

Cold Fusion, a Journalistic Investigation

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In Memory of



Eugene F. Mallove
1947 - 2004

The Question

How could cold fusion be real, considering it had been disproved by several well-respected laboratories?



Prerequisite to considering the reality of cold fusion.

1. Retrospective Studies of Work That Supposedly Disproved Cold Fusion

- Nine retrospective studies performed by 13 scientists.
 - Analysis of 1989 work at Caltech, Harwell, M.I.T.
 - Method of Analysis:
 - Examination of raw data.
 - Personal interviews of original team members.
 - Problems Found:
 - Sloppy calorimetry, rushed work.
 - Experimenter bias.
- See appendix A for references.

Two Trends

	Number of Studies Reporting		
	Caltech	M.I.T.	Harwell
Major Errors	6	4	3
Possible Excess Power	3	2	1

P_{in} (W)	P_{in} (W)	P_x (W)
0.671	0.595	0.076 ^{b,c}
0.672	0.600	0.072

(Caltech, Ref. A1)

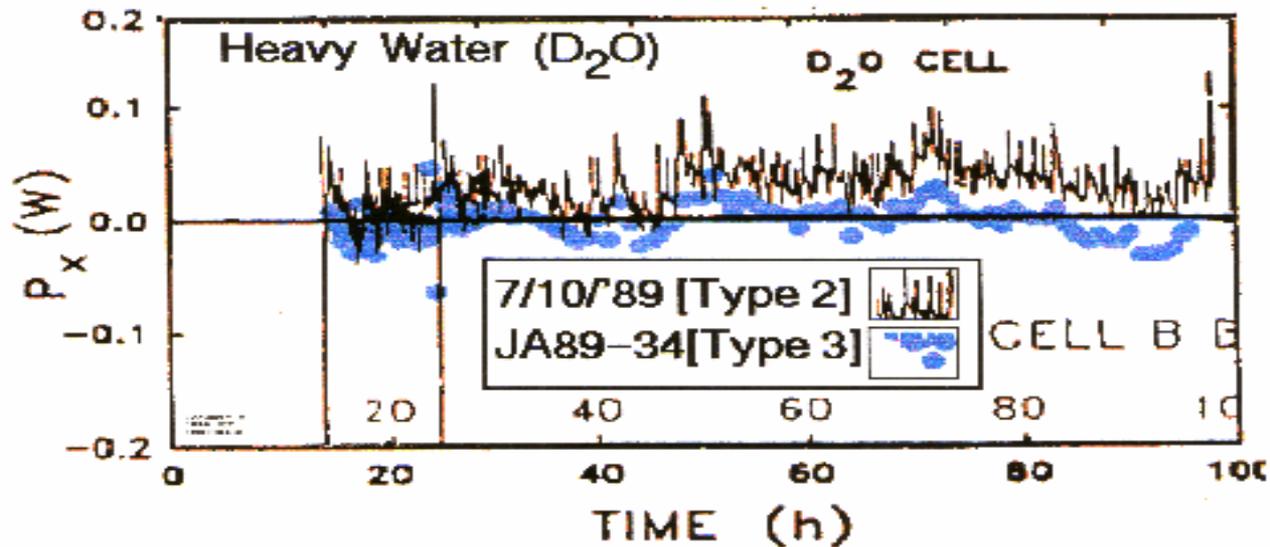
“In Harwell's D2O Cell 3 there are more than ten time intervals where an unexplained power source or energy storage mechanism may be operating.”
(Ref. A3)

Regarding the Caltech Calorimetry Investigation

"Every day they came in and saw that the calorimetry was either producing positive excess heat or negative excess heat, both of which were unbelievable to them, so what they did was change the calibration constant each day so that the excess heat 'went away.'"

-Mike McKubre, SRI International

Data Adjustment at M.I.T.



- Original data, in black, show possible excess heat (unpublished).
- MIT assumed calorimeter faulty, arbitrarily shifted curve downward making the excess heat “go away.”
- Adjusted curve, shown in blue, indicates zero excess heat (published).

Image courtesy of Dr. Mitchell R. Swartz

M.I.T. Analyses

- Data examined by Eugene Mallove, Mitchell Swartz, Philip Morrison.
- Independently reported to MIT.
- MIT response: Data shift insignificant.

