Technology

From the annual meeting in Chicago of the Radiological Society of North America

When children swallow batteries

Those button-like alkaline batteries used to power many items around the home — including calculators, watches and cameras — look like candy to some children. The National Capital Poison Center estimates 850 such batteries may be ingested annually. "The major ingredient in these batteries is aqueous potassium hydroxide — the same stuff used in Drāno for your sinks," notes Salt Lake City radiologist Richard Jaffe. "And sealed only with plastic, when the battery is immersed in the fluid of your stomach or intestines it often leaks," he says. But he and colleague Howard Corneli at Primary Children's Medical Center have worked out a quick and simple retrieval technique.

While restrained on a table, a child is instructed to swallow a long plastic tube into one end of which a small cylindrical magnet has been wedged. Watching the progress through the child's digestive tract via X-ray fluoroscopy, a physician threads the tube to the stomach and then manipulates it to engage the magnet. Then both are pulled back into the esophagus.

The magnet is not strong enough to get the battery past the esophagus, so at this point a Foley catheter is threaded through a nostril and into the esophagus, below the battery. This catheter has a rubber balloon at one end, and once in place the balloon is inflated. Then the magnet is removed and the table tilted until the child's feet are elevated. By pulling the catheter, the battery is pulled up to where it can be spit out.

The procedure, which usually takes less than five minutes, costs only a fraction of what traditional surgical removal would. Though Jaffe admits most batteries pass through the body without injury, at least two children have died from perforated esophaguses. He also notes several surgeons, while removing batteries, have spotted ulcers in the stomachs of patients who had showed no symptoms. (All six of the batteries Jaffe removed showed signs of corrosion.) Jaffe says that in animal experiments, corroding batteries have caused ulcers within only one hour, and perforated the digestive-tract lining within two hours when the battery did not move.

Cutting heart's dose in breast therapy

In the treatment of breast cancer, a lumpectomy followed by radiation therapy has a success rate comparable to a full mastectomy, says University of Kansas Medical Center radio-oncologist Leela Krishnan. Moreover, the lumpectomy — which only removes cancerous tumors — involves less disfigurement. But theoretical calculations the Kansas City researcher and colleagues have made show that with the traditional technique for breast therapy using X-rays, "a possibility exists you could get exposures of up to 4,000 rads to certain areas of the heart," delivered over several weeks. Though the heart is relatively radiation-resistant, Krishnan points out there may be a risk of inducing some heart complications with this therapy. That's why she, Engikolai Krishnan and William Jewell now recommend using versatile linear accelerators for therapy — devices that offer not only X-rays, but also electron radiation.

Electrons can be targeted better than X-rays to deliver most of their cell-killing energy to a specific depth, by adjusting their energy level. As a result, there is less of a chance that this radiation will pass through targeted tissue and into the nearby heart. One can't deliver the entire dose in electrons, however, because too high a dose results in skin reactions such as rashes and scarring. So for now the Kansas team recommends delivering about half of the total breast-therapy dose via electrons, for a reduction of about 60 percent in the radiation dose that would otherwise have reached the heart.

"Cardiac complications have not been reported," Krishnan acknowledges. However, treatment that combines X-rays and electrons reduces the likelihood of any such risks considerably, she notes, "without compromising cosmetics."

Energy

The bright, wet look for solar cells

A solid-state solar cell is not the only device that converts sunlight directly into electricity. One alternative is a photoelectrochemical cell that consists of a semiconductor immersed in a liquid electrolyte. In the Oct. 13 NATURE, a team of German scientists along with Klaus J. Bachmann of North Carolina State University in Raleigh report the development of a new semiconductor-liquid junction cell. The cell has excellent stability even when exposed to air and a solar-to-electrical energy conversion efficiency of 9.5 percent. Earlier versions of such cells suffered from either serious corrosion problems or low energy conversion efficiencies.

The new cell, made from relatively inexpensive, nontoxic materials, consists of a single crystal of $CuInSe_2$, a doped (n-type) semiconductor, in an aqueous solution containing copper and iodide ions and molecular iodine. At the junction that forms spontaneously between the liquid and the semiconductor, light energy is transformed into electrical work, yet no net chemical change occurs in the cell.

In related research a year earlier, chemists at Stanford University in Stanford, Calif., designed a liquid-junction solar cell, using a nonaqueous solvent, that achieved about 13 percent efficiency. Researchers at AT&T Bell Laboratories in Murray Hill, N.J., also working on the problem (SN: 6/25/77, p. 410), created an efficient liquid junction cell in which the light-sensitive electrode was the cathode rather than the anode normally found in most other cells. This change reduces corrosion problems.

Noting these recent advances, Stanford's Nathan S. Lewis says, "... the technology of semiconductor-liquid junction cells substantially lags behind that of solid-state systems. It is equally clear, however, that progress in the area is rapid and that the basic science of the semiconductor-liquid interface poses a challenging scientific problem."

Fueling New York's bright lights

New York City's bright lights soon will be less likely to dim when a new energy source begins delivering additional electric power into the Consolidated Edison Co. power grid. The new source is a demonstration fuel-cell power plant, the first of its kind, that will produce as much as 4.8 megawatts of power and can respond within seconds to fluctuating power demands. The plant's key elements are stacks of fuel cells that combine hydrogen generated from naphtha or natural gas with oxygen from the air to generate electric current (SN: 7/30/83, p. 74).

The fuel-cell plant, constructed in the midst of a densely populated area of Manhattan, took about seven years to complete. Safety controversies, equipment failures and design changes delayed the project and raised its total cost to more than $75 million. Now plant technicians are "chasing gremlins" and tracking down the last minor problems. The plant should begin delivering reliable electric power this month.

Plant project manager Edward Gillis of the Electric Power Research Institute in Palo Alto, Calif., says, "It's the first of a kind, and we're being very cautious." Once the plant begins operating, it will undergo a long series of rigorous tests. One important part of the tests will be the collection of data on plant emissions and fuel consumption. "It's really like putting a big plastic bubble over the whole site and measuring everything that's going in and out," says Gillis.

A fuel-cell plant virtually identical to the one in New York has been operating in Tokyo since last spring. Japanese engineers benefited from the lessons learned during the New York project and from a major change in the design of fuel cells. As a result, Gillis says, "We expect that the Tokyo plant will be much more durable than the one in New York." Nevertheless, the New York fuel-cell plant should be generating power and important data for several years to come.