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COLD FUSION AND THE PRESS

This time honored ritual wherein members are obliged in due course to give a prepared talk must engender some strange topics, but possibly nothing so strange as this one, and the controversy surrounding it.

New developments in science have always held my attention. Beginning with my undergraduate days at MIT, I have followed them at a fairly technical level and I have continued to do so during 32 years of engineering practice. When something seems wrong I am apt to speak up, or write down, as the case may be. And so it is with this matter called cold fusion.

To be fortunate enough to have an audience of those of professional achievement makes my task more pleasurable as it authorizes me to tackle the subject more aggressively and more definitively. Should this field develop rapidly it may well impinge on your professional lives more quickly than you might ordinarily expect.

Although I am attracted to the technical story of cold fusion, my interest is also intrigued by the public assault upon its two discoverers. Assault, by or through the press, upon a newly emerged public figure is now a deplorable commonplace of our communal life. The two discoverers of cold fusion now live and work in France financed by a Japanese company. It has come to that.

Thomas S. Kuhn in his book <u>The Structure of Scientific Revolution</u> makes this observation, "Normal science....often

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suppresses fundamental novelties because they are necessarily subversive of its basic commitments." Cold fusion is subversive of hot fusion, and it is moving right along. Visitors to MITI, The Japanese Ministry of International Trade and Industry, report that it will spend $25 million over a number of years in additional support of the cold fusion research of some 15 companies and several Universities, and that it expects the first prototype power packs using cold fusion technology will be available no sooner than 1997 and no later than the year 2000.

Although this is a professional audience, I recognize it is also a non-technical one. So let me first get out of the way a brief description of the cold fusion device which we will call the cell.

We start with a brief mention of hydrogen, the lightest element; it has in its nucleus one proton. We will also be concerned with an isotope of hydrogen called deuterium; it is like hydrogen except that it has one proton and one neutron in its nucleus, so it is twice as heavy. When its one electron is stripped away leaving just the nucleus, it is called a deuteron.

Heavy water is the name given to water whose molecules are made up of deuterium and oxygen. All water has some deuterium in it; a glass of water has many millions of water molecules made with deuterium instead of hydrogen.

Palladium is a precious metal with certain unique properties. It acts as a catalyst; it makes other things happen while not being itself consumed. A unique characteristic of palladium is that it can absorb large amounts of hydrogen. This has been known for more than half a century and is used as a method to purify hydrogen. It is for this special characteristic that palladium is used in the cold fusion cell.

If you take a one quart mason jar and fill it with heavy water, you have a good start on making a cell. Into this jar place the important electrode, a sheet of palladium metal an inch square or so with a wire connected to it coming out of the jar. Then place a platinum wire in the

water and add a salt, such as lithium hydroxide, to make the water conductive.

If a direct current source is connected to the electrodes with minus on the palladium, the cathode, you have an electrolytic cell not unlike what many of you built in secondary school chemistry class. The action of the current through the solution will cause the water molecules to come apart chemically. Oxygen bubbles up from the platinum electrode, and hydrogen or deuterium gas bubbles up from the palladium electrode.

In March, 1989, two electrochemists, Stanley Pons and Martin Fleischmann, at the University of Utah, Salt Lake City, where Pons was head of the chemistry department, announced at a press conference that they had generated heat in an electrolytic cell by means of a cold nuclear fusion reaction.

In the P&F electrolytic cell, as it was explained by them, the electrical current pulls deuterium atoms into the atomic structure of the palladium electrode. There the deuterium atom finds a place of its own and, if its electron blends in with other electrons in the metal, only the deuteron, the nucleus, remains.

It is argued that nuclear fusion takes place among the deuterons, and maybe among the deuterons and protons, within the metal lattice of palladium atoms. The fusion action releases heat energy into the metal and then into the bath. This heat adds to the heat caused by the original electric current. This increase of heat is referred to by scientists working on these cells, as "excess" energy.

The law of conservation of energy allows that in principle every minute erg of energy can be fully accounted for. With energy traveling about, as it does, by conduction, convection, and radiation, an accounting for every tiny bit can be difficult in practice. Should an experiment release much more energy, atom for atom, than is possible from any chemical reaction, that would be an indication that the energy is coming from the nucleus, and that further scientific investigations are warranted.

