How Can Cold Fusion Be Real, Considering It Was Disproved By Several Well-Respected Labs In 1989?

Steven B. Krivit, Editor
New Energy Times
[redacted]

http://www.newenergytimes.com/Library/2005KrivitS-HowCanItBeReal.pdf

12th International Conference on Emerging Nuclear Energy Systems
Bruxelles, Belgium, August 21-26, 2005

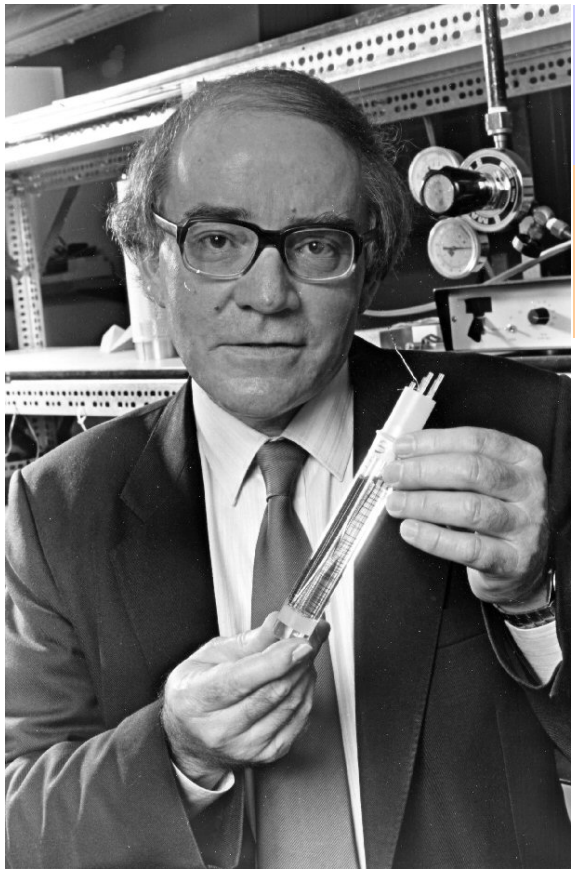
This project was made possible by a grant from the New Energy Foundation

All things are possible until they are proved impossible.

And even the impossible may only be so, as of now.

--Pearl S. Buck

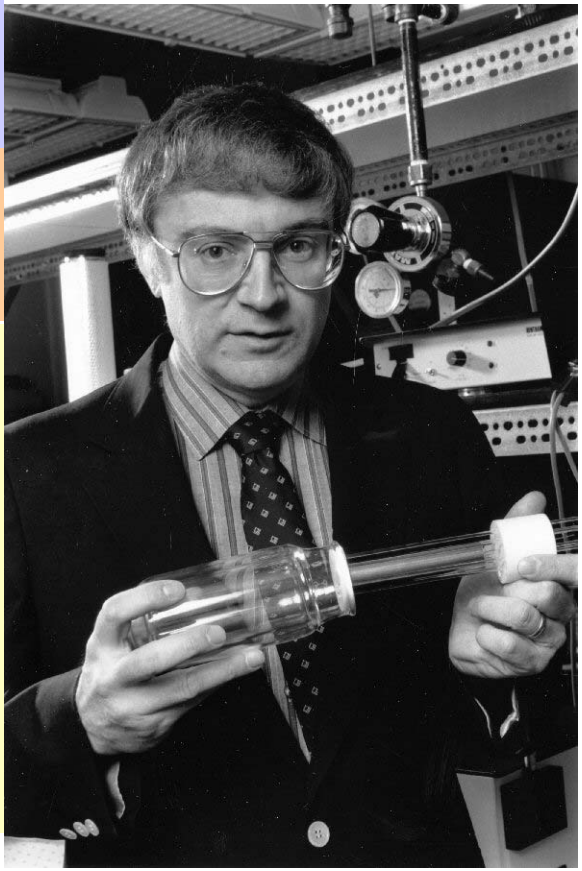
Cold Fusion is Announced



University of Utah Press Conference

March 23, 1989

1. Sustained D-D Fusion
2. Low Temperature
3. Low Neutrons
4. Low Gamma



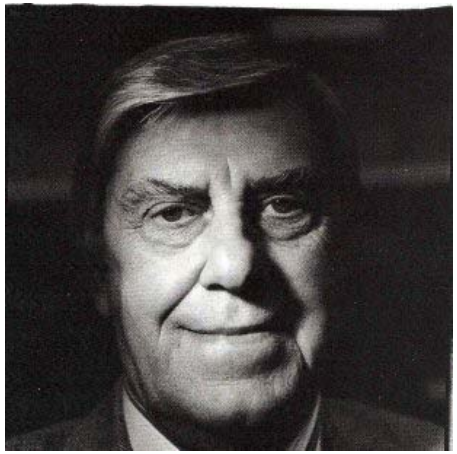
Martin Fleischmann
University of Southampton

Stanley Pons
University of Utah

Cold Fusion is Discredited and Disproved

Nathan Lewis
Caltech
"No evidence"

Ronald R. Parker
MIT
"It's Fraud"

