

Changing Profile of Deep-Sea Miners

"The people who thought they would make money in it are disillusioned. Hell, if you were a craps shooter you'd get out of this game by now."

The speaker was Jack Flipse, formerly the president of Deepsea Ventures, Inc., one of the most important, high technology ocean mining companies. Flipse's views on who is and isn't going to make money mining the deep ocean floor for potato-sized manganese nodules could have implications for U.S. policy at the Law of the Sea Conference. The conference's latest session in Geneva, Switzerland, just recessed without resolving a longstanding deadlock on how much access the rest of the world should have to the wealth of the ocean floor.

Flipse is now a professor at Texas A & M University, but, until last year, his job as head of Deepsea was to develop a brand new technology for mining the ocean floor—technology in which Third World countries at the Law of the Sea Conference are demanding to have a share. And, in this venture he had the enthusiastic support of the president of Tenneco Inc., the mineral conglomerate that owned Deepsea. The president, Flipse recalls, was "enchanted" with the prospect of deep ocean mining. Company calculations in the late 1960's showed that the first years of ocean operations could bring in \$100 million per year after expenses, which would enable the company to make back its \$200 million investment in two, quick years. "In all speculative ventures companies want to make back their investment in just a few years," Flipse explained in an interview with *Science* recently.

But by the mid-1970's, Tenneco's president died, its corporate goals narrowed to near-term development of oil and natural gas, and the company's new leaders were less than enchanted by the long-term adventures of deep ocean mining. Today Tenneco no longer owns Deepsea Ventures; Flipse left last year due to a conflict with the managers of the new consortium that took over the company, made up of Sun Oil Company, U.S. Steel, and the Belgian copper firm, Union Minière.

Flipse says he sees a similar pattern elsewhere in the ocean mining industry, where the former speculators, who were "crap shooting" when they got involved, have since cut back their role. Kennecott, another major entry, had diluted its gamble by bringing in oil and mineral interests along with some Japanese as co-investors. Lockheed has entered the game, but also with a mix of oil and mineral companies as partners. The mineral companies, such as U.S. Steel, are in as a hedge against future low availability of minerals they need. U.S. Steel, for instance, has predicted that in 25 years, Gabon and South Africa will be the only Western sources of manganese; and since you cannot make steel without manganese, U.S. Steel will bet on the deep seabeds as another possible source.

The oil companies, he says, are the chief sources of venture capital for the industry these days, partly because they are among the few enterprises rich enough to make such investments, and partly as a long-term hedge that oil may be found under the deep ocean floor where the nodules are found.

For whatever reason, it is widely believed in the industry now that long-term hedges, and not quick profits, are the name of the deep-sea mining game. One former State Department ocean mining expert explains that under the terms now proposed at the Law of the Sea meeting, only 10 mine-sites a year will be allowed to be exploited, each 40,000 square kilometers in area, and together bringing in only \$40 million after expenses to the industry—instead of the \$200 million per company Tenneco once envisioned.

This declining profitability may be one reason that Elliot L. Richardson, the U.S. Ambassador to the Law of the Sea meeting, has been so pessimistic about the conference—in which the United States has invested a decade of effort. Richardson has also testified in support of protective legislation that would encourage U.S. companies to go ahead and mine the seabeds unilaterally, in the absence of an international treaty. Ironically, this protective legislation, now in committee on Capitol Hill, stands a better chance of becoming law now than it did 5 or 6 years ago, when companies like Tenneco helped to draft it in the belief that deep-sea mining would begin immediately and would be immensely profitable.—D.S.

things together as well. They may share eating utensils, razors, toothbrushes, skin abrasions, needles, lovers, and bed bugs, and any of these or others could permit the intimate, but nonvenereal transmission of viral hepatitis."

Two hepatitis B vaccines are under development in the United States, one by Merck and the other by Robert Purcell and colleagues at the National Institute of Allergy and Infectious Diseases. The Purcell team's vaccine, developed as a demonstration project, is at present undergoing safety tests in humans. More stringent requirements for informed consent and other restrictions have created problems in testing vaccines on traditional groups such as prisoners and children in institutions. The Purcell team vaccine is being safety tested in a community of Trappist monks in Georgia. The community is in many ways ideal for the purpose. There is no problem in obtaining the monks' informed consent, and since the community is known to be free of hepatitis B, any cases that occur would be directly attributable to the vaccine.

So far the vaccine is proving remarkably free of side effects, a trait probably due to its unique method of manufacture. The virus cannot be grown in tissue culture, the usual method of vaccine production, but is harvested directly from the blood of human carriers. So profusely does it grow there that three donors have provided Purcell with enough virus for 20 thousand doses of vaccine.

As for the possibility of a shortage of chimpanzees for production safety testing, Purcell says that that is a problem for the government vaccine regulating agency, the Bureau of Biologics. Robert J. Gerety, chief of the bureau's hepatitis branch, notes that the bureau in anticipation of a shortage set up a breeding colony to supply its own needs. "But I know that the bureau doesn't have enough animals to supply to manufacturers for safety testing," says Gerety.

The world has a growing population of 4 billion people and a dwindling population of some 50,000 chimpanzees. Since the vaccine seems unusually innocuous, and since the disease is only rarely fatal, it would perhaps be more just if the larger population could find some way of solving its problem that was not to the detriment of the smaller.

—NICHOLAS WADE

Erratum. In the report by C. W. McCutchen [197, 691 (1977)], the sentence in paragraph 2, column 3, "The downward motion is an inversion of the upward motion about a point on the axis of samara spin" is in error. It should be replaced by "The downward motion is a reflection of the upward motion successively in a horizontal and in a vertical plane."