To understand the ensuing controversy it is important to remember the grounds upon which the claim of fusion is based. **The claim of cold fusion by P&F and other scientists are based upon the generation of excess heat at a density that cannot be explained by any process other than a nuclear reaction.**

Science is built on the repeatable experiment; so we should ask, Was the P&F experiment repeatable?

Yes and no; the cold fusion experiment is immature. Many have repeated it in that they demonstrably have obtained excess energy. That everyone could not repeat the experiment means that its design is yet only partially understood. Is an immature experiment science? All revolutionary experiments had to go through a process of creation and development until they were perfected. Of course such work is science. But in retrospect, it seems clear that it always looked much easier than it was and, surprisingly, it still does.

Michael C. H. McKubre, at Stanford Research Institute, demonstrated excess energy in P&F type cells during the fall of 1991, and most recently Akito Takahashi of Osaka University also did so. These results have been published in refereed scientific journals. During the past three years the repeatability of the P&F cell experiment has been improving steadily; the experiment has been maturing.

The latest experimental work aims to improve the specification of the palladium electrode and to obtain sufficient infusion of deuterium into the palladium. It is now accepted that to make the cold fusion process begin functioning it is necessary to achieve a "loading" of almost one deuterium atom for each atom of palladium. Some recent experimenters have managed to "load" more than one deuterium atom into the metal for each atom of the palladium.

To share such experimental knowledge from India, Italy, the U.S., and Japan the first annual cold fusion conference was held in Utah in the spring of 1990, a second one in June of 1991 in Como, Italy, the third in Nagoya, Japan, in October, 1992, and the next will be held in Hawaii, December

1993.

You may be aware that in 1989 the State of Utah committed $5 million to support further research. As part of the oversight of this expenditure, the Legislature commissioned Professor Wilford F. Hansen, physicist at the University of Utah, to analyze the raw data that P&F gathered from some of their performing cells. After doing extensive analysis of their data he concluded, in June, 1991, that, for a particular one of the cells, [I quote] "This [excess heat] is already an order of magnitude [ten times] larger than the energy [needed] to vaporize the entire palladium electrode. We have thought of no other self consistent explanation than that the excess heat is real and very significant." For another cell, he reports, [I quote] "The integrated excess heat is about 1700 Ev [electron-volts] of energy per palladium atom. This is about 400 times the vaporization energy of palladium..." "Therefore [this cell] appears to be producing large amounts of excess heat, with the amount increasing with temperature."

Professor Akito Takahashi, Dept. of Nuclear Engineering, Osaka U., Japan, lectured at MIT in the spring of 1992 describing his most recent excess energy results. He reports, [I quote] "Total energy balance for the 1 week + 2 months run was...total input energy = 250 mega-joules, total output energy = 410 mega-joules and net excess heat = 160 mega-joules." Continuing, the "Average input power = 50 watts, average output power = 85 watts and average excess power = 35 watts... Continuing, "We should have, therefore, [a] "hidden" excess heat source in the cell. Other possible heat sources by chemical reactions can be estimated as too small to explain observed excess heat; ...chemical reactions.....can produce heat level[s] of the order of 0.015 mega-joules. The order of excess heat observed is about 1000 times greater than chemical heat sources." [End of quote]

More recently, Pons and Fleischmann report that high levels of heat production are now 100% reproducible and demonstrate a cell with an input power of only 37 watts that can boil away 1/20th of a liter of heavy water in 10

minutes. This feat requires an excess power level of 144 watts during the 10 minutes.

From this variety of evidence and argument, What may we reasonably conclude?

The law of conservation of energy is considered absolute by all parties to the cold fusion controversy. The excess energy absolutely must have an ultimately identifiable source. There is no escape from this imperative. **This quest is the very stuff of authentic scientific exploration regardless of where the answer resides.** Excess energy from the cold fusion experiment is proved but not explained.

No one has any suggestion as to an alternate source of the observed excess energy other than the P&F conclusion that they are witnessing in the cell some species of nuclear process taking place within the atomic lattice structure of the palladium electrode.