CONSEQUENCES OF M.I.T. FINDINGS:

- Negative influence on 1989 DOE Cold Fusion Panel.
- MIT results primary citation for denial of U.S. patents in the cold fusion field.

Conclusion of Analysts Performing Retrospective Reviews

- None claimed these laboratories showed proof of cold fusion

CONCLUSION:

- The experiments were more likely to have replicated rather than disproved the claims of Martin Fleischmann and Stanley Pons.

2. Early Corroborations That Supported the Claims of Fleischmann and Pons

- Four analytical reviews by independent auditors.
- Three papers reporting original experimental work.
- **Experimental work performed by/at:**
 - Fleischmann, Pons, Hawkins (1991 and 1994 analyses).
 - U.S. Navy – China Lake.
 - Amoco Oil Co.
 - Shell Oil Co.
 - SRI international.

See appendix B for references.

Independent Analytical Reviews

- Alan J. Bard, Charlie Barnes, Howard Birnbaum
 - 1991, inspected cold fusion work at SRI International
 - (Unpublished Private Report)
 - Reported seeing “some excess heat effects.”
 - Members of the 1989 DOE ERAB Panel
- Richard Garwin, Nathan Lewis
 - 1993, inspected cold fusion work at SRI International
 - Garwin, well-respected physicist. Lewis, Caltech cold fusion team.
 - Also found evidence of excess heat.
 - (Unpublished Private Report)

*...we held one [a cold fusion cell] in our hands and are now quite familiar with its construction. We also had extensive discussions of data from one of these cells, which according to a summary chart has provided about **3% excess heat.***

Papers Reporting Original Experiments

- Amoco Oil Co.
 - 1995 Unpublished Private Report of their own work
 - Well-funded, careful, slow research
- Shell Oil Co.
 - 1995 Unpublished Private Report of their own work
- Were they considering the possibility of a water-fuel age?
- Performed slow, careful experiments, and well-funded.
- U.S. Navy – China Lake
 - 1993, Published in Conference Proceedings

Early Corroborations - Summary

Number of Studies	Reporting
8	Excess Power
0	Major Errors
2	Tritium
4	Helium-4
3	That a chemical origin of the excess heat was impossible

Not a Chemical Reaction!

"... on cells L3 and L4, we note that a chemical reaction involving the Pd at perhaps 1.5 eV per atom would correspond to about 3.5 kJ of heat; this is to be compared with the 3 Mj of "excess heat" observed, so **such an excess could not possibly be of chemical origin.**"

