TECHNO STAR-GAZING

Pessimists take note–extraordinary technological breakthroughs may soon transform our environmental horizon. Cold fusion, nanotechnology and zero-point energy may be household words for our children.

Committed environmentalists have a siege mentality these days and oddly, it is the environment itself that is doing much of the besieging. The briefest catalog of ecological crises is enough to bring gloom to the stoutest heart. It can be difficult to escape the feeling that the problems are so overwhelming, so intractable, that there is no way out.

The environmentalists may be wrong to despair. A window out of our collective darkened room may be opening. Underlying the prevailing climate of despondency is the assumption that the fundamentals underlying critical variables such as energy usage and manufacturing techniques will change little, if at all. This is not necessarily so. These are dramatic times and dramatic changes, paradigm- and *gestalt*-busting changes, may be headed our way.

Cold Nuclear Fusion

By now most people know, or think they know, the story of cold nuclear fusion. In 1989, two University of Utah scientists, Stanley Pons and Martin Fleischmann, announced that they were producing excess energy at normal room temperatures. A great commotion ensued: if valid, cold fusion was one of the greatest technological breakthroughs of the century, if not all time.

Around the world, scientists tried to duplicate the findings of Pons and Fleischmann. A few succeeded but many failed. The worm was quick to turn. The University of Utah scientists were denounced as incompetent scientists, if not outright frauds. Cold fusion went down as a case study in "pathological science."

For most people, the book was closed, another sorry case of hopes raised and dashed. But far from the story being over, a new chapter was beginning. Quietly, without media fanfare, cold fusion research continued, mostly outside North America. Pons and Fleischmann re-settled in southern France, building a powerful lab with support from the Toyota family of companies. Japan's Ministry of International Trade and Industry (MITI) established a program for cold fusion research with four-year funding of US$ 30 million.

Slowly, the resurrection began. Scientist after scientist in country after country-over thirty countries as of this writing-reported the production of excess energy. Today, cold fusion research is alive and well. In the words of Moray King, an expert in new energy research and author of *Tapping the Zero-Point Energy,* "You could shoot Pons and Fleischmann tomorrow and it wouldn't make a difference." (Not to the advancement of cold fusion, anyway!)

By and large, the mainstream scientific community has turned a blind eye to these developments—nowhere more than in the U.S. This is difficult to explain, given scientists' professional commitment to objectivity and rationality. From another angle, however, it is understandable, given the mainstream's enormous emotional, intellectual and financial investment in the status quo, including hot fusion.

The U.S. Department of Energy, after receiving a negative report from the Energy Research Advisory Board, has refused to fund cold fusion research, even though respected government-sponsored labs such as Los Alamos and Oak Ridge have produced evidence supporting the phenomenon. The U.S. Patent Office refuses to issue patents in the field. Seemingly irrational responses like these have armed supporters of cold fusion with a phrase, "pathological skepticism," that they wield in delighted counterpoint to the "pathological science" charge frequently hurled their way.

But the winds are changing, in no small measure because the mainstream media have begun to sit up and take notice. MIT's respected *Technology Review* has published a favorable article. The Canadian Broadcasting Corporation has produced an upbeat documentary. Even the *Wall Street Journal* has run a respectful story. Although cold fusion has not yet cast off its status as scientific pariah, it is clearly on the road to redemption.

More important than cold fusion's reputation, though, are its implications, which are nothing short of staggering. Writing with typical *brio* in the magazine *Cold Fusion,* novelist Arthur C Clarke describes them as follows:

"What are the implications of [findings of excess energy produced by cold fusion]? I'd like to give several scenarios.

"There's a conspiracy of hundreds of scientists in dozens of countries. They're either totally incompetent, or they're superbly organized and out to make a killing in oil and coal shares.