It is for this reason that the experimental and theoretical work that passes under the name of "cold fusion," is a thoroughly legitimate scientific activity and deserves to be so recognized and funded.

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Lets see, then, how the critics approach the matter of cold fusion.

Of the five books now available on this subject, the two that are most critical entirely avoid the implications of excess energy. Neither of them in more than 250 pages tells the reader that excess energy has been well confirmed, that its magnitude is beyond chemical sources, nor offers explicitly the author's opinion of its significance.

Then the critics look for evidence of nuclear reactions -- nuclear ash -- that are generated by nuclear processes. Physicist and chemists with extended experience in the nuclear field, naturally enough, rummaged through the experimental data looking for fusion's familiar neutrons and gamma rays. Finding few or none of these, they have raised a hew and cry against cold fusion saying that it isn't.

But this assumes the heat generating process in question is known. Certainly one can look for the products of those fusion processes that are recognized from other work, but that involves the assumption that nothing really new is happening here. Such considerations are named by Prof. Huizenga, the author of Cold Fusion: The Scientific Fiasco of the Century, "miracles," as a way to rhetorically discredit their possibility.

The measurement of excess energy by many scientists is accurate, real, and large. Also no one, physicist critic or scientific experimenter, can even suggest possible sources for this amount of energy other than by a nuclear source. Therefore we might anticipate the identification of new and now unfamiliar nuclear reactions. This now seems to be the working assumption of those scientists leading the experimental work.

The criticisms levelled by those who did not see familiar nuclear emissions from the cells, and who did not much care about something called excess energy, are well documented.

Prof. Stephen E. Koonin, a respected physicist, "We have suffered enough from the delusions and incompetence of Pons and Fleischmann."

Prof. Ronald Parker, Director of the MIT Plasma Fusion Center, said, the work of P&F is "scientific schlock," and "maybe fraud."

Prof. John R. Huizenga, U. of Rochester said, cold fusion is "...pathological science."

This last phrase appeared in the Department of Energy Cold Fusion Panel of the Energy Research and Advisory Board [ERAB] whose report released in October of 1989 recommended no money for cold fusion and prohibited any such research activities in Department of Energy laboratories. Notice the severity of this report. Some of our finest scientists are directors of federally funded laboratories and by this administrative fiat they are not permitted to carry on cold fusion experiments with discretionary funds. This is probably the principle act that has prevented an expansion cold fusion research studies in the U.S.

And the critics continued. Prof. H.W. Lewis, professor of physics, said "That they lived to hold their press conference is clear and unambiguous proof that they did not produce any noticeable amount of power through cold fusion." And, "We mortals cannot change those facts."

Dr. George Chapline, Livermore Laboratory, said that the Utah results were "a case of self-deception ... The claims of these people are preposterous on the face of it."

In his defense Stanley Pons said, "We haven't any doubt that a deuterium fusion reaction is occurring in the palladium." And, "There is no reason the [fusion] reaction has to be the same [as in hot fusion]."

That, in a nutshell, is the source and the content of the controversy.

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Now, briefly, let us look at how this was handled in the press.

Jerry Bishop, a name you may well be familiar with, is a science writer and editor for The Wall Street Journal who has published some 30 reports on cold fusion during the past four years. In recognition of the quality of these reports, The American Institute of Physics, in January 1992, gave him the "Science-Writing Award in Physics and Astronomy." Aware of how different his reporting was from that of other publications, Bishop offered the following admonition, "A reporter gets into a very dangerous situation when he begins to decide what the public should know or should not know."

The New York Times did its usual thing. It reported the controversy as a political story, rather than as a science story. The majority view set the tone or attitude for each story; that majority quickly became the "scientists," and the successful cold fusion experimenters became the "enthusiasts." But the Times overlooked a third party in this contention: she often goes by the name of mother nature. In all this dispute, we must never forget that mother nature is a silent partner.

Mother nature knows, even if the New York Times does not,

whether or not cold fusion is happening in the cells. Mother nature will determine the outcome, and will do so quite without regard to the persuasion of the majority.