- **Richard Garwin, 1993 Private Report to EPRI and the Pentagon**

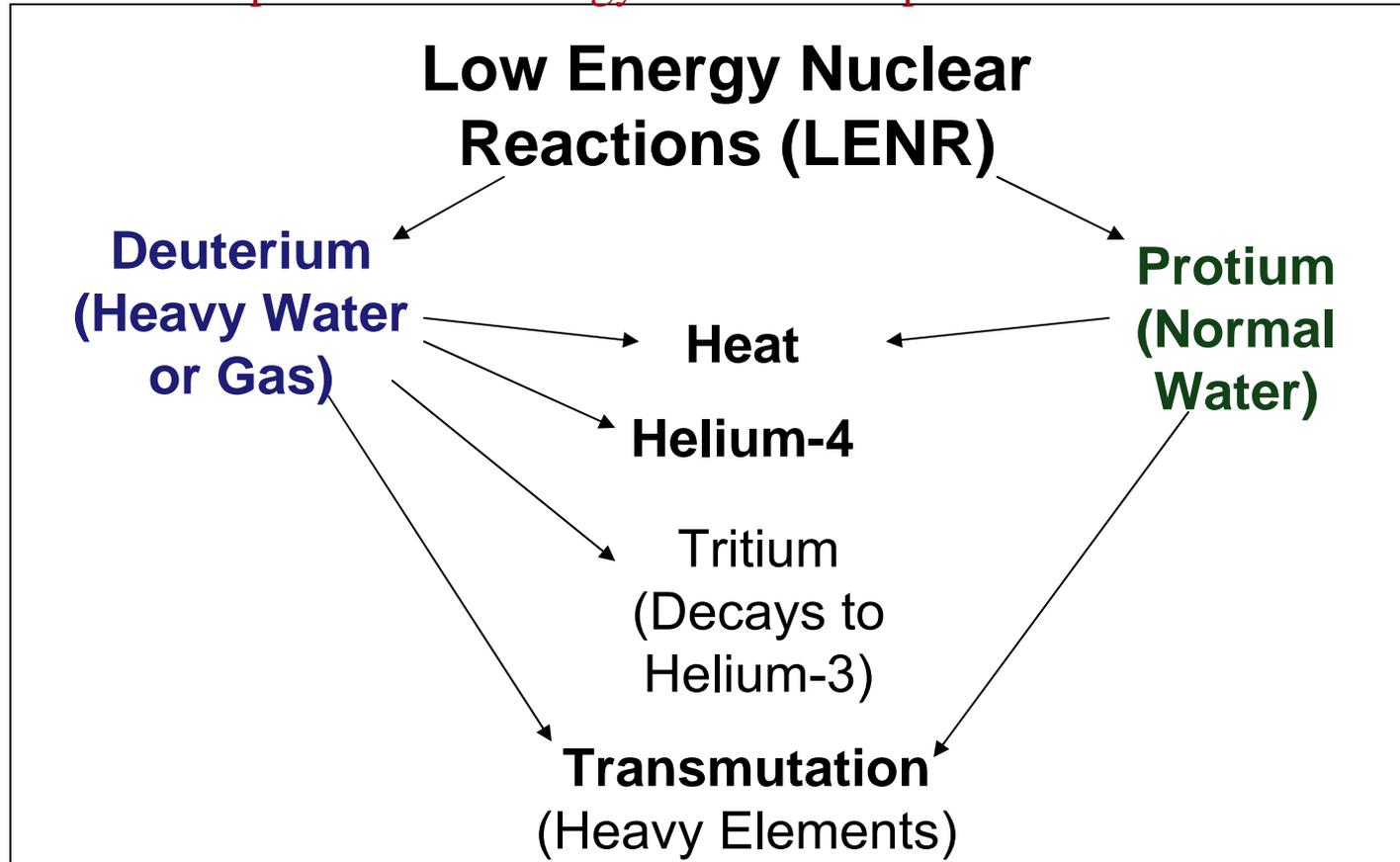
Full report : <http://www.newenergytimes.com/reports/garwin.htm>

3. Overview of Cold Fusion Branches

A Guide to experimental observations. Work in progress (24 March 2005)

Represents general agreement but not consensus

More details: <http://www.newenergytimes.com/Reports/TheColdFusionEffect.htm>



4. Comparison of Hot and Cold Fusion

See Appendix C for References

U.S. Government-Sponsored Research	Hot Fusion	Cold Fusion
Years Studied	50	15
Estimated U.S. funding to date	\$16 Billion ¹	\$25 Million ²
Committed future U.S. funding	> \$10 Billion	None
Experimental Qualities		
Shows potential for large-scale power generation	Yes	No
Potential for power production at point of consumption	No (too big)	Yes
Demonstrates self-sustaining nuclear reaction	Never	Yes ³
Peak Experimental Power Levels		
Peak output power levels / Duration	16 Megawatt / 1 Sec.	10 watts / 2000 hrs ⁴
Ratio of power out/power in (break-even =1.0)	0.6	> 1.1 ⁴
Typical Experimental Power Levels		
Typical excess power levels	0	1 watt
Duration	n/a	5-600 hours ⁵
Fuel		
Fuel required	D + T + Lithium	Deuterium
Dangerous and/or radioactive fuel	Yes	No
Commercialization Expectations		
Earliest estimated commercialization	2050	2010
Requires power distribution grid	Yes	No
Potential use: mobile terrestrial, air, and space	No	Yes
Single point of failure for large service area	Yes	No
Security risk	Yes	Yes

Questions

- How likely is it that 200+ men and women, with strong backgrounds in science, from 13 countries, working independently over the last 16 years, are all lying, self-delusional or incompetent?
- Should new empirical observations be dismissed or ignored simply because they are not 100 percent reproducible or because they are not well understood?

The results of this research may provide a new source of energy, new substances and new technologies.

