Progress, in the Condensed Matter Nuclear Science, on excess energy production: towards practical applications?

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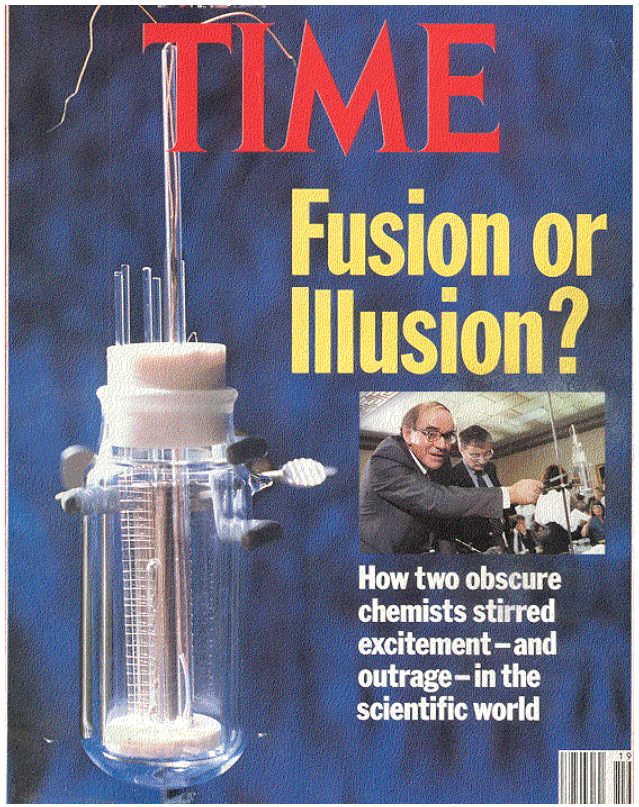
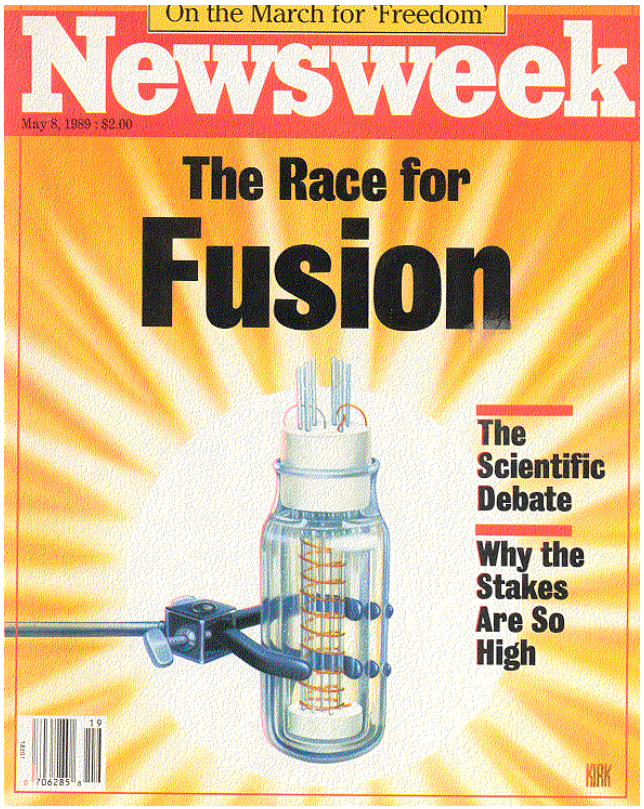
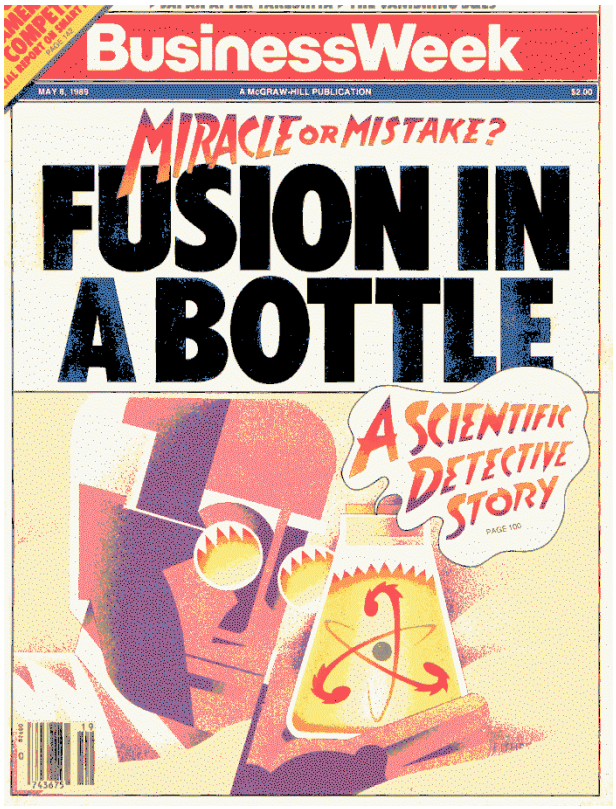
Magazine Cover Stories
8 May 1989