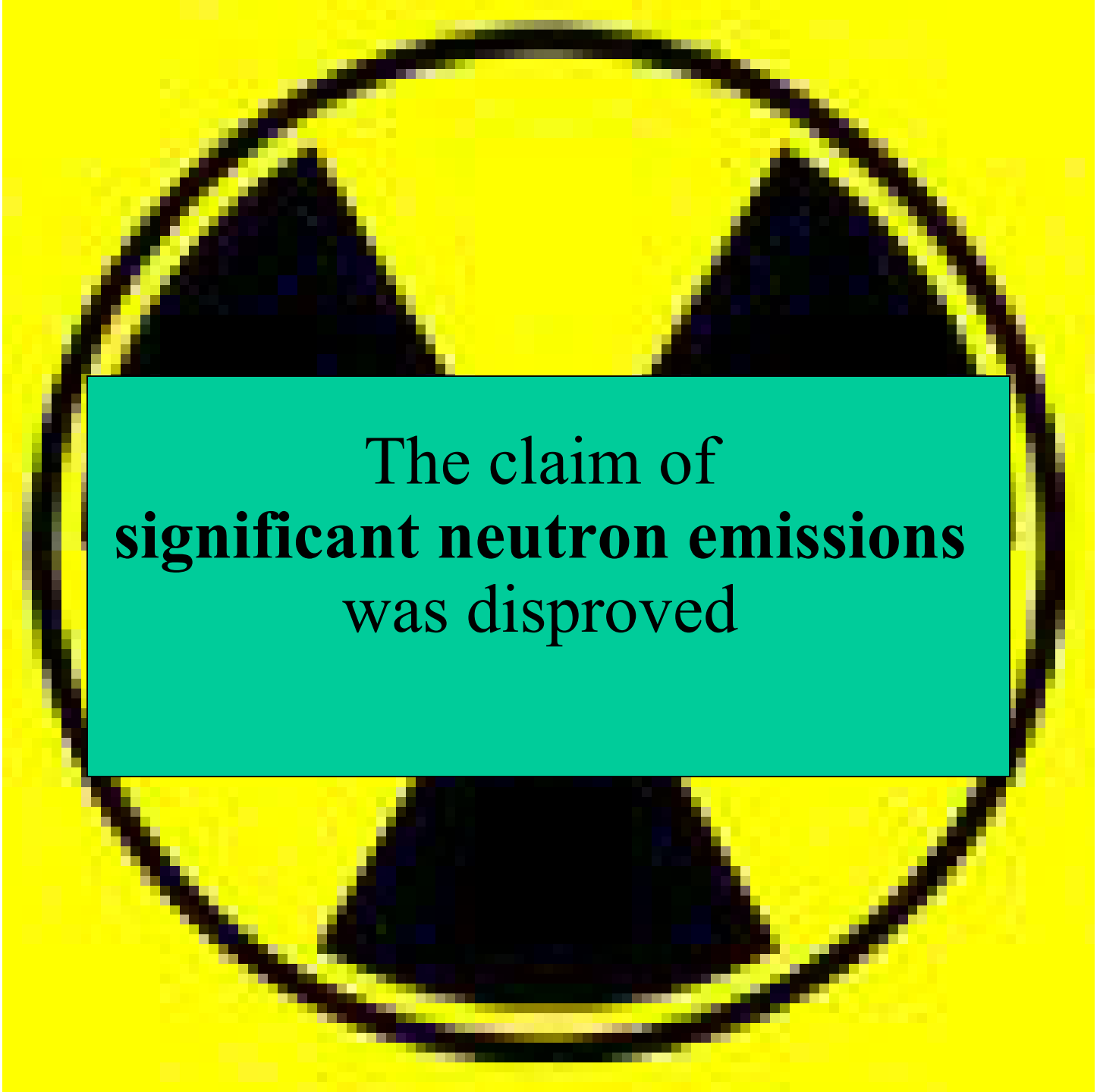


John Huizenga
1989 Dept. of Energy
Cold Fusion Panel
"Cold Fusion: The Scientific Fiasco of the Century"

The New York Times : "The Utah claim is dead."

May 3, 1989


The claims of excess heat were never disproved



False Negatives: Retrospective Reviews of Work That Supposedly Disproved Cold Fusion

See Appendix A for References.

- Eight retrospective studies performed by 13 scientists.
- Analysis of 1989 work at Caltech, Harwell, M.I.T.
- Method of Analysis:
  - Interviewed Original Research Teams
  - Inspected Raw Data
- Two types of Problems Found:
  - Sloppy calorimetry.
  - Experimenter bias.

Two Trends

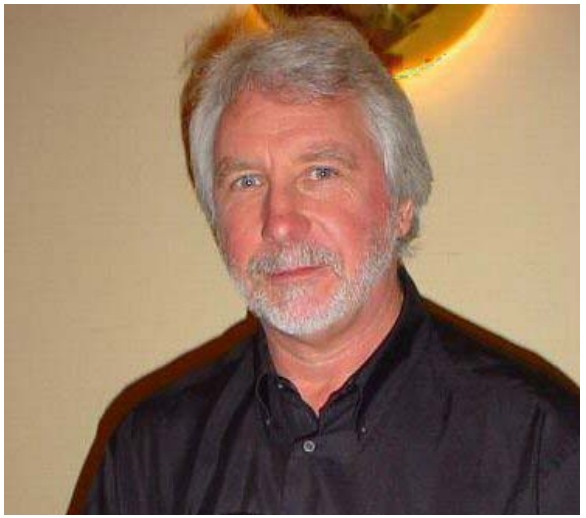
See Appendix A for References.