This concept is important because provincial papers like our Portland Press Herald use newswire services most of which, except for Reuters, tend to follow the lead of the Times. As an editorial in the WSJ put it, "There is an odd habit among presumably competitive journalists....of deciding that they will agree with each other on the meaning of major news stories." The major media definitely agrees with the Times on the meaning of the cold fusion story: there is nothing there except unmitigated scientific hype.

A number of refereed scientific journals, such as Fusion Technology, Journal of Fusion Energy, and The Journal of Electroanalytical Chemistry and several others are willing to run the gauntlet of elite opprobrium and publish cold fusion technical articles.

The opposition to such articles, however, has not reached the point that it did during the anti-nuclear power days when opposition to publication of particular articles, such as the Inhaber report, was overtly organized and orchestrated.

The preeminent scientific journals, Nature, Technology Review, and Scientific American, that write for a broad audience are now closed to technical news and articles on cold fusion. But more significantly, they are also closed to discussions about the merits of studying the excess energy phenomena. **From their point of view in their pages there is no scientific controversy about the existence of cold fusion.**

They do, however, comment editorially on the foibles of others. For example, at one of the early cold fusion wakes the Editor of Nature intoned, "Would a measure of unrestrained mockery, even a little unqualified vituperation, have speeded cold fusion's demise." Or (for a second wake), I quote, "Farewell (not fond) to cold fusion....the cold fusion fuss is discreditable to the scientific community as a whole....so many serious people

have been bamboozled for so long....a shabby example for the young....the time wasted....there is a limit to people's patience...." At no place in a full page of this censure is there any reference to the significance of the observed excess energy.

With these words the editors of Nature have painted themselves into a tight corner. I watch with anticipated amusement to see when the editors begin to have some first thoughts about digging themselves out. Scientists and science writers who address a broader audience than that offered by the refereed technical journals are thus led to periodicals on the publication fringe. To the dismay of these authors, articles derived from the Second Annual Cold Fusion conference in Como, Italy, appeared, for example, in 21st Century Science and Technology, a magazine published by Lyndon LaRouche supporters. We will see below how the anointed elite make a powerful weapon of this fringe phenomenon that they have engendered.

Editors of the scientific press are often the ones to whom the general press looks for the meaning of science stories.

For example, the U.S. governments' credibility in their 1982 charge that the Soviet Union was using a new T-2 mycotoxin chemical weapon in Laos and in Afghanistan was effectively undermined by the appearance in Scientific American of a ten page article purporting to show that "yellow rain," as it was called, was merely the excretions of honey bee swarms. A similar situation has arisen now with regard the credibility of cold fusion research results, but with a new twist.

As you are no doubt aware, Scientific American is printed in many countries with more or less identical page content except for the language. But in each country it is a separate publishing venture. The Nikkei Publishing company publishes the Japanese version under the name Saiensu (Science).

In the March 1992 edition of the Japanese issue, the results of Takahashi's experiments and consequent

theoretical musings were well reported in a news story covering two pages and with illustrations and what I will call quantized information -- what others might call actual numbers. Naturally enough, some American scientists called the offices of the American publication, whose long time editor is Jonathan Piel, to ask why it has not published any cold fusion experimental results in the U.S.

Their answer is instructive. It was published in the (U.S.) May issue which some of you may have seen. If one wants to understand what is going on -- and that is a large part of my purpose -- the answer, by editor John Horgan, is worth a brief analysis.

The editorial is entitled, "Japan, Cold Fusion and Lyndon LaRouche."

> "If U.S. proponents of so-called cold fusion, otherwise known as fusion-in-a-bottle, are to be believed....
>
> "Cold Fusion has been dismissed as 'pathological science' by the vast majority of scientists since it was proposed three years ago by chemists B. Stanley Pons and Martin Fleischmann."

Notice how the author put it. It is "proponents" versus "scientists."

> "But the undeniably attractive idea of limitless energy from batterylike [sic] cells still has its believers."

Notice how "proponents" have now become "believers" -- maybe members of some kind of religious sect.

> "To regain respectability -- and, even more important, funding -- proponents are raising the familiar specter of Japan."