(David Nagel, 2011)

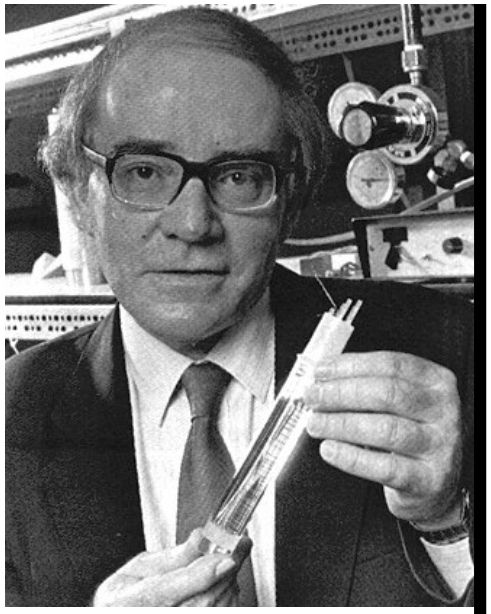




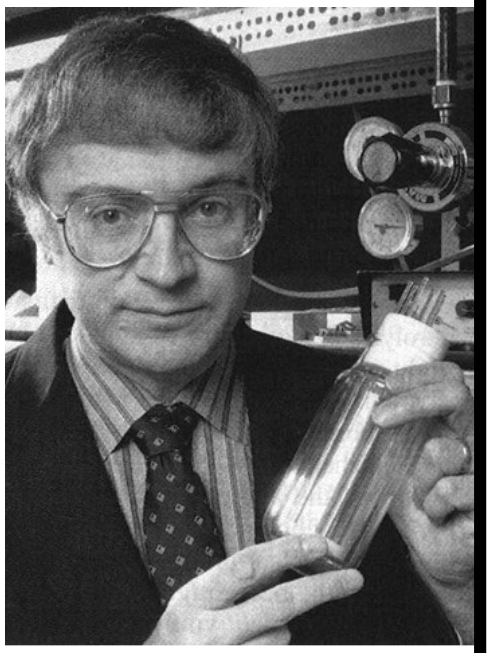


TRULY EXTRAORDINARY INTEREST

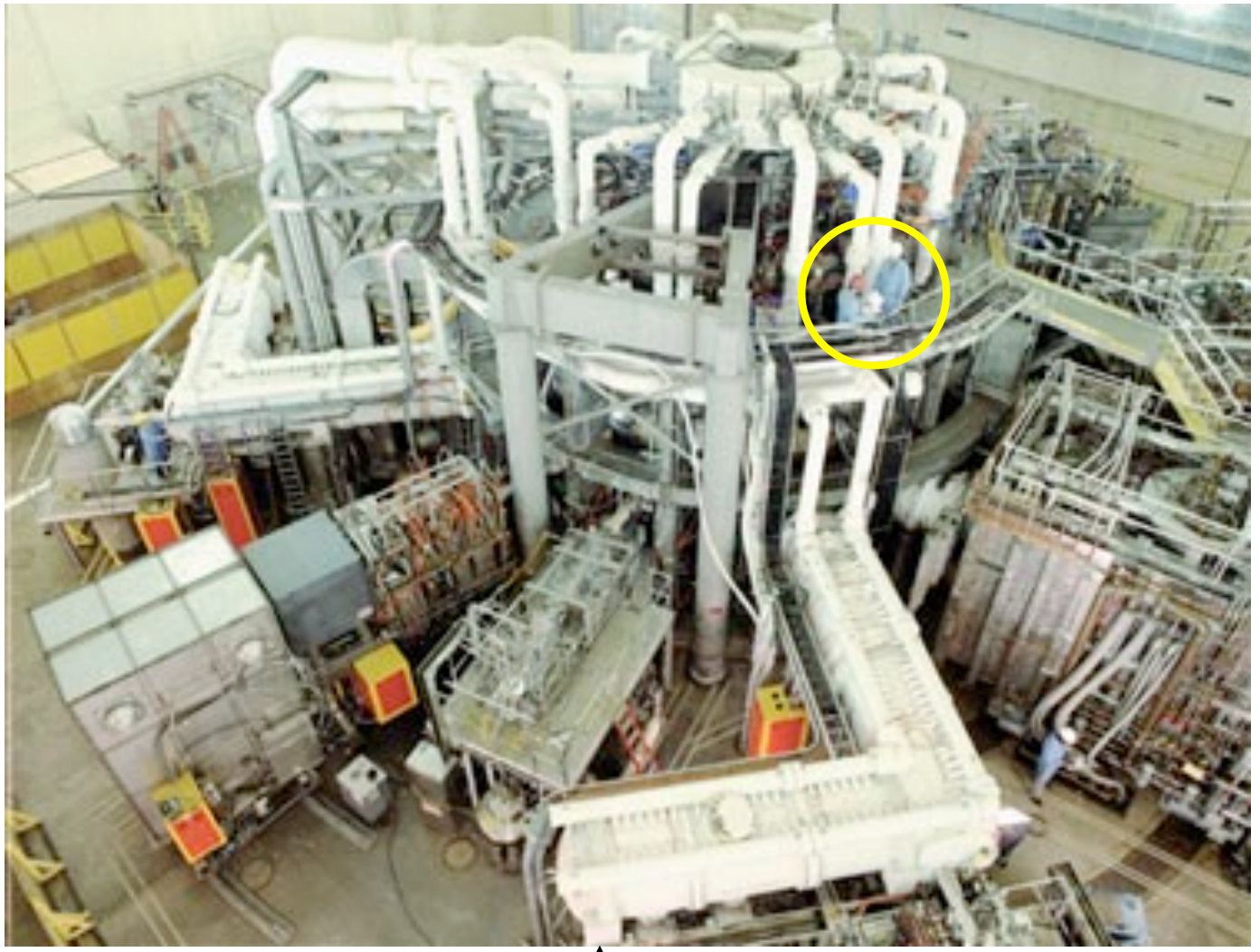
TFTR
Princeton University