For Further Information:

- This presentation and references are available at:
www.newenergytimes.com/reports/aps2005.htm
- Web site: www.newenergytimes.com
- New Energy Times™ Newsletter
- Cold Fusion Library: www.lenr-canr.org
- International Society of Condensed Matter Nuclear Science:
www.iscmns.org
- *Excess Heat* by Charles G. Beaudette ISBN 0967854830

Appendix A - 1989 Lab work

Studies of Work That Supposedly Disproved Cold Fusion

Year	Analysts (Qty on Team)	Cal Tech	MIT	Harwell
1991	1st China Lake Team (2)	Excess Power (1)	Major Errors(1)	Major Errors(1)
		Major Errors(1)		
1991	Noninski & Noninski		Excess Power (2)	
1992	Melich & W. Hansen			Excess Power (3)
1993	Noninski & Noninski	Excess Power (4)	Major Errors(4)	
		Major Errors(4)		
1993	2nd China Lake Team (5)	Excess Power (5)		
		Major Errors(5)		
1993	Swartz & Mallove	Major Errors(6)	Excess Power (6)	
1994	Melich & W. Hansen	Major Errors(7)		Major Errors(7)
1994	3rd China Lake Team (3)	Major Errors(8)	Major Errors(8)	Major Errors(8)

Appendix A

Studies of Work That Supposedly Disproved Cold Fusion

1. Miles, Melvin, et al., "Calorimetric Principles and Problems in Pd-D₂O Electrolysis, The Third International Conference on Cold Fusion," Nagoya, Japan:, Universal Academy Press, Inc., Tokyo: (1991), p. 113
2. Noninski, V.C. and Noninski, C.I., "Comments on 'measurement and analysis of neutron and gamma-ray emission rates, other fusion products, and power in electrochemical cells having palladium cathodes,' Fusion Technology, Vol. 19, (1991), p. 579
3. Melich, Michael E. and Hansen, W.N., "Some Lessons from 3 Years of Electrochemical Calorimetry, "Third International Conference on Cold Fusion," Nagoya Japan: Universal Academy Press, Inc. (1992)
4. Noninski, V.C. and Noninski, C.I., "Notes on Two Papers Claiming No Evidence for the Existence of Excess Energy During the Electrolysis of 0.1 M LiOD/D₂O with Palladium Cathodes," Fusion Technology, Vol.23, (July 1993,) p. 474
5. Miles, Melvin, et al., "Correlation of excess power and helium production during D₂O and H₂O electrolysis using palladium cathodes," Journal of Electroanalytical Chemistry, Vol. 346, (1993), p. 99 Also similarly published 1994, Fusion Technology, Vol. 25, (1994), p. 478
6. Swartz, Mitchell, "Some Lessons from Optical Examination of the PFC Phase-II Calorimetric Curves, Vol. 2," Fourth International Conference on Cold Fusion, sponsored by EPRI and the Office of Naval Research, December (1993)
7. Melich, Michael E. and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute, (1993)
8. Miles, Melvin, et al., "Calorimetric principles and problems in measurements of excess power during Pd-D₂O electrolysis," Journal of Physical Chemistry, Vol. 98, (1994), p. 194

Appendix B - Corroborations

Early Successful Excess Power Analyses & Experiments

Year	Analysts	Fleischmann & Pons	China Lake - U.S. Navy	Amoco Oil Co.	Shell Oil Co.	SRI International
1991	Wilford Hansen (Analysis)	EP (1) Not chemistry(1)				
1991	Alan J. Bard, Charlie Barnes, Howard Birnbaum (Analysis)					EP (2) No major errors (2)
1993	China Lake Team (5) (Experiment)		EP (3) Correlated heat & Helium-4 (3)			
1993	Richard Garwin & Nathan Nathan Lewis (Analysis)					EP (4) No major errors (4) Not Chemistry(4)
1994	Melich & Hansen (Analysis)	EP (5)		EP (5) Tritium (5)		
1995	Shell Oil (DuFour, Foos, Millot) (Experiment)				EP (6) He-4 (6)	
1995	Amoco Oil (Lautzenhiser, Eisner, Phelps) (Experiment)			EP (7) Tritium (7) Not chemistry (7)		

