the Vaupel study range as broadly as one might expect in such a divided field. "I think there is going to be tremendous pay dirt there," says gerontologist Caleb Finch of the University of Southern California. Finch, who is the author of *Longevity, Senescence, and the Genome*, a book that deals with aging and senescence in a wide range of species, is particularly intrigued by Carey's medfly results. The steady increase of mortality with age has been shown for humans and suspected for other species, says Finch, but "Jim Carey's data look convincing that under some circumstances medflies don't show this." As to what the final word will be on biological limits to life, Finch declares it "a wait-and-see situation."

Olshansky is a bit skeptical, not of Vaupel's results but of their practical importance. "Vaupel, I believe, has incontrovertible evidence to indicate that if there is a 'death gene,' it certainly [doesn't exert its effects] before the age of 110 in humans." But, he says, while that may have disproved Fries' extreme position, it doesn't mean life expectancy will soar into the hundreds, as long as there are multiple, theoretically but not practically preventable diseases that are likely to kill people sooner.

Fries would not comment in detail until he sees the Vaupel data for himself next week. He says, however, that any findings Vaupel might have would not alter his conclusions, unless they were to change the slope of his intersecting life expectancy lines and shift the crossing point to a higher age. "If he had a curve that extrapolated to age 100, that would be counter evidence," he says, "but he doesn't; I know he doesn't. We have done it for the United States and Japan, and I know that the life expectancy data for age 85 aren't any better in Sweden." Fries adds that if Vaupel is seeing a decrease in mortality for 85-year-old Swedes, it must be due to reduction in preventable deaths. "There are still preventable deaths at age 85," he says.

"If Fries is willing to admit that there is substantial premature death above age 85, that is something," Vaupel says. "That would mean we should be able to improve life expectancy." If this pre-symposium exchange is any indication, then the upcoming encounter may simply confirm what many in the field suspect: The debate over limits to lifespan is far from over. ■ MARCIA BARINAGA

ADDITIONAL READING:

J.F. Fries, "Aging, Natural Death and the Compression of Morbidity," *New England Journal of Medicine* 303, 130 (1980).

G.C. Myers and K.G. Manton, "Compression of Mortality: Myth or Reality?" *The Gerontologist* 24, 346 (1984).

J.F. Fries, "The Compression of Morbidity: Near or Far?" *The Milbank Quarterly* 67, 208 (1989).

S.J. Olshansky, B.A. Carnes, and C. Cassel, "In Search of Methuselah: Estimating the Upper Limits to Human Longevity," *Science* 250, 634 (1990).

The Sound of One Dune Booming

Space scientist David R. Criswell of the University of Houston still can't explain what he observed in the mid-1970s at an isolated sand dune, called Sand Mountain, about 20 miles east of Fallon, Nevada. The dune is no ordinary pile of sand, Criswell will tell you. When he and his co-workers dug into it with their hands or shovels, or even when they simply walked on it, they got "a sound like a strumming on a bass violin," he says. When they sat on its 300-foot crest and together pushed off a ripple of sand, the sound swelled to "a very loud and continuous booming" like a turbo-prop plane passing overhead at low altitude, complete with rumbles in their boots. "You had the sense that this shouldn't be happening," Criswell recalls. Now Sand Mountain's strange voices are wrinkling a few more brows.

"You had the sense that this shouldn't be happening."

—David Criswell

Last week, Criswell presented the first full report on his 15-year-old observations of Sand Mountain at a meeting of the Acoustical Society of America in Houston. His hope: that someone in his audience will be able to shed more light on the little-known phenomenon of booming dunes. Says Robert D. Finch, a University of Houston mechanical engineer who invited Criswell to speak: "Most people at the meeting had not heard of this [phenomenon] before."

If Criswell or his audience at the Acoustical Society meeting can understand Sand Mountain, they may have solved an acoustic mystery that is apparently common to many dry parts of the world. Reports of booming dunes, barking dunes, and otherwise vocally notable sand formations appear in folklore and literature as long ago as 1500 years. In Tunyang, China, for example, the Hill of the Singing Sound makes rumbles like "distant carts, drums, or thunder," according to published travelers' tales. Other "singing" dunes populate the Mideast, South Africa, Chile, California, and Hawaii.

Finch's interest in the phenomenon goes even further afield. He scheduled Criswell's talk for a session on the use of acoustics in space exploration—an odd context, you might think, for a booming dune. In fact, it was space exploration that first prompted Criswell, then at the Lunar Science Institute in Houston, to trek out to Sand Mountain. During the 1972 Apollo 17 lunar landing mission, a geophone placed in lunar soil by astronauts picked up mysterious vibrations, or "moonquakes," after every lunar sunrise. At the time Criswell learned of the moonquakes, he was pursuing an interest in how winds produce patterns in sand. In his reading, he happened onto an account of Sand Mountain's freakish acoustic behavior, which was known to Native Americans and Pony Express riders. Criswell thought that it might hold some clues to understanding the moonquakes.

To get to the bottom of the dune's behavior, Criswell's team used microphones for recording the low-frequency sounds and geophones to measure ground vibrations accompanying the louder ones. They also harvested sand samples, which yielded the strongest clues to the mechanism.

"Compared to normal beach sand," Criswell says, "the grains of the booming sand are very smooth on the micron level." He suspects this feature may be at the heart of the mechanism that transforms the tumbling motion of the grains into "very pure oscillations in the ground and in the air." The smoothness may enhance the grains' ability to remain dry or avoid latching onto one another. Either way, their tendency to dissipate energy soundlessly by sticking together would be reduced, Criswell thinks. But he hasn't gotten much further than that. "It still isn't clear what is producing the sound," Finch says.

Understanding terrestrial booming dunes may not solve the moonquake mystery, Criswell cautions—data about the quakes are too sparse. But it might have some arcane industrial spinoffs, he muses. He half-seriously imagines a way to improve earth-moving machines that rely on vibratory action: by redesigning them to act as booming dunes in reverse. ■ IVAN AMATO