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

"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." (Appendix A3)

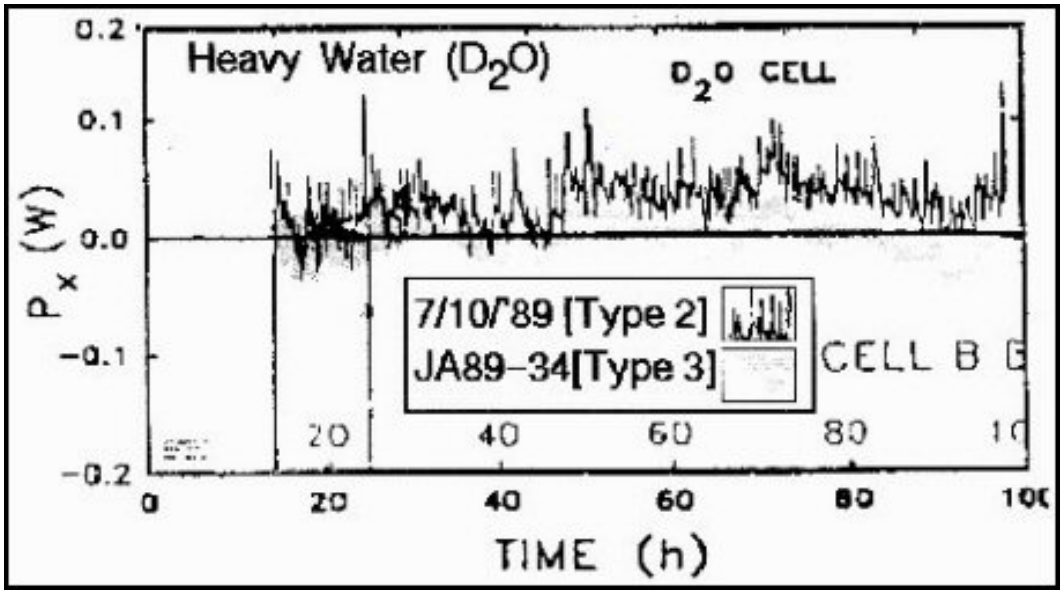
Regarding the Caltech Calorimetry Investigation

"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.



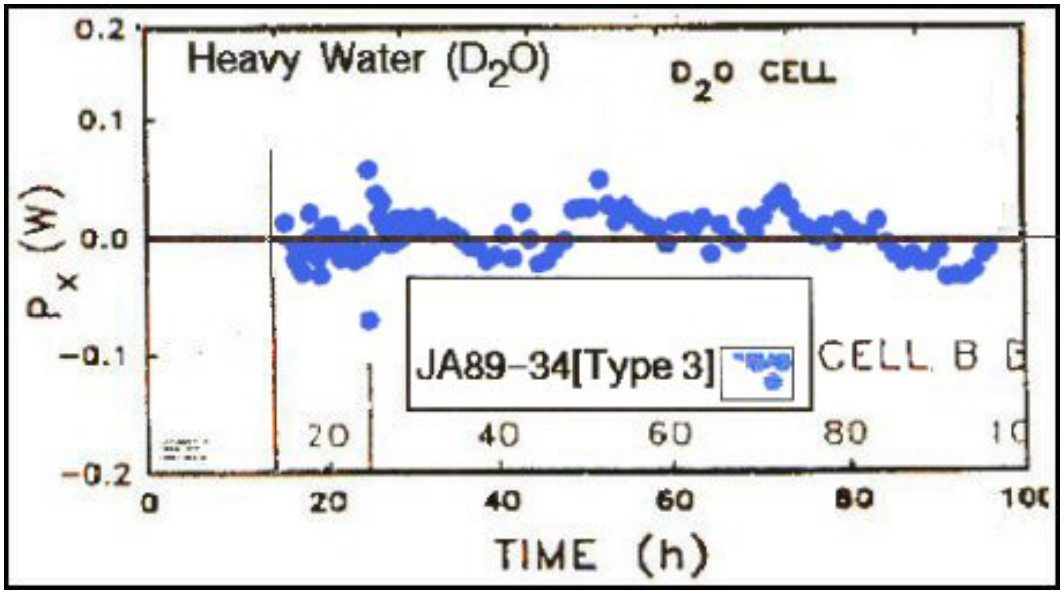
Original data shows possible excess heat (unpublished report).

Eugene Mallove, Chief Science Writer, MIT News Office

Mitchell Swartz MIT Graduate

Philip Morrison MIT Professor, Manhattan Project Member

Data Adjustment at M.I.T.