"Slightly more probable: C/F is a laboratory curiosity, of great theoretical but no practical importance. Frankly, I doubt this. Anything so novel indicates a breakthrough of some kind. The energy produced by the first uranium fission experiments was trivial—but everyone with any imagination knew what it would lead to. Cold fusion can be scaled up to moderate levels, say 100 to 1,000 kilowatts. Even that could be revolutionary, if cheap and safe units could be manufactured. It would make possible the completely self-contained home that Buckminster Fuller envisaged, because the electric grid would no longer be necessary for domestic distribution. And it would be the end of the gas-fueled car—none too soon. Automobiles could, quite literally, run on water, though perhaps only heavy water.

"The third possibility is that there are no upper limits. In that case, the Fossil Fuel Age has ended, along with CO_2 buildup, acid rain and air pollution."

And in a letter to vice-president Al Gore, Clarke added the following addendum:

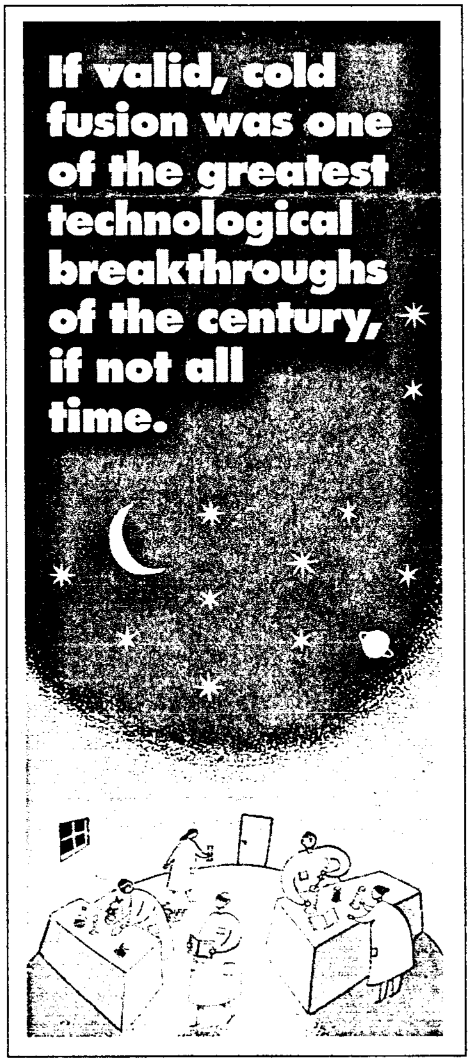
"...With monotonous regularity, all throughout history, religious crackpots have predicted the imminent end of the world. I have about 90 percent confidence that I'm now doing something similar...And this time, it's good news."

Zero-Point Energy

Cold fusion isn't the only area of potentially paradigm-shattering "new energy" technology that's not quite in the news. There's also something even more controversial called space energy, or zero-point energy. Scientist Andrew Michrowski of the Planetary Association for Clean Energy explains:

"Empty space is not truly empty but contains an enormous amount of untapped electromagnetic energy known as zero-point energy ('zero' referring to the fact that this energy exists even at a temperature of absolute zero when no thermal effects remain). Vacuum energy is traced to the radiation from fluctuating quantum motion of charged particles distributed throughout the universe...It is likely that gravity is an effect of vacuum energy."

The notion of space energy is not new, and neither is the concept of extracting and controlling it. In 1901, Dr. Nikola Tesla, an almost-Nobel Laureate and prodigious genius whose many insights never quite made it into the mainstream patented a procedure for tapping space energy and reportedly developed a motor based on that patent. Research has continued unbroken since Tesla's time, with more than the occasional report of success. But space energy has never really broken out from the scientific underground, which is where it remains today.



It is an extremely active underground, though, abuzz with scientists and inventors hard at work in labs around the world. There are many claims of functioning 'over-unity' machines—'over-unity' because they output more energy than they consume—some of which may even have merit. Dr. Hal Puthoff, a highly respected scientist with the Austin Institute of Advanced Studies, has results coming out of his lab promising enough to have attracted the preliminary interest of venture capitalists. Troy Reed reportedly plans to drive from St. Louis to Los Angeles without re-charging his space energy-driven electric automobile—a spectacular demonstration, if it happens. And there are other tantalizing projects as well.

