ducted were not sufficient to pass judgment on the chemical or thermodynamic changes in the machine, or to evaluate economic feasibility. Gordon Walker of Smith-Emery Co., the other laboratory that did tests, was quoted in the New York Times article as saying, "I could find no evidence of hanky-panky." But when asked by SCIENCE NEWS whether he would still stick by that statement he would only reply, "I don't care to discuss it further."

Randall Presley, president of the Presley Companies, was also reluctant to talk, saying the issue is "just a bit premature to discuss." Asked whether he believed the process was really self-sustaining, he replied only that "this is the inventor's claim;" just reserving residential application rights is "our total involvement at this point."

Mirkin is still enthusiastic, but because of the continuing SEC investigation he emphasized that his views should not be interpreted as relating to the Presley case. He told SCIENCE NEWS that the tests needed to establish cycling and energy efficiencies will be run in the near future and that he remains confident that "we can get more energy out of it now than we put into it."

When asked about whether the machine would violate laws of physics, Mirkin excused himself on grounds of lacking a scientific background and let his vice president, Patrick McDonald, reply. The basic contribution of the inventor, McDonald said, was to challenge "conventional wisdom;" the machine "liberates the potential energy in water in a way others believed could not be done."

Leach, though he appeared for the Times, is now apparently unavailable for comment. Attempts by SCIENCE NEWS to reach him were unsuccessful.

Hydrogen production from metal-water reactions is nothing new. As long as 60 years ago hydrogen was produced commercially by mixing powdered iron with steam. Today, work on systems similar to Leach's (as far as one can tell) is going on around the world. One of the laboratories involved is Chicago's Institute of Gas Technology, where Derek P. Gregory has been a leader in the movement toward a "hydrogen economy" (SN: 9/1/73, p. 135). Mirkin said that when he showed Gregory the new machine, "He was flabbergasted." But in an interview, Gregory said, "I would not want to be quoted as being enthusiastic."

The promoters, he said, "have failed to prove to me that they did what they claimed. . . . The one vital piece of information needed [flow rate versus energy input] was not available." Gregory said that his institute has also developed a closed-loop hydrogen generator based on cadmium. But no system, he says, will actually approach what Mirkin claims: "If it works the way they say it does, it is perpetual motion. That's impossible." □

Science and safety: 'Acceptable' risk

Though specific safety issues receive widespread publicity—are nuclear reactors safe, will the SST destroy the ozone layer, should possibly dangerous research in genetic manipulation be banned?—far less attention has been paid to discovering better ways to answer these pressing questions.

William W. Lowrance, now a research fellow at Harvard, used a two-year Sloan fellowship at the National Academy of Sciences to attack the problem, and his new conclusions have been published in a new book, *Of Acceptable Risk.*

Much of the current confusion about the nature of safety decisions, Lowrance says, results from deeply rooted misunderstanding about what safety is. Specifically, he challenges the dictionary definition of "safe" as meaning "free from risk." Since nothing is really risk-free, safety decisions must be based on measurements of what risks really are inherent in a given situation, followed by a value judgment of whether accepting those risks is reasonable. The book is thus based on a more pragmatic definition of safety: "A thing is safe if its risks are judged to be acceptable."

His book is an eminently readable attempt to answer the questions that quickly arise from the basic premise—how should risks be measured and who shall judge acceptability? Full of lively anecdotal material and an occasionally frightening summary of just how many hazards do surround us, the book is aimed at the "well-informed layman," to serve as a primer for responsible action. Lowrence worked with the Academy's Panel on Science and the Determination of Safety, which in some measure set the book's tone and scope. But by encouraging this work, rather than issuing yet another formal report on safety policy, the NAS may well have provided a much wider audience with a much more articulate presentation of its case.

Lowrance bears down most heavily on perspective, beginning with the historical perspective of consumer problems in ancient Rome, when lead-glazed pottery may have caused chronic poisoning of the aristocracy. Many of today's controversies, he concludes, arise simply because our ability to assay potential dangers has become so sensitive. The municipal drinking water of Duluth, Minn., for example, appeared clear and free of particulate matter under a light microscope, but when it was examined in 1973 with an electron microscope, it was found to contain up to a hundred *billion* fibers of asbestos per liter. The resulting controversy over the water's "safety" still rages.

To be able to estimate the risks involved in such cases, more research must be done to relate exposure to effect. Already such research has produced some insights into bodily response to environmental hazards, but Lowrance says that for most toxic chemicals, radiation and other low-level or delayed-effect hazards, the question of a threshold for deleterious effects has never been satisfactorily resolved. Indeed, for many hazards, more research is needed just to determine what safety tests to perform. For example, to test a pesticide or food additive to ensure it would cause no more than two tumors in one million people might require experimenting with three million test animals, and even then questions arise about how well one can extrapolate such results.

Even given all these difficulties, the tougher question is still how to determine acceptability once a risk is known. All traditional methods have increasingly evident limits. Table salt and cyclamate were once judged acceptable because of custom; they were "generally recognized as safe." Then in 1969 cyclamate was suddenly banned because of controversial animal experiments. Later experiments have now led to a move to reinstate cyclamate and possibly ban its substitute, saccharine. And what does one do about salt, which has now been implicated in high blood pressure, but which is necessary for life.

One strong recommendation Lowrance makes is to increase the number of retrospective studies on items whose safety has already supposedly been determined. He cites a study that shows that nearly four times as many new drugs became exclusively available in Great Britain as in the United States during the 1960s, with less stringent marketing controls initially but better follow-up programs. The study concluded that "on balance, Britain appears to have gained in comparison."

During an informal discussion last week at the Academy, Lowrance summarized his case by parodying an old ad line: "Progress is our most important problem." Some new ways of slowing down are needed—new choices between the extremes of banning a product or licensing it unconditionally. More people must become involved in the decision making process with both sides of issues brought into real juxtaposition, he says, rather than the sometimes ritualized presentation at regulatory hearings. The result may be a new level of mutual restraint: "I'm a real dreamer, I hope for a different ideal of progress."

Scientists must play a key role. In his book, Lowrance frequently refers to the "any-man's-land" between the two tasks of measuring risk and judging acceptability. It is here that the scientist must accept new responsibility: "Recognizing that they are making value judgments for the public, scientists can take several measures toward converting an 'arrogation of wisdom' into a 'stewardship of wisdom.'" □