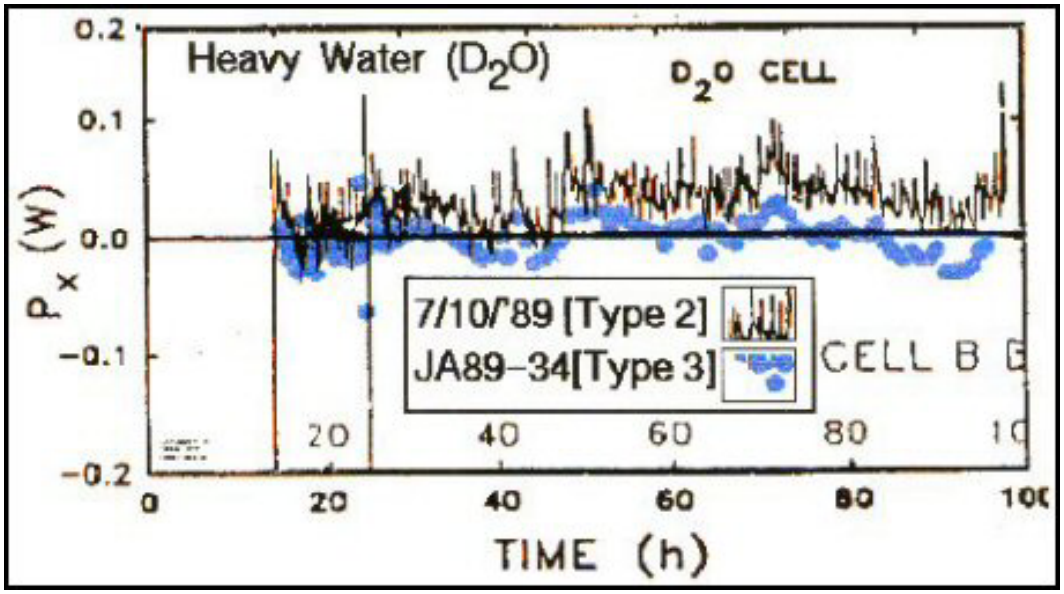
Adjusted data, shown in blue, indicates zero excess heat (published report).

Eugene Mallove, Chief Science Writer MIT News Office

Mitchell Swartz MIT Graduate

Philip Morrison MIT Professor, Manhattan Project Member

Data Adjustment at M.I.T.



Overlay of data adjustment.

Eugene Mallove, Chief Science Writer MIT News Office

Mitchell Swartz MIT Graduate

Philip Morrison MIT Professor, Manhattan Project Member

Conclusion of Analysts Performing Retrospective Reviews

None of the analysts claimed that these laboratories showed proof of cold fusion.

- However -

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

Unknown Positives: Early Confirmations of Cold Fusion

See Appendix B for References.

- March 25-26, 1991:

  Alan J. Bard*, Howard Birnbaum*, Charlie Barnes

  Audit SRI International cold fusion experiment;
  Privately report evidence of excess heat.

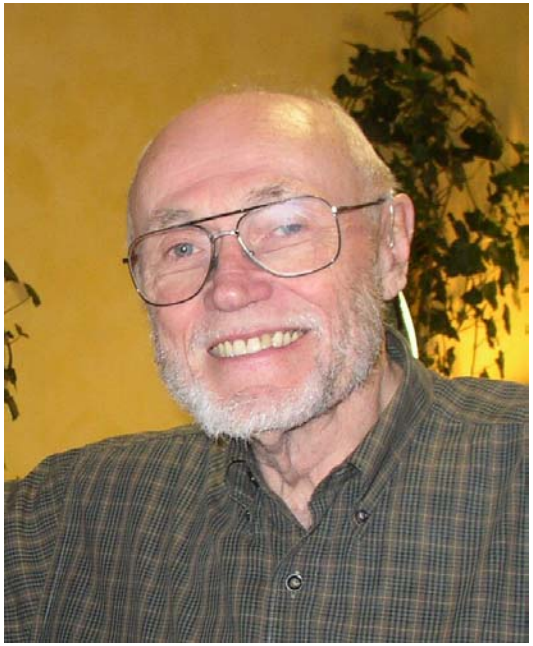
  (*Members of 1989 Dept. of Energy Cold Fusion Panel.)

- October 19, 1993:
  Richard Garwin, Nathan Lewis
  Audit SRI International cold fusion experiment;
  Privately report evidence of excess heat.

"...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.**"*
(Appendix B4)

SRI International Audits

Sponsored by the Electric Power Research Institute



Tom Passell

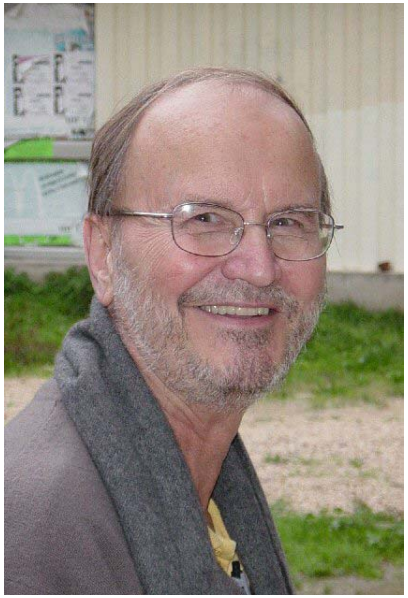
EPRI Program Manager

- Auditors reported findings to EPRI and Pentagon, but kept it secret from the public.
- EPRI hoped the consultants would inform the scientific community.
- Unfortunate delay in progress of science.

Early Confirmations

See Appendix B for References.

- Amoco Oil - 1994
  - "Results indicate a positive energy output…"
  - Melvin Eisner: Renewed interest in 2004



Shell Oil - 1995 "Excess energy production up to several watts has been constantly observed…"

Jacques Dufour
Director of scientific relations, Shell Research Group

Early Confirmations - Summary

See Appendix B for References.

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!

Richard Garwin
receiving presidential award

"... 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."

1993 Private Report to EPRI and the Pentagon

http://www.newenergytimes.com/reports/garwin.htm

Some of the Many Myths (and Facts) about Cold Fusion

<u>Myth</u>: Cold fusion is not reproducible.

A reproducible effect is one that happens "more often than not."

