ENERGY

Spinach power

Sunlight-activated power from spinach? He's not got much yet, but that's the idea behind Christopher Ludlow's research at West Virginia University. With chlorophyll from spinach, he is attempting to mechanically harness photosynthesis for the direct production of electricity.

Two polished platinum electrodes—foil, really—are mounted on glass microscope slides. A Teflon spacer with a hole cut into the middle separates them. Pasted on one electrode is a mixture of lipoic acid and chlorophyll A, the type believed most active in a plant's light gathering and light activation. Distilled water fills the 5/16-inch gap between electrodes.

Ludlow says his cell produces a voltage similar to that achieved by silicon photovoltaic cells — about 0.4 volts — but that its amperage is almost too low to measure, meaning the cell is virtually powerless. Hoping to improve that, Ludlow aims to refine the paste to better resemble chlorophyll A's chemical structure within plants. While he is not alone in developing synthetic leaves, Ludlow believes the utter simplicity of his system may be the key to economically simulating plant power.

Perhaps, but Michael Wasielewski at Argonne National Laboratory, near Chicago, appears to be at least one step ahead of Ludlow. Wasielewski's cells use chlorophyll A that's been chemically altered in an eight-step process to remove all the functional chemical groups that contribute to its instability. The payoff is a longer-lived system — measured in days to months, not just hours — and a synthetic environment that duplicates the chemistry and reaction rate (measured in picoseconds) of a real leaf's electron-pumping "reaction center."

Texaco's stratified-charge engine

Texaco Inc. has designed an auto engine that could help solve fuel-availability headaches in decades to come — a stratified-charge engine that without adjustments can run on anything from jet or diesel fuel to high-octane gasoline. Under license, United Parcel Service is developing a kit to convert the GMC 292-cubic-inch, six-cylinder gasoline engine used in its fleet of 35,000 heavy-duty delivery vans. For a conversion cost of less than $2,000 per van, UPS claims the Texaco-designed engine will deliver a 30 percent increase in the miles per gallon with an accompanying reduction in exhaust emissions.

As with all stratified-charge engines, Texaco's creates a nonhomogeneous mix of fuel and air in the combustion chamber so that the fuel ignites in a relatively rich (fuel-to-air ratio) environment, but burns, for the most part, in a leaner — more fuel efficient — environment. And unlike such other stratified-charge engines as Honda's CVCC and Ford's Proco, the Texaco model does not inject fuel until the spark plug sparks. By thus eliminating any precombustion-residence time for the fuel, the Texaco engine can run on any grade of spark-ignitible fuel without fear of engine "knock."

UPS has already tested one engine and plans road tests for several more. If all goes well, UPS will retrofit 500 vans.

Coming diesohol?

Weaning the diesel community onto a semi-alcohol diet—the diesel equivalent of gasohol — may be desirable from an exhaust-emissions standpoint, but not easy. The reason is that the cetane number — equivalent to gasoline's octane number — decreases when ethanol is added, thereby making fuel harder to ignite. The University of Wisconsin's Phillip S. Myers is exploring ways to overcome this, such as by adding spark plugs, adding ignition-enhancing chemicals, emulsifying alcohol and fuel, and fumigating (spraying minute alcohol droplets into the engine).

EARTH SCIENCES

Susan West reports from San Diego at the meeting of the Geological Society of America

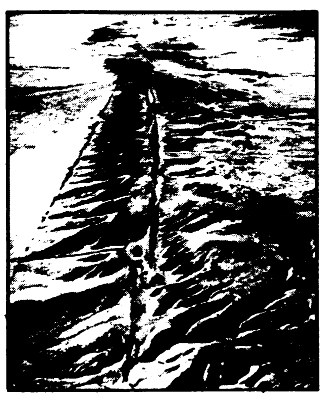
Earthquake studies: In the lab . . .

Unlike other scientists, earthquake researchers cannot decree when their experiments—earthquakes—will occur. And, unlike one cell of an organism or one reaction of a series, one part of an actual earthquake cannot be isolated for detailed study. But geologists have learned to compensate. The study of rock mechanics—simulating certain conditions in the lab and watching how rocks behave—has let them recreate some parts of a quake. And, according to W.F. Brace of Massachusetts Institute of Technology, recent rock mechanics studies may help predict the style and timing of an earthquake.

More and more, says Brace, researchers are studying the physical characteristics of the broken rubble — known as fault gouge—found between the sides of a fault. "It's like a sandwich and gouge is the stuff between the bread," he says. "Before, we were looking at the bread. Now we're looking at the filling." Apparently, he says, the nature of the fault gouge can govern how a fault behaves. The types of minerals, the size of the rocks and other factors may determine if a fault "creeps"—relieving stress slowly—or slips suddenly and violently. Clay, for instance, may be important in the amount of friction along a fault. Clay holds water and, even under very high pressure, can act as a lubricant.

In addition, Brace says, researchers have noticed that the character of foreshocks changes prior to a laboratory-induced quake. The seismic waves from a foreshock attenuate, or decrease in amplitude, more quickly some months before a quake, and the foreshocks tend to cluster into a narrow band along the eventual fault plane.

All these results, however, are based on assumptions about the type of rock material found in the fault zone. Successful rock mechanics studies, says Brace, require drilling on a fault to retrieve gouge and underlying rock. The U.S. Geological Survey is expected to begin such a program, according to officials there.



. . . and in the field

Despite the limitations, some rock mechanics studies appear to be holding up in the field, according to Lucile Jones of the Massachusetts Institute of Technology. Jones, who recently returned from five months of study with the Institute of Geophysics in Beijing, reported a foreshock pattern prior to the Feb. 4, 1975, Haicheng earthquake that is very similar to that predicted by rock mechanics.

The magnitude 7.3 quake had been predicted based on foreshock activity. A total of 550 foreshocks—all but seven within 26 hours of the main event — were recorded before the quake. Jones's analysis, with Wang Biquan and Xu Shaoxia of the institute, showed two clusters of shocks taking place on two nearly perpendicular fault planes. Most of the activity occurred on a north, northeast plane, which was a previously detected fault. But another cluster centered on a northwest trending plane, a previously unmapped fault zone on which the earthquake eventually occurred.

The newly broken fault may indicate, says Jones, the possibility that the stress field—the underlying source of geologic stress —in China may have shifted in the past several thousand years. Such a shift, she said, may account for the unpredicted, disastrous T'angshan earthquake in 1976, which led to the rupture of a new fault.