Environment

Silica: Freshest dust may be deadliest

Sand blasters, rock drillers, and silica-flour millers all face a high risk of acute silicosis, a life-threatening inflammatory disease that disables its victims—sometimes in as little as 5 years—by killing lung cells and letting their liquids leak out. Many other workers who inhale the same substance, dust-size pieces of crystalline quartz, develop instead a slowly debilitating scarring of their lungs. Which of these respiratory diseases develops depends on how freshly hewn the inhaled mineral particles were, a new study suggests.

Previously, Val Vallyathan and his coworkers at the National Institute for Occupational Safety and Health in Morgantown, W. Va., showed that freshly cut surfaces of silica dust harbor copious quantities of free radicals (a class of biologically damaging molecules or molecular fragments that contain an unpaired electron). In the presence of moisture, such as that found in the lung, the freshly ground microscopic mineral shards generate large amounts of hydroxyl radicals, the most destructive free radical. In contrast, surfaces of several-months-old particles of silica dust hosted fewer free radicals.

Now, together with NIOSH colleagues in Cincinnati, Vallyathan's team has exposed young male rats to air laced with either freshly cut or 60-day-old silica dust. Animals inhaled the dust-laden air 5 hours a day for 10 days. Then the researchers flushed the materials from the animals' lungs and examined the lungs for signs of inflammation, free radical activity (as measured by the oxidation of lipids), and cell damage.

In the September AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE, they report that animals breathing in fresh dust experienced somewhat more inflammation and 40 percent more lipid oxidation than did rats breathing in aged dust. Vallyathan's team also found significantly more signs of cellular breakdown in the materials washed from the lungs of animals exposed to fresh dust.

Taken together, Vallyathan concludes, these data argue that in situations where silica particles will be fractured, such as during rock tunneling or mining, workers should religiously use the respirators and other air-filtering devices provided them. He suggests that employers also consider substituting less toxic materials for silica in sand-blasting operations.

Childhood lead linked to adult obesity

Many studies have linked low exposures to lead with reduced stature in children. One investigation even found hints of a possible mechanism for this: the heavy metal's inhibition of an individual's secretion of growth hormone (SN: 8/29/92, p.143). Now, a group of researchers has examined the fallout of these youthful exposures to lead. To his surprise, says study leader Rokho Kim of the Harvard School of Public Health in Boston, he found that in 20-year-olds, early lead exposures were more strongly linked to weight than to height.

The team studied 79 young adults whose tooth reservoirs of lead—a measure of youthful exposure—had been assayed at about age 7. In the new study, Kim's group reassessed lead stores in the body, this time using an X-ray fluorescence technique (SN: 2/18/89, p.111) on the shin and kneecap.

Overall, the researchers found, adults who had taken in the most lead as children also gained the most weight (relative to their height) between the ages of 7 and 20. Indeed, Kim notes, some of the subjects with highest exposures were obese.

"If our finding is replicable and robust, the ramifications are significant," his team argues in the October ENVIRONMENTAL HEALTH PERSPECTIVES. Both excess weight and high concentrations of lead in the body (SN: 9/3/88, p.158) have been associated with high blood pressure in adults. This suggests, Kim says, that lead's link to high blood pressure—a major risk factor for heart disease—may actually reflect its apparent role in weight gain.

Physics

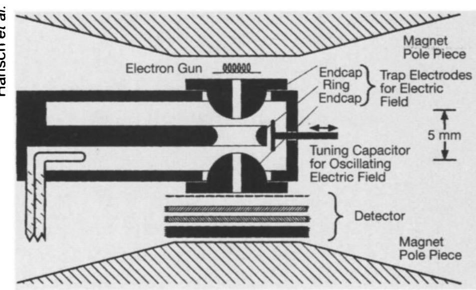
Setting an antimatter trap

No atom is simpler than hydrogen—just an electron in orbit around a proton—or more abundant in the universe. In contrast, antihydrogen—a positron orbiting a negatively charged antiproton nucleus—has yet to make an appearance in the laboratory.

Now, physicists have for the first time trapped electrons and positively charged ions at the same time in the same small region of space. "Confinement of particles with opposite charges and very different mass in the combined trap represents an important step towards the synthesis of antihydrogen," say Theodor W. Hänsch and his coworkers at the Max Planck Institute for Quantum Optics in Garching, Germany. Their report will appear in an upcoming PHYSICAL REVIEW LETTERS.

Researchers have already developed convenient techniques for capturing, cooling, and storing large numbers of positrons (SN: 7/15/95, p.38) and antiprotons in various types of electric and magnetic traps. The latest development demonstrates how a combination of two such traps can be used to confine clouds of different kinds of particles simultaneously to a small volume (see diagram).

As practice for creating antihydrogen, Hänsch and his colleagues plan to use a carbon dioxide laser to stimulate confined electrons and protons into forming ordinary hydrogen atoms.



Hänsch *et al.*

Two traps in one: A magnetic field together with an electric field confine positively charged ions, while another electric field oscillating at microwave frequencies traps electrons in the same small volume.

Skating on thin water

There's nothing really simple about skating smoothly across a sheet of ice.

One standard explanation of why skates slide so easily on ice holds that the pressure produced by a skate's sharp blade forces a little of the ice to melt, creating a thin, slippery film of water on which the skate actually glides. But this answer doesn't hold up under close scrutiny. Samuel C. Colbeck of the U.S. Army's Cold Regions Research and Engineering Laboratory in Hanover, N.H., reviews some of the arguments against pressure melting as the cause of the low friction encountered in ice skating and snow skiing in the October AMERICAN JOURNAL OF PHYSICS.

Colbeck argues that the pressure needed to reach the melting temperature of ice would more likely cause the ice to crack and fragment. Even if melting did occur, only an exceedingly thin film of water would be present. "Pure liquid water cannot coexist with ice much below -20°C at any pressure," he adds, "and friction does not increase suddenly in that range." Skating and skiing are still possible below this temperature.

Heating caused by the friction of a skate moving rapidly across the ice represents an alternative mechanism for the formation of a water film to facilitate skating. "This mechanism generates heat at the interface where it is needed, by the shear of the thin water film," Colbeck notes.

However, it's also possible that an effect known as surface melting may play a role. Researchers have found that a solid can sometimes develop a liquid film on its surface at a temperature below the solid's normal melting point (SN: 7/1/95, p.4). Others have suggested that a skate may glide on microscopic balls of ice or even a cushion of water vapor.