Richard Garwin
IBM Fellow Emeritus

Myths and Facts of Cold Fusion

Fact: Cold Fusion is Highly Reproducible

New Energy Times
2003 Cold Fusion Reproducibility Survey:

83% - Average Reproducibility

100% - Takahashi, Chicea, Storms, Karabut, Iwamura, Higashiyama

Myths and Facts of Cold Fusion

Myth: "Nobody in mainstream science" is researching cold fusion.

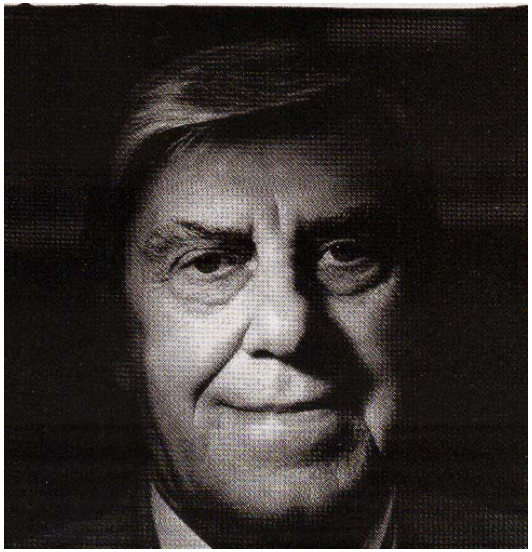
"Scientists who work in universities" are mainstream scientists.

Frank Close, Rutherford Appleton Laboratory

Fact: Dozens of University Scientists Are Researching Cold Fusion (Appendix E)

Myths and Facts of Cold Fusion

Myth: Cold fusion is "impossible according to current nuclear theory."



John Huizenga
1989 Dept. of Energy Cold Fusion Panel Chairman

Fact: That was true in 1989, but no longer.
(Li, Chubb S., Hagelstein, Takahashi, Kim and others)

The U.S. Department of Energy 2004 Cold Fusion Review

What did it accomplish?

1. Politically – Nothing.
2. Practically - Awakened Commercial Interest and Funding

BEST REFERENCE: THE REVIEWER'S COMMENTS

Concerns about Cold Fusion

Destructive Applications or Weapons

Disruptive Technology

IAEA and UN - ???

Hopes and Expectations

Cold Fusion,
also known as
Condensed Matter Nuclear Science
demonstrates the potential for:

New Substances

New Technologies

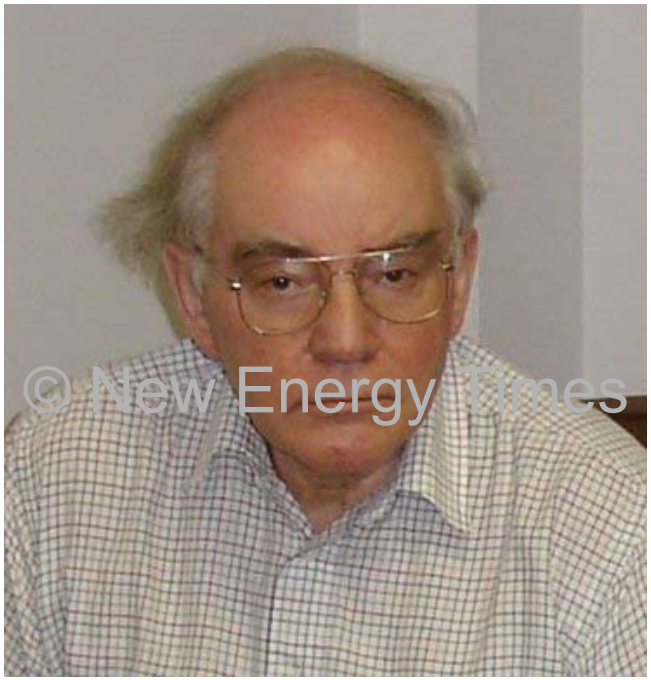
A New Source of Clean Nuclear Energy

For Further Information:

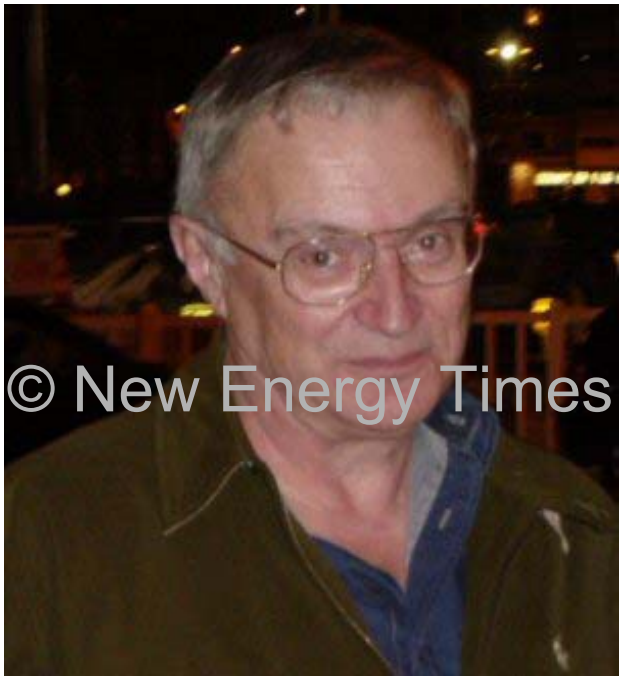
- *The Rebirth of Cold Fusion*, by Krivit & Winocur
  - ISBN 0976054582
- *Excess Heat* by Charles G. Beaudette
  - ISBN 0967854830
- New Energy Times ™ Web Site www.newenergytimes.com
- New Energy Times™ Newsletter
- Cold Fusion Library: www.lenr-canr.org
- International Society of Condensed Matter Nuclear Science: www.iscmns.org
- International Conference on Condensed Matter
  - www.iccf12.org