All of which raises an obvious question. If the energy of the vacuum can be accessed for commercial applications and if there are all these functioning machines out there, then why has there been no commercial or scientific liftoff? In a variation of "If you're so smart, why ain't you rich?", if the science is so good, why ain't it successful?

Mainstream scientists say it's because there ain't no science there. Members of the space energy community rebut this charge by offering three explanations for their lack of professional and commercial success.

First: not enough money. Space energy research is much too chancy for venture capitalists and the inventors themselves are badly undercapitalized. According to Hal Puthoff, in many cases excess energy is produced too sporadically to attract funding: "It happens once, then not again for another six months." This happens often in new areas of scientific inquiry, but coupled with the lack of a theoretical foundation it has been a killer for space energy.

Second: what Jeane Manning, author of *The Coming Energy Revolution* from Avery Press, only partly ironically calls "the system." Inventors sink so much of their lives and money into their work that they get possessive about it, both emotionally and financially. Says Manning, "Giving their knowledge to the world would be better but it's not something they're prepared to do."

No publication, no validation. No validation, no credibility.

Third: resistance of the mainstream scientific community. Like cold fusion, space energy threatens to undermine key elements of the current scientific paradigm. Orthodox scientists with heavy investments in the status quo are only too eager to dismiss developments in the field. They have, one might say, a "de-bunker mentality."

In fairness, the space energy community has earned some of that distrust. Scientific method calls for the publication of methodologies and the replication of findings and the compulsive, sometimes paranoid secretiveness of space energy researchers has kept that from happening.

Hal Puthoff, who is the space energy researchers' unofficial ambassador to the mainstream scientific community, has issued a "One-Watt Challenge" that calls for an inventor to go public with the details of a device that continually generates "on a stand-alone, self-powered basis...a minimum of at least one watt *excess* average output power." Proof of this sort, he believes, would go a long way toward filling space energy's substantial credibility gap. Meanwhile he is laying a badly-needed theoretical foundation by publishing highly professional, peer-reviewed articles in all the right journals.

Are commercial applications based on space energy a foregone conclusion? Puthoff answers guardedly: "Only the future can reveal whether a program to extract energy from the vacuum will meet with success."

Space energy scientists have been making unsubstantiated claims for years, so a modicum of caution about the current crop of space energy devices is warranted. But if they do turn out to be more than smoke and mirrors—and little by little, a credible foundation is being laid—commercial applications are likely to be with us soon. Author

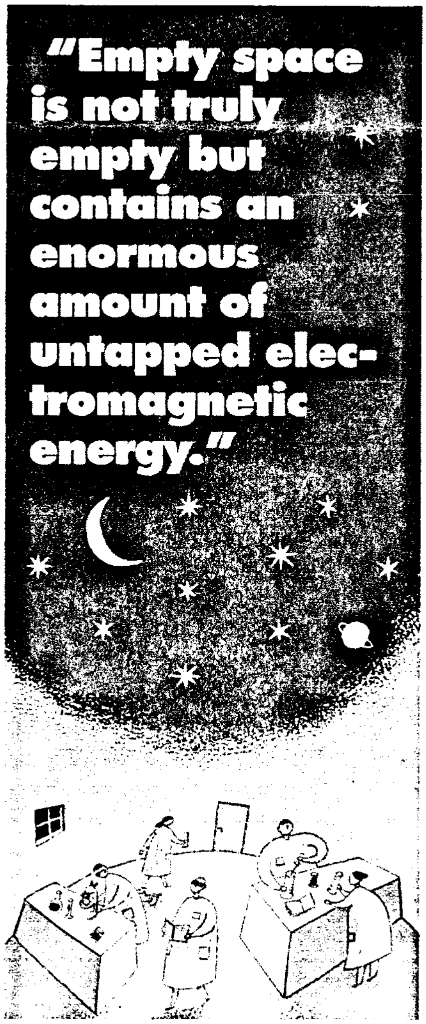
Jeane Manning anticipates that within ten years, "space energy devices will be somewhere between the early stage of proliferation and widespread availability."