Martin Fleischmann

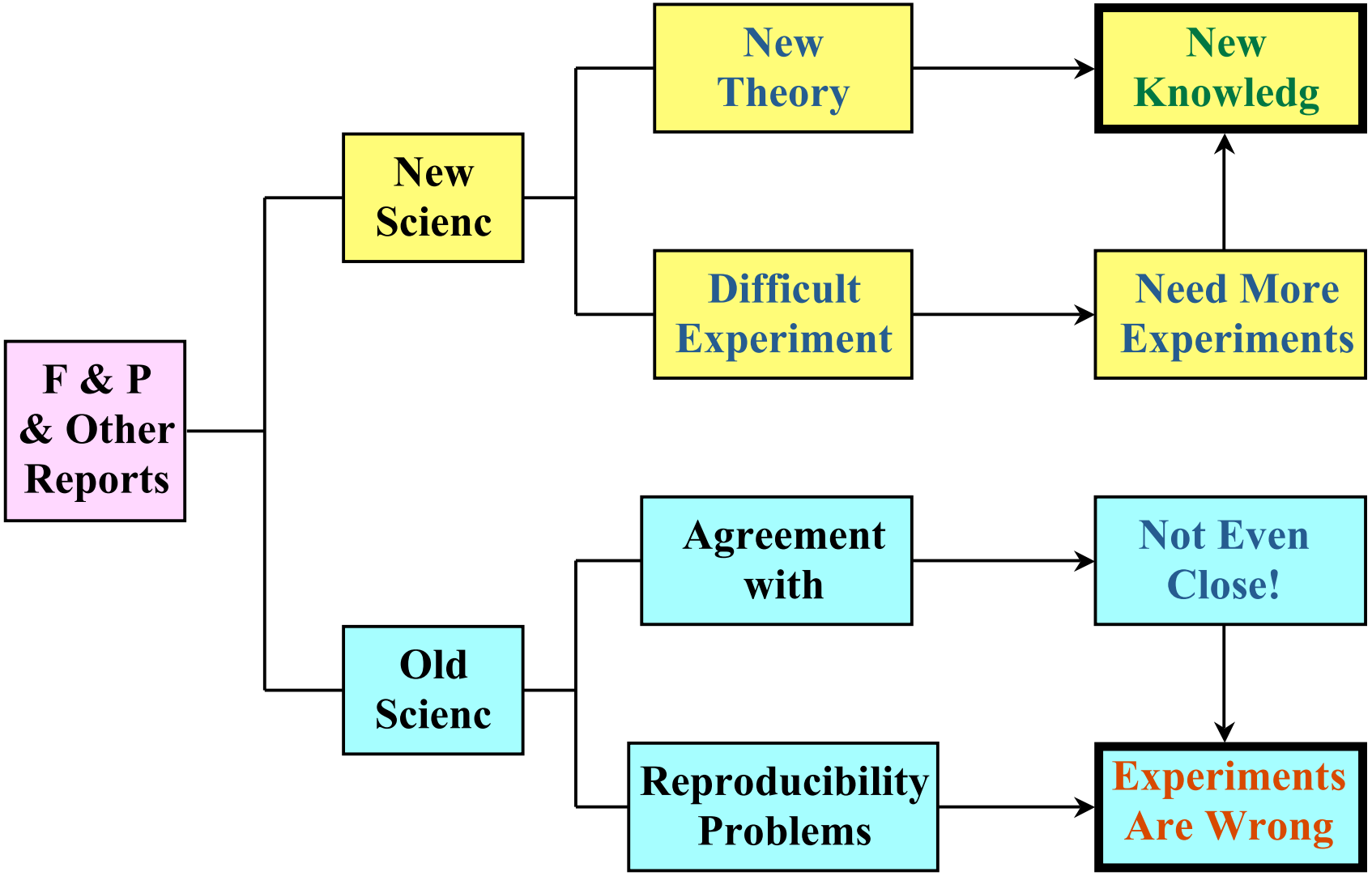


Stanley Pons



1989

A Major Problem with LENR



Progress = Robust Results

Better Instrumentation,
Calibration and Controls

