The electrical shrinking gel

When an electric field is applied across a gel, a jellylike form of matter intermediate between a solid and a liquid, the gel may collapse to a volume several hundred times smaller. Toyoichi Tanaka and his colleagues at the Massachusetts Institute of Technology suggest in the Oct. 29 SCIENCE that such gels, controlled by low-voltage microcomputer signals, may eventually be used for artificial muscles. "It may also be possible to store two- and three-dimensional images by using the local collapse and swelling of the gel," they write.

A gel consists of long-chain polymer molecules, cross-linked to form a tangled network and immersed in a solvent. The liquid prevents the polymer network from collapsing while the network stops the liquid from flowing away. In previous research, Tanaka showed that drastic but reversible volume changes can be brought about by small shifts in temperature, solvent composition, acidity or the concentration of an added salt. This abrupt volume change is the consequence of a transition from one network arrangement to another. Low voltages also induce this phase transition.

In his experiments, Tanaka used a partially hydrolyzed polyacrylamide gel in a 50 percent acetone-water mixture. The cylindrical gel, 3 centimeters long and 4 millimeters in diameter, was placed between two platinum electrodes. When the applied voltage reached 1 volt, the gel's shape began to change, and by 2.15 volts, the entire gel collapsed. When the electric field was removed, the gel returned to its original shape in about 10 minutes.

Tanaka says the collapse time is approximately proportional to the square of the diameter. Micron-sized gel fibrils should collapse in milliseconds. "It's very interesting that when nature made the muscle, nature made a bundle of very thin fibrils, of micron size, which make the muscle respond within 10 milliseconds," he says.

The muscle itself is a kind of gel, in which the passage of calcium ions determines its volume. "We have a new phenomenon in which we can use electric fields to control this," says Tanaka. "We should be able to make artificial muscles in the future in which we control the contraction and expansion by electric fields."

Tanaka and his group plan to extend their work to other gels. Tanaka says, "This question is very important because we showed theoretically that this is a very general phenomenon." There is already some evidence that such sharp transitions occur in other gels like polystyrene in nonaqueous solutions.

These studies are important in terms of applications. "For each application, we have to optimize the chemical structure," Tanaka says, "but now we have the guiding principle to what kinds of gels are better for such purposes." —*I. Peterson*

In Tylenol's wake—tamper-proof packaging

As a result of the seven deaths from cyanide-laced Extra-Strength Tylenol capsules, the Food and Drug Administration will be issuing regulations requiring that all nonprescription drugs be sold in tamper-resistant packaging. The agency expects to have rules outlining its tamper-resistant standard out by the first week in November, with a potential implementation date affecting the most vulnerable products roughly 90 days later.

Because FDA does not approve specific packaging technologies or equipment, its standards will actually amount to a regulatory definition of what constitutes tamper resistance, explained Daniel Michels, Associate Director of Compliance in FDA's Office of Drugs. "Industry is responsible for choosing the most cost effective way of meeting that standard," he said. Some potentially suitable technologies may be mentioned (by way of example) in the regulations, Michels said. But, he added, "That does not mean that we're endorsing them or holding the pharmaceutical industry to any of those technologies. If a better mousetrap comes along, or an equally good one that we have not thought to include," industry can use it.

Since "the whole motive for the regulations was tampering at the consumer level," prescription drugs will not be included, Michels said. And, he said, the earliest implementation dates will be assigned to those "dosage forms" deemed most vulnerable to tampering — such as capsules and bottled liquids. —*J. Raloff*

Kudos to SN writer

Janet Raloff, policy/technology editor at SCIENCE NEWS, will receive the American Speech-Language-Hearing Association's 1982 National Media Award for magazine reporting on Nov. 19 at the organization's national convention in Toronto. ASHA cited Raloff for "outstanding reporting" in "Occupational Noise — the Subtle Pollutant" (SN: 5/22/82, p. 347).

Since 1978, ASHA has given annual awards in four categories — radio, television, newspapers and magazines — to honor producers, reporters and editors who have enhanced the public knowledge and understanding of communicative disorders. With 37,000 members, ASHA is a national scientific and professional association representing speech-language pathologists and audiologists. □

The case of the missing hormones

As every mystery buff knows, the key to solving a murder is figuring out the motive. But even the most rigorous logic is useless against wanton crime. Where logic fails, however, chemistry may provide clues. According to two psychiatrists, psychopathic murderers may suffer from a specific hormonal deficit—a deficit that is being increasingly linked to impulsivity and may help to explain, and perhaps even predict, senseless violence.

National Institute of Mental Health psychiatrist Markku Linnoila and University of Helsinki psychiatrist Matti Virkkunen have studied 25 convicted murderers who were referred by the courts to the university's forensic psychiatry clinic. The subjects comprised two groups: psychopaths, who had committed unprovoked murders, and paranoid murderers, who according to Linnoila had killed only after lengthy contemplation. The researchers carried out a biochemical analysis of the subjects' cerebrospinal fluid. The preliminary findings, Linnoila said in an interview, show a striking difference between the two groups: the psychopaths had significantly lower levels of a chemical called 5-HIAA than did either the paranoid subjects or normal controls.

The 5-HIAA is the metabolic residue of the neurotransmitter serotonin; the low levels in spinal fluid are taken to indicate a serotonin deficit in the brain. The biochemical distinction of psychopaths is interesting in light of other recent research that has linked subnormal serotonin activity to aggressiveness and to violent suicide (SN: 5/29/82, p. 355). And in a separate study, Linnoila says he has found the same hormonal deficit in schizophrenic patients who, though they showed no signs of depression, attempted suicide. Where low serotonin was once thought to indicate depression, Linnoila says, what now seems more likely is a connection with general impulsivity that can lead to violence toward one's self or toward others.

Linnoila says that, while there are many kinds of murderers, these two classes show the clearest behavioral contrast: "The psychopaths kill violently, out of the blue, and they feel no remorse for their killing," Linnoila says. "The paranoid people have well organized delusional systems and have killed, after lengthy consideration, the perceived instigator of their problems." The psychopaths also tend to have histories of childhood behavioral problems and adult alcoholism, Linnoila adds; if these findings hold up, he says, they raise the possibility of predicting and perhaps even preventing — through the use of serotonin-enhancing drugs that already exist—violent killing.

—*W. Herbert*

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