Water-splitting method questioned

A recent report by researchers at the University of California at Berkeley that they have found a method to extract hydrogen from water using solar energy and inexpensive materials has received mixed reviews. Some scientists believe that, although it is unlikely the scheme will ever be commercially feasible, its novel chemical components are worth noting; others question whether the system is even splitting water.

The system, developed by UC's Gabor Somorjai and colleagues, was described by Christofer Leygraf, a post-doctoral student in the group, at the recent American Chemical Society meeting in Kansas City, Mo. Several other laboratories have developed methods that use light to dissociate water into hydrogen gas, a fuel, and oxygen; but these processes rely on expensive components such as platinum (SN: 8/16/80, p. 105) or the ultraviolet range of the light spectrum, Leygraf reported. The new system, on the other hand, uses "cheap and abundant materials" and visible light to split water, he said.

The Berkeley system consists of two wire-connected iron oxide disks immersed in a solution. One iron oxide disk has been impregnated with magnesium, causing it to be an electron-deficient, or positive, terminal. The other disk has been doped with silicon, causing it to be an electron-excessive, or negative, terminal. When light shines on this set-up, electrons flow from the silicon-doped iron oxide terminal to the magnesium-doped one, Leygraf said. There, the aqueous hydrogen ions (H^+) pick up electrons to form hydrogen gas (H_2). At the silicon-doped electrode, hydroxyl ions (OH^-) ions react to form oxygen (O_2) and more water (H_2O) molecules. The system slows down drastically after running for about eight hours but can be restored by running a stream of air through it, Leygraf reported. While the overall power conversion efficiency (energy output divided by energy input) now is only 0.05 percent, the Berkeley researchers are confident this can be improved.

The scheme, which is described in the September Proceedings of the National Academy of Sciences, is a "nice, sound piece of academic science," says photochemist Mark Wrighton of the Massachusetts Institute of Technology in Cambridge. "The efficiencies are trivial," he says, but researchers never before have seriously considered using iron oxide to build a positive photo-terminal — "and that's what's interesting." Iron oxide has a small "band gap" — the "forbidden" space between a material's electronic ground and conduction states. In solar energy terms, this simply means that the material can use more of the visible sunlight range.

But Bruce Parkinson of the Solar Energy Research Institute in Golden, Colo., is skeptical that an iron oxide photocathode has been successfully constructed. "How can you claim [the iron oxide electrodes are] catalytically splitting water," he explains, "when, every eight hours, you have to regenerate the system ... Do they really know what they've got there?" And even if the claims are true, Parkinson says, according to calculations based on band gap size, the maximum solar energy conversion efficiency one could theoretically achieve using iron oxide is only 6 percent — "and that's just a theoretical maximum."

Somorjai replies: "You must realize that this is a highly competitive field ... in which others have worked for years to find something cheap and catalytic ... None of these people have tackled the problem," he told Science News, "and now I think we have something that could work."

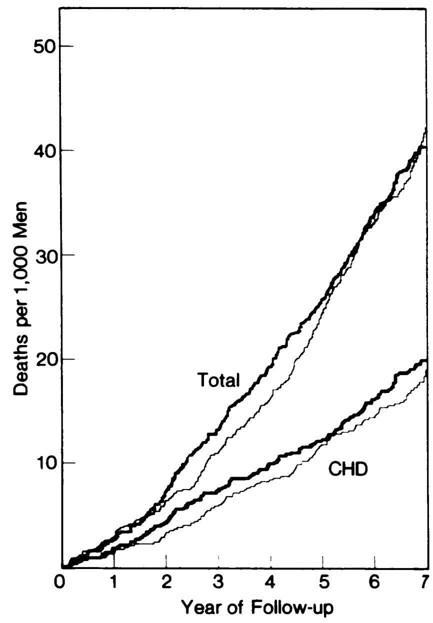
Says Parkinson, "I think [Somorjai and colleagues] are making a big deal out of nothing." —*L. Garmon*

Heart risk study: Unexpected results

Ten years ago a massive, expensive, federally funded clinical study was launched to see whether reducing heart disease risks also reduces death from heart disease. Now the results of the study, published in the Sept. 24 Journal of the American Medical Association, reveal that the question is still unanswered, apparently because of unforeseen complications in study design.

Under the auspices of the National Heart, Lung and Blood Institute, 250 investigators at 28 institutions recruited over 12,000 men at high risk of death from heart disease because of high blood pressure, elevated levels of cholesterol in the blood and/or cigarette smoking. The men were randomly assigned to one of two groups. Those in an intervention group received, four times a year or more, stepped-up treatment for high blood pressure, counseling against cigarette smoking and dietary advice for lowering blood levels of cholesterol. Those in a control group were referred to their personal physicians for treatment of risk factors but were also invited once a year to a study center for a physical exam and lab tests. The results of the exam and lab tests were not just used in the study but were also conveyed to their personal physicians, who were aware of the objectives of the study. All the subjects were then followed for six or seven years to see whether their risk factors changed and whether they died from heart disease.

As anticipated, the intervention group reduced its heart disease risk substantially during the study period compared with what it had been to start with. But unexpectedly, those in the control group



Deaths from heart disease and all causes. Controls are heavy line, test group thin one.

reduced heart disease risks markedly, too. The reduction could have occurred because the group had received more help from personal physicians in reducing risks than had been foreseen, because persons volunteering for a six- or seven-year trial are unusually health-conscious and motivated to change in the first place, or because, as Oglesby Paul, professor emeritus of Harvard Medical School and chairperson of the study steering committee, suspects, the group had become increasingly concerned, like many Americans during the 1970s, with the dangers of heart disease risks. In any event the surprising reduction of risk in the control group reduced the statistical power of comparison between the intervention and control groups. It may have been why only a statistically nonsignificant seven percent difference was found between the number of heart disease deaths for the intervention group and the number for the control group — 115 for the former versus 124 for the latter. In other words, the study failed to demonstrate that reducing heart disease risks reduces heart disease deaths.

What's more, it produced a disquieting result. A subset of patients in the intervention group — those who started the study with high blood pressure and electrocardiographic abnormalities — suffered a higher heart disease death rate than did the same subset of patients in the control group. Because more patients in the intervention group had been given drugs to combat high blood pressure than had those in the control group, it's possible that the drugs were responsible for the excess number of heart disease deaths among the former. This eventuality, JAMA Editor George D. Lundberg points out in an accompanying editorial, flies "in the face of current medical dogma and practice." This likelihood, he says, "will no doubt foster substantial debate...." —*J. A. Treichel*