As for the implications of tapping the energy of the vacuum, they are potentially no less than those of cold fusion-the end of the Fossil Fuel age.

Nanotechnology

Also on the horizon is a technology that while not literally paradigm-shattering—it doesn't contravene current scientific understanding—could have a transformative impact of truly extraordinary dimensions. It is called nanotechnology and it is seems destined to transform the nature of manufacturing.

Instead of manufacturing 'down'—hewing out of wood, etching out of silicon—nanotechnology makes it possible to manufacture 'up,' atom by atom, molecule by molecule. Writes Foresight Institute head Eric Drexler, arguably the embryonic technology's leading light: "The ancient style of technology that led from flint chips to silicon chips handles atoms and molecules in bulk; call it *bulk technology.* The new technology will handle individual atoms and molecules with control and precision; call it *molecular technology*...Molecular manufacturing will do for matter processing what the computer has [and will] do for information processing...Twentieth-century technology is headed for the junk heap."



Nanotechnology gives *precision manufacturing* a whole new meaning. Not only does it become possible to manufacture a vast array of new products but their fabrication can conform precisely to design specifications—literally down to the last atom. Whereas today's clunky bulk manufacturing technology makes compromises inevitable, what you want is what you get, or will get, with nanotechnology.

In medicine, nanotechnology may make it possible to build devices that target cancer cells without harming their neighbors, a huge improvement over the mayhem wrought by today's shotgun chemo- and radiation therapy. In healthy people, nanotechnology-built cell repair machines may be able to identify abnormal cells and return them to their healthy state, thereby retarding aging.

As for the environment, here, too, nanotechnology promises to have an extraordinary impact:

Nanotechnology will make it possible to fabricate lighter, stronger, longer-lasting products, thereby reducing materials consumption.

Nanotechnology will enable the manufacture of products without producing chemical or solid waste. "Pollution results from a lack of control," writes Eric Drexler. "With control stretching all the way down to the molecular level, material pollution need no longer be part of the production process..."

Products as well as processes can be designed to be environmentally neutral—or even active do-gooders. Why not, queries Drexler, design products to do as green plants do so that they consume rather than produce carbon dioxide?

Specialty products can be fabricated that tackle specific environmental problems head-on. For instance, Drexler envisions molecular cleaning devices that neutralize dangerous chemicals such as dioxin by rearranging their atoms.

The coming of nanotechnology is in many ways a frightening proposition. It could be used, for example, to produce horrific weapons. But it can just as clearly do a world of good. And for better or worse, its arrival seems to be inevitable.

Imminent, too. Japan's MITI, a world leader when it comes to visionary long-term planning, is sinking $200 million into nanotechnology research over the next ten years. As for the state of the art, scientists are already knocking at nanotechnology's door—hard as it may be to believe, IBM researchers have constructed an image of the corporate logo using 35 xenon atoms.

Eric Drexler's best guess is that nanotechnology will start producing commercial applications around 2010. Hal Fox, editor of *New Energy News,* is more optimistic: "A scientist in Minsk is already developing nanotech devices—I would say by the year 2000." Even if we add ten years to Drexler's 2010 estimate on the principle that technologies always roll out more slowly than anticipated, that's only twenty-five years away—as near to us in time as the Vietnam war.

It can be difficult not to view technologies like cold fusion, space energy and nanotechnology as the stuff of science fiction. The promised transformations seem too immense, the technologies themselves too "gee-whiz." But our skepticism may say more about the limits of our imagination than about the actual technologies. In this age of extraordinary scientific and technological breakthroughs, the truth can be stranger than fiction.

The arrival of any one of these three technologies (let alone two or all three) would create a vastly more positive set of assumptions about our environmental condition and prospects than the one we live with today. Improbable and melodramatic as it may seem, the technological cavalry may be headed our way. At this very moment, it may be just over that hill, just on the other side of the millennium. ●

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