Appendix B

Early Successful Excess Power Analyses & Experiments

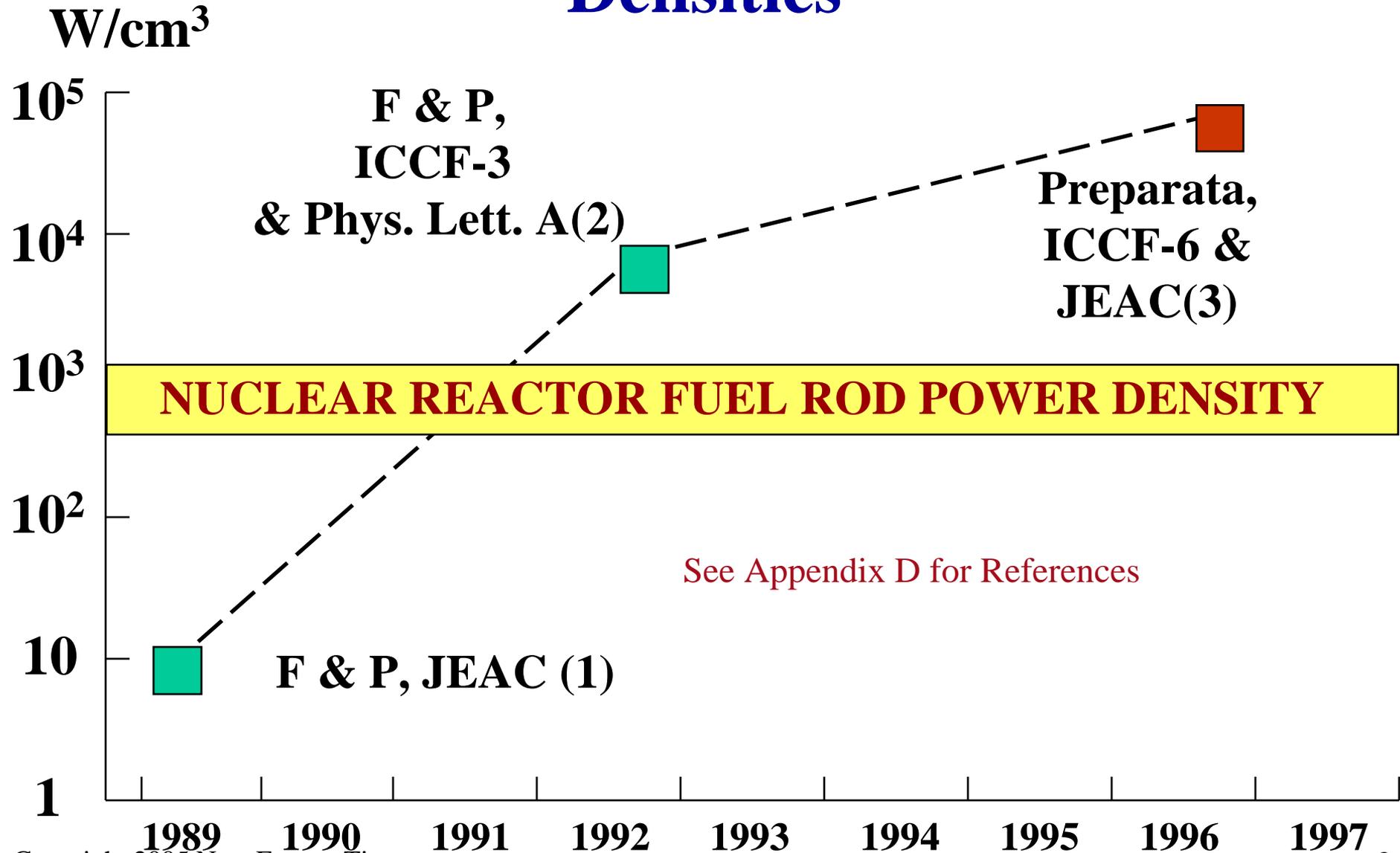
1. Hansen, Wilford N., "Report to the Utah State Fusion/Energy Council on the Analysis of Selected Pons Fleischmann Calorimetric Data," Second Annual Conference on Cold Fusion, Como, Italy: Societa Italiana di Fisica, Bologna, Italy, (1991)
2. Bard, Alan J., Barnes, Charlie, Birnbaum, Howard, "Comments on SRI RP-3170 Review Meeting 25-26 March 1991", Unpublished private report, (1991)
3. Miles, Melvin, et al., "Correlation of excess power and helium production during D2O and H2O electrolysis using palladium cathodes," Journal of Electroanalytical Chemistry, 1993. 346: (1993), p. 99 Also similarly published Fusion Technology, Vol. 25, (1994), p. 478.
4. Garwin, Richard L., Lewis, Nathan, "Report from SRI Visit October 19, 1993," Unpublished private report, (1993)
5. Melich, Michael E., Hansen, Wilford N., "Back to the Future, The Fleischmann-Pons Effect in 1994," Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute, (1993)
6. Dufour, Jacques, et al., J. Foos, J.P. Millot, Shell Research/ CNAM Laboratoire des Sciences Nucléaires 2 rue Conté 75 003 Paris, 9 April 1995, Excess energy in the system Palladium/Hydrogen isotopes, Measurements of the excess energy per atom hydrogen, Listed in index as ICCF5 paper # 604, but unpublished
7. Lautzenhiser*, T., Phelps*, D.W., Eisner**, M., (* Amoco, ** University of Houston,) Cold Fusion: Report on a Recent Amoco Experiment, Amoco Production Company, Report T-90-E-02, 90081ART0082, 19, March 1990, Private Report