Notice that, in the eyes of the editors of <u>Scientific American</u>, the cold fusion scientists do not have even "respectability."

> "On paper, the Japanese effort in cold fusion does sound impressive. It involves some 100 Japanese scientists from 40 academic and industrial institutions....these workers are expected to attend the Third International Conference on Cold Fusion in Nagoya in October....In addition, a Japanese company is reportedly sponsoring research by Pons and Fleischmann in a

laboratory near Nice, France."

Notice that "the Japanese effort," as described, is not about scientific work underway, but merely an administrative body count.

> "Like their American counterparts, Japanese cold fusion researchers periodically announce astonishing results.
>
> "Akito Takahashi of Osaka University recently claimed .... excess power from an apparatus similar to the one originally used by Pons and Fleischmann.... Yet Takahashi's results remain unreproduced by other researchers and unpublished in a peer-reviewed journal."

Notice that when this was written it had only just happened. Twelve months later Scientific American's readership had not yet been informed that Takahashi's work had been published in the International Journal of Applied Electromagnetics in Materials [3 (1992) 221] in 1992, nor had they been informed that his work had been reproduced by Dr. Edmund K. Storms at the Los Alamos National Laboratory, and published in Fusion Technology [23 (1993) 230] in 1993, even though editor Horgan admitted that Takahashi's claim represented "astonishing results."

> "Fleischmann, when pressed, reluctantly confirms that he and Pons are indeed supported by Technova. Although he declines to reveal details about his work..."

Notice that the editor avoids revealing to their readership that P&F have published extended papers on their work in peer-reviewed journals.

> "Although [Fleischmann] declines to reveal details about his work, he does note that 'good information' on cold fusion can be found in 21st Century Science & Technology, a journal published by followers of Lyndon H. LaRouche. LaRouche, who is now....serving a 15-year sentence for fraud, has previously claimed the existence of an international drug cartel run by the Queen of England."

End of editorial. And I have to admit that the editors

have there a nice punch line.

So, we are now being asked by the editors of Scientific American to associate the founders of what has become the scientific field of cold fusion research with the works and claims of Lyndon LaRouche. This reminds me of a despicable practice once called guilt by association and now sometimes referred to by the name of McCarthyism.

I ask you, Is this sort of thing enough to explain why Stanley Pons departed his job and home in Utah and took his family to southern France, there with Martin Fleischmann to resume his work?

Finally, on the editorial, notice that it never mentions why it was written, what its sister publication in Japan is publishing, or that it was asked by American scientists for an explanation. For their subscribers all context is omitted. I fear that that great publication is resting on its laurels.

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The critics chose to trust only the nuclear physics of fifty years ago. They pointedly ignored the law of energy conservation, a much older and more fundamental regimen. So what? There's nothing particularly wrong with being wrong, except being wrong. On such a matter as this, they will find themselves in excellent company, and a lot of it. But how are we to explain the largess of vitriol that has and is being slung at Stanley Pons and Martin Fleischmann?

In this protracted conflict between theory and experiment remember always what it is that makes science be science: experiment prevails over theory. Theory ever bows to experiment.

The excess energy of the P&F cell has been competently demonstrated. Finding its source is a wholly legitimate scientific enterprise now well underway. Nature and Scientific American magazines have greatly hindered this scientific work by heaping calumny on those scientists engaged in identifying its source.

As happens in many new scientific developments that

promise useful applications, this line of research is now dividing into two avenues. Systems for the generation of high levels of excess energy will largely disappear into the commercial laboratory and there be shrouded in the conventional secrecy of new product development.

The scientific search for the origins of excess energy, and possibly immortal renown, will continue unabated in foreign laboratories. We must allow this exploration for the indefinite future as mother nature guards her secrets with great jealousy.

Whether this country will participate more than just peripherally depends entirely on the character of our scientists in facing the politically inspired imposition of the press. Their track record to date is not encouraging.

I have brought you what, in our country, is a sorry tale of process, but globally, an exciting tale of progress. Between now and the turn of the century we should witness the fascinating development of this new energy source.

Thank you very much.

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