Physics

From Norfolk, Va., at the 136th biannual meeting of the Acoustical Society of America

Blue eyes, big earplugs: Bad hearing?

For 30 years, evidence has mounted that black people, on average, hear better than whites, and that within both races, women surpass men. A partial explanation of the differences may lie in the abundance in the inner ear of melanin pigments, which are also found in skin and irises. Lending credence to that notion, numerous studies have found that people with light eye colors, such as blue, green, and hazel, are more vulnerable to hearing damage than are people with brown or black eyes.

Taking a new look at old data, Julia D. Royster of Environmental Noise Consultants in Raleigh, N.C., finds further reason to believe that eye color matters. She reanalyzed records collected some 20 years ago by her husband, Larry H. Royster, at a large, noisy textile plant in North Carolina. She reports that the 21 light-eyed, black workers showed significantly poorer hearing than the 327 dark-eyed, black workers. No comparable difference in hearing loss emerged between light-eyed and dark-eyed whites.

Reasons for the greater susceptibility among light-eyed blacks remain obscure, but "melanin may have something to do with it," she says. Researchers have determined that the inner ear produces extra melanin when stressed by noise. Melanin, however, may both protect and harm hearing. It sometimes mops up harmful molecules called free radicals, but at other times, it contributes to their creation.

Larry Royster, who is at North Carolina State University in Raleigh, also reanalyzed the data he collected in the late 1970s. He offers a new, anatomical explanation for the hierarchy of hearing detected among blacks and whites.

From the distributions of earplug sizes used by plant workers, he extrapolates that black women had the narrowest ear canals, black men and white women occupied a middle range, and white males had the widest canals. Since hearing ability follows the opposite pattern—black women having the best hearing and white men the worst—ear-canal size might correlate with "big differences in [potentially damaging] sound levels at the eardrums" and, consequently, in hearing loss, Royster says. *—P.W.*

Cooking up bubbles to make tiny pumps

Imaginative aircraft designers envision that the skin of future airplane wings will ripple with moving swells and dimples like the surface of a wind-blown lake. Millions of minuscule lifting devices, each controlling the height of a patch of wing, could rapidly adjust wing contours in response to changes in the fast-moving currents of air. By preventing turbulence in those currents, the fluctuating wing shapes might allow extraordinary maneuverability, stability, and fuel economy.

To achieve this vision, aircraft makers will require a fast, inexpensive, and reliable way to control and power those millions of tiny lifting machines. Engineers at Johns Hopkins University in Baltimore, Md., report that they are developing diminutive, bubble-powered pumps that may be good candidates for the job. The pumps would work by firing a series of miniature heaters in sequence along a capillary tube. This action would create vapor bubbles, whose well-timed swelling and shrinking would drive the fluid along.

"Bubbles are inherently fast, and they also pack a whole lot of energy per unit area," says Andrea Prosperetti, leader of the Johns Hopkins project, which is funded by the Air Force Office of Scientific Research. Bubbles also lack mechanical moving parts that can wear or break, he adds.

So far, the team has proved that it can make bubbles, a fraction of a millimeter in size, in water by sending current through a resistance heater made from a filament of gold affixed to silicon by standard computer-chip-making techniques. The researchers next plan to test computer models of bubble action by using a 100-micrometer-diameter capillary tube covered with Plexiglas so they can watch their bubbles work. *—P.W.*

Sound was secret weapon in Civil War

They could prevail against thunderous cannon fire or overwhelming odds, but more than a few U.S. Civil War generals appear to have been outmatched by a more subtle enemy: unexpected acoustics.

Charles D. Ross, a Civil War buff and physics teacher at Longwood College in Farmville, Va., reports evidence that sound blockage by hills or foliage and the bending and bouncing of sound by winds and air-temperature patterns may have profoundly affected the outcomes of at least 10 battles.

At Gettysburg, for instance, hot summer air near the ground may have steered the thunder of cannon blasts upward. Interposing hills may have also blocked sounds so well that a Confederate commander didn't hear an artillery barrage that was to signal him to attack Union lines. As a result, the Union regiments that his men were supposed to pin down defeated another Confederate force, instead.

The Civil War marked a turning point in martial history because of the adoption of modern weaponry and tactics, says Ross, who bases his views on information culled from period newspapers and soldiers' diaries. Acoustics, however, could nonetheless sway the course of the war, he says, because "quick decisions by commanders were still made by the most ancient way—the sounds of battle." *—P.W.*

African dialect uses unexpected sound

A sound believed not to exist in human language regularly slips past the lips of speakers of a dialect of the African language Setswana, a Georgetown University linguist in Washington, D.C., reports.

Elizabeth Zsiga made the discovery when One Tlale, a student from the University of Botswana in Zsiga's phonetics class and a native speaker of the dialect Sengwato, asked Zsiga to help her identify a sound from her language that resembles a combination of "f" and "s."

"I said, 'Wait a minute, that's not supposed to exist!'" Zsiga recalls.

Current linguistic wisdom holds that combinations of hissing sounds such as "f" or "s," which are known as fricatives, only occur serially. Yet, Zsiga made spectrograms of Tlale's utterances revealing that, in words for milk, dog, new, and to belch, the sounds overlap. Zsiga found that a friend of Tlale, another native speaker of the dialect, also overlapped the pronunciations. Zsiga estimates that a few hundred thousand people speak Sengwato. *—P.W.*

Better seal for see-through sound wall

Theorists proposed in the early 1990s that a phalanx of cylindrical, metal bars, like thick bristles of a giant brush, could act as an impenetrable barrier to sound in certain bands of frequencies. In 1995, Spanish scientists reported the first example of a structure—an outdoor sculpture in Madrid—that behaves as such a filter. The theorists were surprised that metal bars in air, rather than in another metal, could block sound. The sculpture's performance falls short of perfection because sound in the forbidden frequencies still traverses the artwork from certain angles.

Now, a member of that research group, Francisco Meseguer of the Polytechnic University of Valencia in Spain, reports that the scientists have created a structure of rods in air that stops sound in the forbidden band from every angle.

The group hit upon the pattern that accomplishes this by experimenting in the laboratory with arrays of 100 to 500 bars positioned on square and triangular grids filling up to 40 percent of the space. Such structures may prove of practical use "to shield low-frequency sound by trucks on the highway, for instance," Meseguer says. *—P.W.*