Appendix C – Fusion Compared

Comparison of Hot and Cold Fusion

1. Nagel, David J., "Fusion Physics and Philosophy," *Accountability in Research*, 8, (2000), p.137
2. Estimates based on miscellaneous reports of DARPA and Navy funding.
3. Mizuno, Tadahiko, "Nuclear Transmutation: The Reality of Cold Fusion," Infinite Energy Press, Bow, New Hampshire, (1998); Fleischmann, Martin, and Pons, Stanley, "Calorimetry of the Pd-D₂O system: from simplicity via complications to simplicity," *Physics Letters A*, V. 176 (1993), p. 118; Miles, Melvin, et al., "Thermal Behavior of Polarized Pd/D Electrodes Prepared by Co-Deposition," The Ninth International Conference on Cold Fusion, Beijing, China, (2002); Szpak, Stan, et al., "Thermal Behavior of Polarized Pd/D Electrodes Prepared by Co-deposition," *Thermochimica Acta*, Vol. 410, p. 101, (2004)
4. NOTE: The listed value of 10 watts is conservative. Arata, Yoshiaki, Zhang, Yue-Chang, "Anomalous production of gaseous 4He at the inside of 'DS cathode' during D₂O-electrolysis," *Proc. Jpn. Acad.*, Ser. B, 75: p. 281 (1999); Arata, Yoshiaki, Zhang, Yue-Chang, "A new energy caused by 'Spillover-deuterium,'" *Proc. Jpn. Acad.*, Ser. B, 70 ser. B: p. 106, (1994); Takahashi, A., et al. Anomalous Excess Heat by D₂O/Pd Cell Under L-H Mode Electrolysis in Third International Conference on Cold Fusion, "Frontiers of Cold Fusion". 1992. Nagoya Japan: Universal Academy Press, Inc., Tokyo, Japan.
5. Storms, Edmund, "A Critical Review of the "Cold Fusion" Effect", *Journal of Scientific Exploration*, 10, #2, p. 185, (1996)

Appendix D - Cold Fusion Volumetric Power Densities



Appendix D

Cold Fusion Volumetric Power Densities

1. Fleischmann, M., S. Pons, and M. Hawkins, "Electrochemically induced nuclear fusion of deuterium," *Journal of Electroanalytical Chemistry*, Vol. 261, p. 301 and errata in Vol. 263 (1989)
2. Fleischmann, M. and S. Pons, "Calorimetry of the Pd-D₂O system: from simplicity via complications to simplicity," *Physics Letters A*, Vol. 176, (1993), p. 118
3. Preparata, Giuliano, et al., "Isoperibolic calorimetry on modified Fleischmann-Pons cells," *Journal of Electroanalytical Chemistry*, 411, 9 (1996)

Solving the Puzzle

- We have concluded that LENR is possible in the framework of modern physics theory.
- Investigation of this phenomenon requires the knowledge of different branches of science: nuclear and atomic physics, chemistry and electrochemistry, condensed matter and solid state physics.
- The puzzle of poor reproducibility of experimental data is due to the fact that LENR occurs in open systems and is extremely sensitive to parameters of external fields and systems. Poor reproducibility and unexplained results do not mean that the experiment is wrong.
- F.A.Gareev, I.E. Zhidkova, Yu.L. Ratis
Joint Institute for Nuclear Research, Dubna, Russia

Worldwide Interest

- 200+ Researchers
 - Primarily from University and Government Labs
- 13 Countries
- 3,000+ Papers
- 16 years
- 11 International Conferences, 5 in Italy, 12 in Russia, 5 in Japan

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