Biomedicine

Spray fabric dye linked to pneumonia

The origin of a rare type of potentially deadly pneumonia, called organizing pneumonia, has stumped physicians. Some patients diagnosed with the infection also have connective tissue diseases, such as arthritis. Others are drug users. In England, some people suffer episodes every spring.

Scientists have for the first time connected some cases of this mysterious pneumonia to exposure to chemicals in the workplace, according to Carmen Moya of the Health and Consumer Council in Valencia, Spain, and her colleagues.

Health experts tracked down the disease in Valencia while investigating why three employees at one textile factory developed lung disorders between February and April 1992, Moya's group reports in the Aug. 20 LANCET.

The researchers examined 257 people at eight factories in Valencia whose jobs related to spraying fabric dye, similar work as that performed by the three people who became ill.

They found 71 cases of the pneumonia. After 1 year, six of the patients had died. By July 1992, the two factories where the illnesses occurred stopped spray printing — and people stopped getting sick.

A variety of clues convinced the scientists that aerosolized chemicals caused the illness. For example, most of the patients who became sick worked at the factory with the highest concentrations of airborne aerosol, Moya's team reports.

Workers at the two factories handled products not used at the other sites the researchers studied. One of those chemicals had been reformulated in 1991 — Acramin FWR, a powder, became Acramin FWN, a liquid.

Other businesses use the new product without problems, the researchers say. But the workers at the Valencia factories were not following the manufacturer's instructions. They mixed Acramin FWN with a chemical solvent instead of water and sprayed it instead of applying it with a brush or sponge. They ended up creating a toxic aerosol.

The researchers note that they aren't the only ones finding health risks from reformulated products. The Centers for Disease Control and Prevention in Atlanta recently described cases of respiratory illness caused by inhalation of two sprays used in waterproofing and conditioning leather. Both chemicals had been reformulated to eliminate ozone-depleting solvents and propellants.

Endotoxins harm grain workers' lungs

For the 5 million agricultural workers in North America exposed to grain dust, lung disease is a serious threat.

Investigators now have further evidence that endotoxins — bacterial poisons — lurking in grain may cause much of the illness, report David A. Schwartz and his colleagues at the University of Iowa College of Medicine in Iowa City.

Schwartz' team took mice bred to be either sensitive or resistant to endotoxins and exposed them to corn-dust extract, among other substances. In measuring the degree of lung inflammation in the animals, the scientists found that the sensitive mice were worse off than the resistant ones.

The researchers were able to make the sensitive mice tolerate the endotoxins by repeatedly exposing them to the toxins. Schwartz and his colleagues then compared what happened when these desensitized animals and sensitized mice breathed corn dust. They found that the desensitized group had less of an inflammatory response.

"Our results indicate that endotoxin appears to be the principal component of grain dust responsible for the development of the inflammatory response in the lower respiratory tract," they will report in an upcoming AMERICAN JOURNAL OF PHYSIOLOGY.

Physics

Putting electrons into orbit

According to the laws of quantum mechanics, it's normally impossible to pinpoint the orbit of an electron bound to an atom. The electron's position at any given moment is best represented by a hazy cloud, which specifies only its probable location. Now, researchers have introduced the possibility of creating an atomic system in which, for short periods of time, an electron behaves more like a planet orbiting the sun than a quantum-mechanical particle whose behavior is defined strictly in terms of probabilities.

As the electron circles the nucleus, it traces an elliptical path, just as planets do in orbiting the sun, says Carlos R. Stroud Jr. of the University of Rochester's Institute of Optics in Rochester, N.Y. Stroud and coworkers Zagorka D. Gaeta and Michael W. Noel suggest a technique for producing such an atomic system in the Aug. 1 PHYSICAL REVIEW LETTERS.

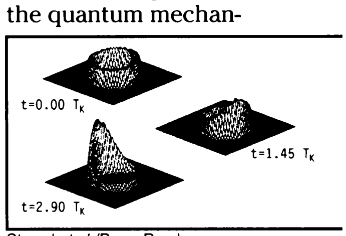
At the heart of the technique lies the use of extremely short, precisely tuned laser pulses to excite an atom so that one of its electrons spends most of its time far from the nucleus — as much as 10,000 times farther away than usual. In this case, one can picture the electron's probable location as a ring around the atom (see diagram).

Stroud and his coworkers suggest that a short, strong electrical pulse can alter this probability distribution from a uniform ring to a sharply peaked configuration, or wave packet. In effect, the pulse would nudge the electron in such a way that its probability of residing in a particular location increases sharply. It's the resulting localized wave packet that would follow an elliptical orbit for up to three or four revolutions before dispersing and smearing.

Researchers can also use a weak electric field to deform the electron's initial orbit from a circle to an ellipse of a particular eccentricity, which defines how squashed the ellipse can be. Theoretically, it's even possible to deform the orbit so much that the wave packet representing the electron's probable location travels along a straight line.

Now, it's a matter of putting theory into practice. "We are working on the experiment at the moment," Stroud says.

By achieving such control over electron wave packets, researchers may gain insights into how the quantum mechanics of the microscopic realm meshes with the classical mechanics of everyday objects.



A brief electrical pulse transforms a circular electron state into a well-defined wave packet following an elliptical orbit.

Stroud *et al.*/PHYS. REV. LETT.

Reaching a record low temperature

It's getting colder in the laboratory. Physicists at the National Institute of Standards and Technology (NIST) in Gaithersburg, Md., have chilled atoms to 700 nanokelvins, a temperature barely above absolute zero. Although other researchers have reached lower temperatures either transiently or in one or two dimensions, this represents the lowest temperature yet attained involving the motion of atoms in three dimensions.

The NIST team achieved the new record using a technique borrowed from researchers at the École Normale Supérieure in Paris (SN: 7/16/94, p.47). William D. Phillips and his colleagues at NIST trapped cesium atoms in an "optical lattice" created by four intersecting laser beams. Oscillating back and forth in the "hollows" of this lattice, the trapped atoms reach a temperature close to 1 microkelvin. Reducing the laser intensity drives the temperature to 700 nK, slowing the atoms to an average velocity of 7 millimeters per second.