Acknowledgments

- Eugene Mallove, for his pioneering work in cold fusion journalism.
- Charles Beaudette, author of *Excess Heat & Why Cold Fusion Research Prevailed*, 2002, 2nd Ed.
- Edmund Storms and Jed Rothwell, for the LENR-CANR.org cold fusion library.
- Edmund Storms, "Why You Should Believe Cold Fusion is Real," presented at APS, March 2005



Martin Fleischmann



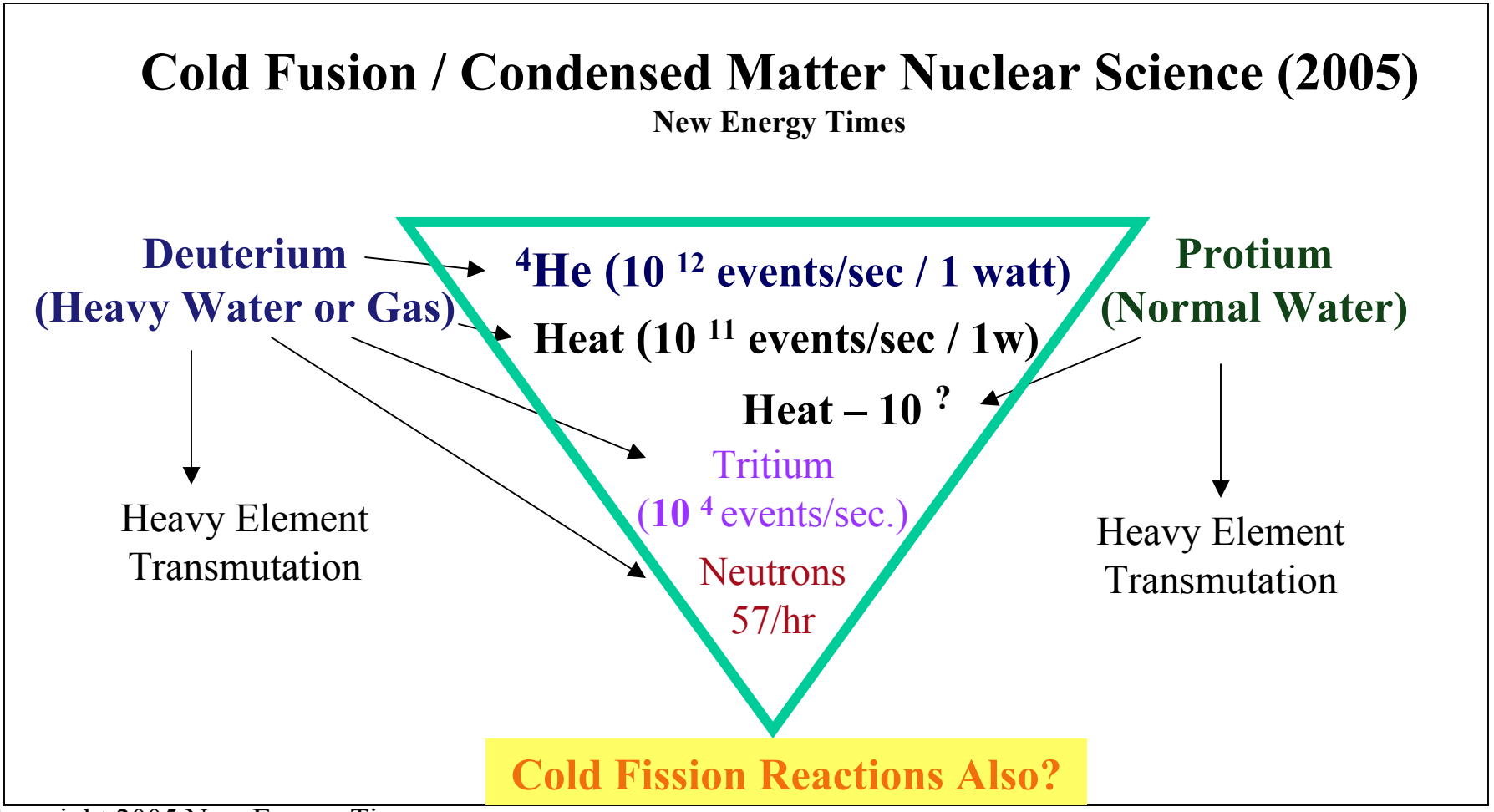
Stanley Pons

Supplemental Slides

Overview of Reaction Products

"Work in progress … represents general agreement but not consensus."

http://newenergytimes.com/Library/2004StormsE-ICCF11Class-AnUpdateOfLENR.pdf
http://www.newenergytimes.com/Reports/TheColdFusionEffect.htm



Review of Transmutation Reactions in Solids

http://www.lenr-canr.org/acrobat/MileyGHreviewoftr.pdf

Research performed in this field at the following institutions:

Hokkaido University, Japan - Mizuno et al., Notoya et al.
Mitsubishi Corporation, Japan - Iwamura et al.
Osaka University, Japan - Takahashi et al., Arata et al.
University of Leece, Italy - Vincenzo et al.
Frascati Laboratory, Italy - De Ninno et al.
SIA "LUTCH", Russia - Karabut et al., Savvatimova et al.
Tomsk Polytechnical University, Russia - Chernov et al.
Lab des Sciences Nucleaires, France - Dufour et al.
Beijing University, China - Jiang et al.
Tsinghua University, China - Li et al.
University of Illinois, Urbana, USA - Miley et al.
Portland State University, USA - Dash et al.
Texas A & M University, USA - Bockris et al.
Shizuoka University, Japan - Kozima et al.
Iwate University, Japan - Yamada et al.

