Linda Garmon reports from Boulder, Colo., at the Third International Conference on Photochemical Conversion and Storage of Solar Energy

Forgotten sunshine

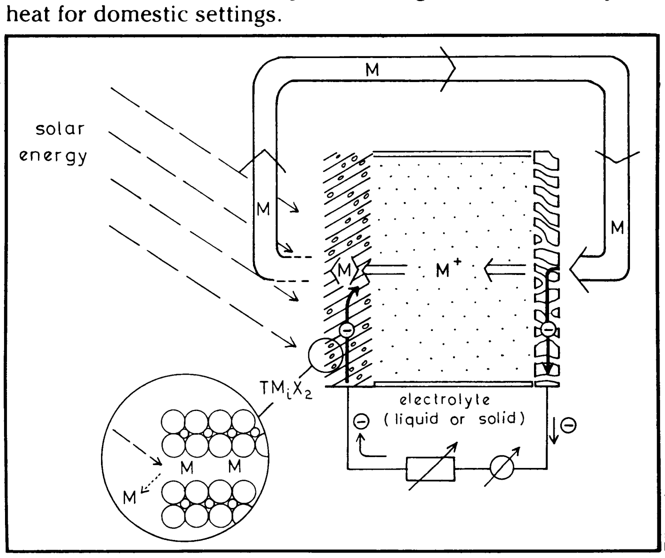
American Indians once transported their goods on leather sewn between two poles hitched to horses. "If only that saddle, instead of dragging, had been rolling, those same horses could have carried five or six times the load," said Denis Hayes in his address to the solar energy researchers. Hayes, director of the Solar Energy Research Institute in Golden, Colo., soon made clear the reason for interjecting Indian lore into a solar energy conference: "The energy policy of almost every country in the world has been focused upon thinking of new ways to breed horses," he said, while what really is needed is some one to invent "some new things like wheels."

Helmust Tributsch may be such a person. He has a reputation in solar energy circles for continually breaking new ground. The latest in his series of "wheels" evolved from an investigation of what he calls the forgotten aspect of solar energy—evaporation.

"Nature," says Tributsch, "is harvesting large amounts of solar energy by evaporating water from thin capillaries which are extending from the roots to the leaves of plants." Molecules that interact with heterogeneous micro-environments—such as the thin capillaries of plants—are more difficult to evaporate than molecules from the surface of a homogenous environment—such as a lake. The resulting negative pressure is what pumps water more than 100 meters in sequoia trees, desalinates sea water in mangrove trees and extracts moisture from arid land for desert shrubs.

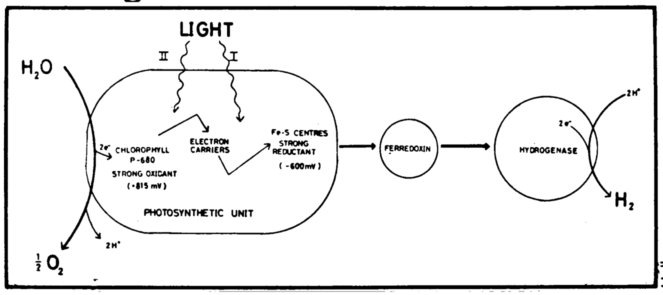
While Tributsch says that attempts to harvest evaporation energy nature's way (tensile hydrostatic energy) "are not promising"—thin capillaries are difficult to synthesize and maintain and negative pressure is difficult to sustain—evaporation energy can be converted to electrical energy. His proposed evaporation energy conversion cycle requires a layer type material, TX_2, in which atoms or molecules, M, can be inserted to form TM_iX_2. The intercalated M is evaporated from the layer material and condenses on an anode. Since it takes evaporation energy to kick M from the layer material, recycling it to its original position releases energy. This "free energy of insertion" can be harvested in the form of electrochemical energy. In Tributsch's system, electricity is generated when an electron from M moves in an outer circuit.

This proposed energy system is attractive not only because it is recycling, but also because energy can easily be stored either by withholding M from the anode or by opening the circuit of the cell, Tributsch explains. And although it is not yet spinning, Tributsch's "wheel" has the potential to generate electricity and heat for domestic settings.



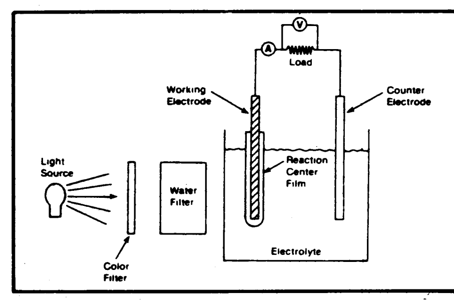
Tributsch

Stealing from nature



Hall

Researchers are putting plant parts to work in the laboratories. David O. Hall and colleagues of the University of London King's College produce hydrogen in a system that includes plant chloroplasts immobilized on a calcium alginate gel, the enzyme hydrogenase and the electron carrier ferrodoxin. Michael Seibert of the Solar Energy Research Institute in Golden, Colo., and colleagues coat an electrode with bacterial photosynthetic units. In this electricity-generating system, light kicks electrons from the units into the electrolyte solution. The electrons travel to the counterelectrode and return via an outer circuit to fill the positive "holes" they left at the working electrode.



Seibert

Because of the instability and expense of biological materials, neither Seibert's nor Hall's system is well suited for the development of large-scale solar converters, but the systems do serve as stepping stones to practical, wholly synthetic models.

Solar reflections

When solar energy meeting chairman John S. Connolly began outlining the conference agenda, he had no problem in slicing the solar research pie. Some studies aim at stimulating the photosynthetic water-splitting process by mimicking the overall plant reactions (SN: 8/9/80, p. 84) or by mimicking an individual step (SN: 8/2/80, p. 68); other water-splitting systems are not closely related to the photosynthetic reactions (See p. 103). Photoelectrochemical cells (PEC's)—electrodes in an electrolyte solution—comprise yet another category of solar energy research. PEC's generate electricity or chemical energy after light is absorbed by components in the electrolyte solution (photogalvanic cells) or near the (usually semiconductor) electrode surface. Electricity also can be generated when light falls on the boundary between certain pairs of dissimilar materials in a photovoltaic, or solar, cell, forming another category of research on Connolly's agenda.

But as the conference drew to a close, it became clear to Connolly of the Solar Energy Research Institute in Golden, Colo., that the now separate areas of solar research are beginning to merge into one recognizable scientific discipline—"chemical photoconversion." This is a "healthy sign," says Connolly, who is convinced that the practical payoff to solar energy research will come out of this pooled knowledge.

And although he attributed this encouraging merging of paths in part to the field's enthusiastic and innovative participants, he did reserve some of the credit: "I propose a toast," he said, raising his glass before an assemblage of conference delegates, "to the sun."