedly bark as well as roar. They make the same rumbling sound heard in deserts, but emit a "hoot-like sound" when clapped between the hands.

### Elusive Source

Because most of the singing dunes are composed of quartz, quartz's piezoelectric properties were first suspected to cause the phenomenon. But then there are Hawaii's calcium carbonate sand dunes to consider. Scientists now believe the roaring may be due to a mechanical process called shearing. Yet despite more than a hundred years of investigation, the precise booming mechanism remains a mystery.

Under magnification, booming and silent sounds are virtually identical. But with a scanning electron microscope scientists have seen that the surfaces of booming sand grains are significantly smoother than silent sands, the surfaces of which resemble the pock-marked surface of the moon.

The smoothness of the grains shows that they have blown over great distances or, in the case of the Hawaiian sands, have been in the dune a long time. In fact, most booming desert dunes are at the downwind end of large dune fields or have been carried a long way from the most available source of sand. This is the case with the Kelso Dunes in California, Sand Mountain in Nevada, and the Tun Huang dunes in China.

The wind moves sand in a process called *saltation*. The grains are picked up and hurled against other particles, making them bounce. The higher the wind velocity, the higher the bounce. During a sandstorm, says one geologist, although it looks like the wind is carrying the sand, it's actually more "like a crowd of frogs all hopping in the same direction." Each time they bounce, the grains

become rubbed smoother. When they finally pile up at the end of a long dune field, they are rubbed smooth, and a booming dune may be born.

But smoothness is not all the story. Peter Haff at the California Institute of Technology has put roaring sands in a bottle in the lab and produced a thrumming sound. Yet glass beads, with a much smoother surface, didn't even growl, much less roar.

Sand grain size may also be a factor in the production of a roar. Booming dunes usually produce the best sounds near the crest, where the well-rounded sand grains are all of a fairly consistent size, heavier grains having slipped to the base of the dune, and light ones having been blown away. Sands of mixed grain sizes are mute.

However, Haff has found that the uniformity of size alone doesn't create booming either. He examined two groups of sand, one roaring, one silent. He removed a precise number of grains of a certain size from the silent sand and replaced them with an equal number of booming sand grains of the same size. The silent sand remained silent. Worse, when the grains were transferred back to the booming sand, there was a decrease in the sound production. Something in the silent sand appeared to have "contaminated" the booming sand.

One thing that makes a difference in a dune's "boomability" is its dryness. Dennis Trexler reports that as little as 0.1 percent moisture in Sand Mountain makes a difference in the sound produced, and even little more than one percent is enough to muzzle the mountain. The exceptions, of course, are the dunes in Hawaii where humidity is generally high. Even there, though, the dryer the dune, the bigger the boom.

Once captured roaring sand has lost its boom, the phenomenon may be restored by heating. Haff baked the moisture out of some booming sand in a frying pan. He stirred it as it cooled, producing "an astounding symphony of groans, yips, yaps, wheezes, and oomphs."

David Criswell and John Lindsay hypothesize that the smoothness of

the grain surface may result in the sand drying quickly and completely, thus contributing to the booming. They also speculate that, although relatively rare on Earth, booming dunes may be common in the ultra-dry atmosphere of Mars, where ferocious winds whip sand into massive dunes.

### Serious Sandbox

Despite the tone of serious science, one suspects these "dune boomers" are having more than a little bit of fun while investigating these great natural sandboxes. One scientist had his assistants slide down the dunes on their backsides so he could analyze the sounds. Haff found the best way to stimulate a dune was to "climb up to the top of a nearby slip face and forcefully dislodge sand with a boot . . . the boot test often gives spectacular and memorable results."

The 19th century dune investigator H. Carrington Bolton discovered the best way to make Hawaii's sand bark was to load samples into two bags and bang them together. "A bag full of sand will preserve its power for some time," he wrote, "especially if not too frequently manipulated." The only way he could have discovered that, one would think, would be to manipulate the bags frequently — presumably while barefoot on the beach.

To collect and carry his sand specimens, Haff used the scientific equipment known to five-year-olds everywhere: one-gallon plastic milk jugs. "When booming sand is introduced into a milk jug and sloshed back and forth," he writes, "a definite rhythm, like fingers on a washboard, is detectable in the vessel wall, and a pleasing thrum issues from the bottle." Such a rhythm could quickly tempt even a scientist to convert his milk bottles into booming maracas.

So if you are ever hiking in the desert and hear a distant rumbling, humming, groaning sound, relax. It is not a UFO, a sandworm, or angry desert spirits. It is just a sand dune singing you a dusty ditty that is truly as old as the hills. ♦



*Slipping sand caused by the advance of the Land Rovers caused this dune to roar as we left the field of dunes on Namibia's Skeleton Coast.*