Selected Transmutation Studies

Iwamura, Y., et al., "Elemental Analysis of Pd Complexes: Effects of D2 Gas Permeation," Jpn. J. Appl. Phys. Vol. 41 (2002) pp. 4642–4650
http://lenr-canr.org/acrobat/IwamuraYelementalaa.pdf

Higashiyama, T., "Replication Of MHI Transmutation Experiment…"
http://lenr-canr.org/acrobat/Higashiyamreplicatio.pdf

Iwamura's Presentation at ICCF-11 Short Course October 31, 2004

"Nuclear transmutation induced by deuterium permeation through the Pd complexes detected by surface and bulk analysis methods."

http://newenergytimes.com/Library/2004IwamuraY-ICCF11Class-NuclearTransmutation.pdf

http://newenergytimes.com/Library/2004IwamuraY-ICCF11Class-PdComplex.pdf

http://newenergytimes.com/Library/2004IwamuraY-ICCF11-TheRoleOfCaO.pdf

Yasuhiro Iwamura, Mitsubishi Heavy Industries

Appendix A – False Negatives

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 (2)

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 – Unknown Positives

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 (2)

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

Energy Production: Selected Reports of Excess Heat

See Appendix C for References

Ref	Name	Year	Max.Excess Heat	% Excess Heat	Time	Excess Energy
1	Arata	1999	10w	No data	2000h	No data
2	El-Boher #56	2004	3.5w	80%	300h	3.1Mj
2	El-Boher #64a	2004	34w	2500%	17h	1.1Mj
2	El-Boher #64b	2004	32w	1500%	80h	4.6Mj
3	Stringham	2004	40w	No Data	No Data	No Data
4	Takahashi	1992	130w	70%	1440h	No Data

Appendix C

Energy Production

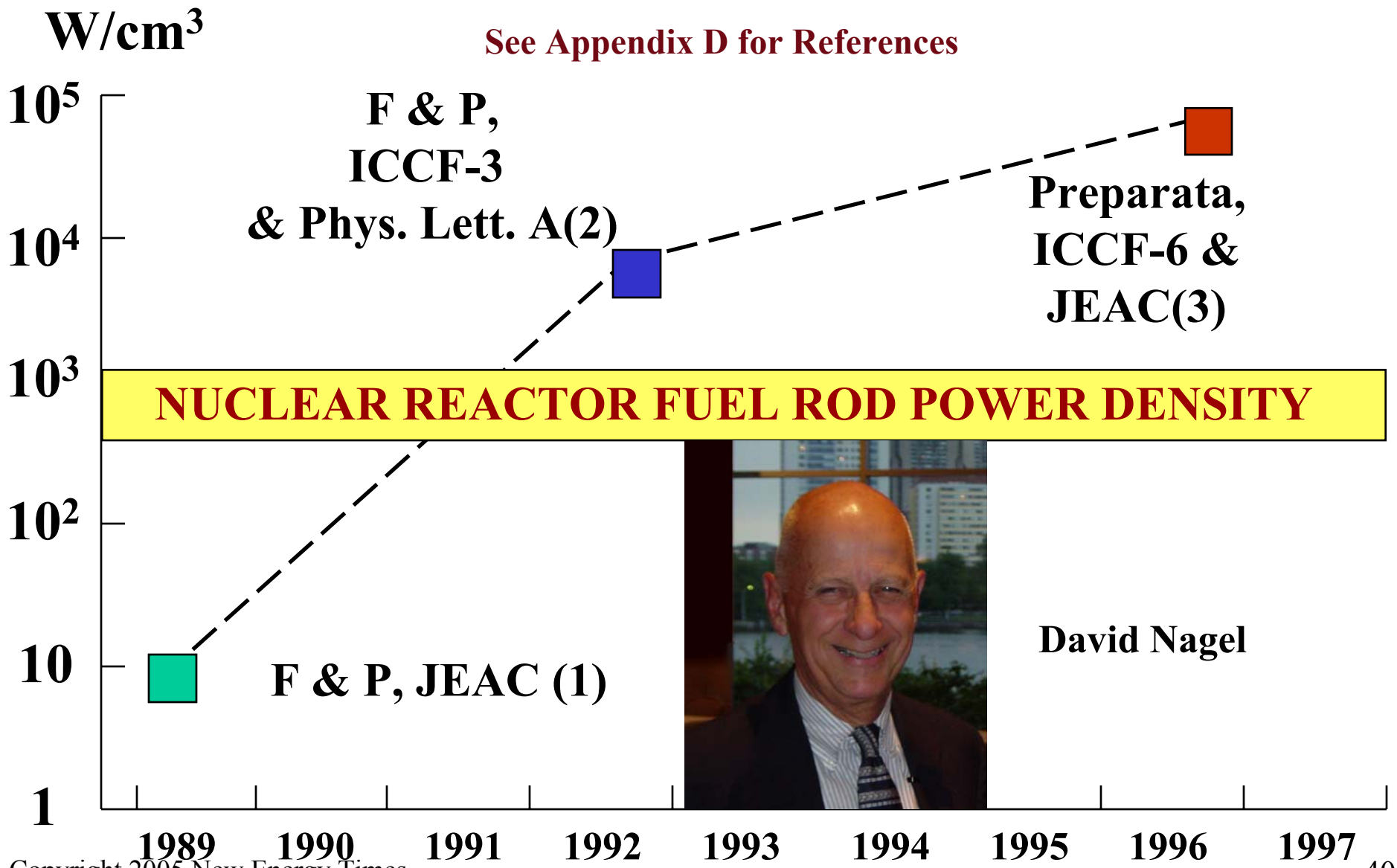
1. Arata, Yoshiaki, Zhang, Yue-Chang, "Anomalous production of gaseous 4He at the inside of 'DS cathode' during D2O-electrolysis," Proc. Jpn. Acad., Ser. B, 75: p. 281 (1999)
http://newenergytimes.com/Library/1999ArataY-AnomalousProduction.pdf

2. El Boher et al., "Excess Heat In Electrolysis Experiments At Energetics Technologies," (to be published Proceedings of 11th International Conference on Cold Fusion, Marseilles, France, 2004)
http://newenergytimes.com/Library/2004ElBoher-ExcessHeatInElectrolysis.pdf

3. Stringham, R., "1.6 MHz Sonofusion Device," (to be published Proceedings of 11th International Conference on Cold Fusion, Marseilles, France, 2004)
http://newenergytimes.com/Library/2004StringhamR-1.6MHzSonofusion.pdf

4. Takahashi, A., et al., "Anomalous Excess Heat by D2O/Pd Cell Under L-H Mode Electrolysis," Third International Conference on Cold Fusion, Nagoya, Japan: Universal Academy Press, Inc., Tokyo, Japan. (1992)
http://newenergytimes.com/Library/1992TakahashiAAnomalousExcessHeat.pdf

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)

Appendix E -"Mainstream Scientists"* Studying Cold Fusion (1)

- *** As defined by Frank Close, "scientists in universities."**

- *Dmitriy Afonichev*, professor of physics, Institute for Metals Superplasticity,
- Russian Academy of Sciences
- *Yoshiaki Arata*, professor of physics emeritus, Osaka University, Japan.
- *Jean-Paul Biberian*, professor of physics, University of Luminy in Marseilles,
- consultant with the French Atomic Energy Commission (ret.)
- *John O'M Bockris*, professor of electrochemistry Texas A&M University (ret.)
- *Robert Bush*, professor of physics, California Polytechnic Institute, Pomona,
- California
- *Dan Chicea*, professor of atomic and nuclear physics, University Lucian Blaga of
- Sibiu, Romania
- *Dennis Cravens*, professor of chemistry and physics, Eastern New Mexico
- University
- *John Dash*, professor of metallurgy and physics, Portland State University
- *Melvin Eisner*, professor of physics, University of Houston (ret.)
- *Peter Hagelstein*, professor of electrical engineering and computer science, MIT
- *Wilford Hansen*, professor of chemistry and physics, Utah State University (ret.)

Appendix E -"Mainstream Scientists"* Studying Cold Fusion (2)

- *Andrei Lipson*, professor of physics, University of Illinois, Urbana and Russian
- Academy of Sciences.
- *Xing Zhong Li*, professor of theoretical nuclear physics, Tsinghua University, Beijing
- China.

Michael Melich, professor of physics, U.S. Naval Post-Graduate School

- *Melvin Miles*, professor of chemistry, University of La Verne, California
- *George Miley*, professor of Nuclear and Electrical Engineering, University of Illinois
- *Tadahiko Mizuno*, assistant professor of nuclear engineering, Graduate School of
- Engineering, Hokkaido University, Japan
- *David Nagel*, research professor, The George Washington University
- *Richard Oriani*, professor of physical chemistry emeritus, University of Minnesota
- *Steven Jones*, professor of physics, Brigham Young University
- *Yeong Kim* professor of physics, Purdue University
- *Ludwik Kowalski*, professor of physics, Montclair State University
- *Hideo Kozima*, professor of physics, Portland State University
- *J. Reece Roth*, professor of fusion energy, University of Tennessee
- *Krityunjai Prasad Sinha*, visiting professor of theoretical physicist, MIT
- *Akito Takahashi*, chair of nuclear instrumentation, Department of Nuclear
- Engineering, Graduate School of Engineering, Osaka University, Japan

Comparison of Hot and Cold Fusion

See Appendix F for References

U.S. Government-Sponsored Research	Hot Fusion	Cold Fusion
Years Studied	54	16
Estimated U.S. funding to date	$16 Billion [1]	$25 Million [2]
Committed worldwide government funding	> $12 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		(Conservative Values)
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		(Conservative Values)
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: fixed, mobile terrestrial, air, and space	No	Yes
Single point of failure for large service area	Yes	No
Security risk	Yes	Yes

Appendix F – 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-D_2O 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)
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Worldwide Effort

- 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