Some Systematics Found & Verified
for Heat Generation Experiments

Nuclear Ash Measured &
Correlated with Heat Production

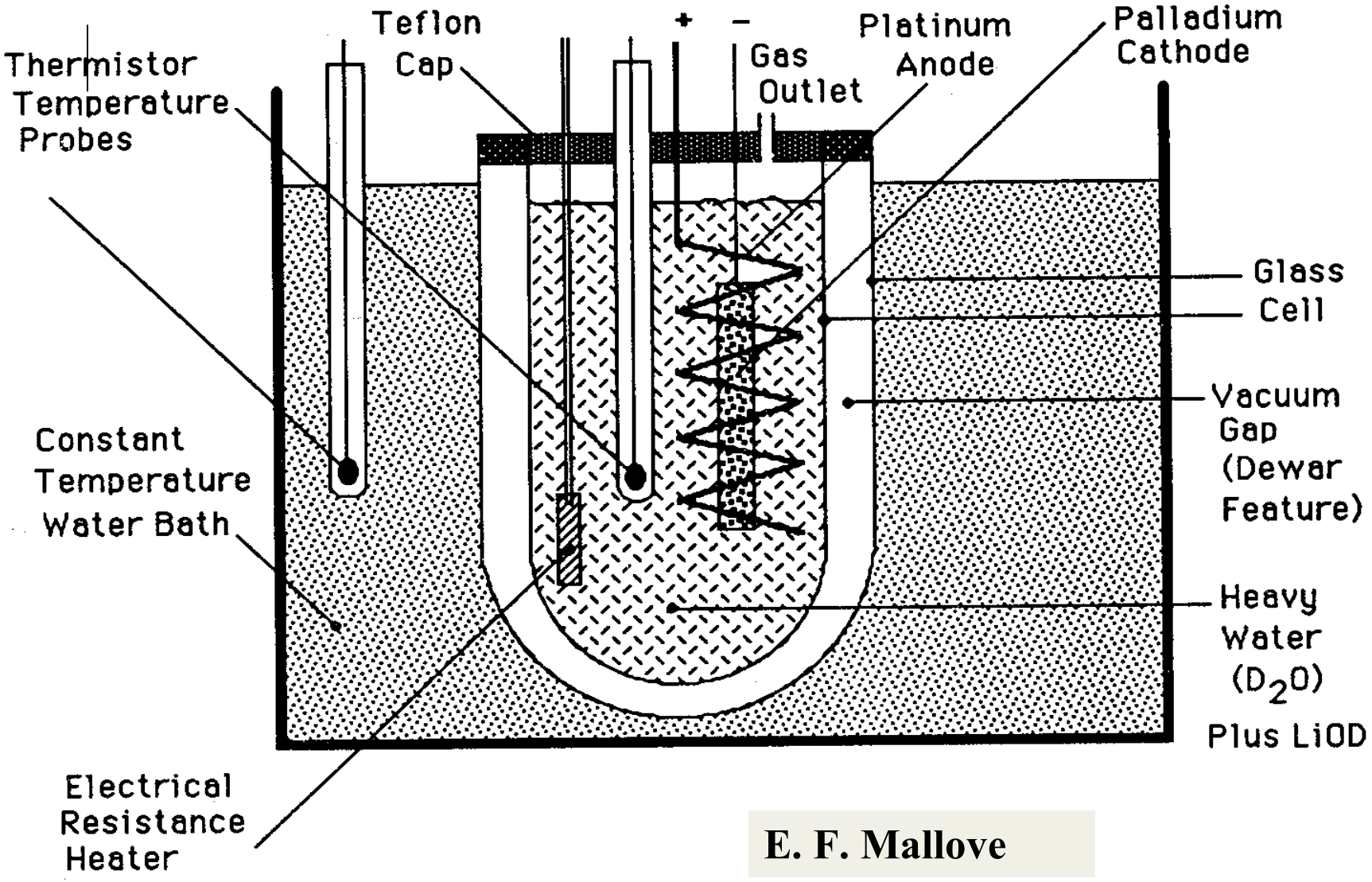
Many New Experiments Performed

More Attention to Materials

Improved Inter-Lab Reproducibility

Continuous Activity &
International Conferences

Electrochemical Loading & Heat



E. F. Mallove

Power x Time = Heat Energy ⟶ Temperature Increase

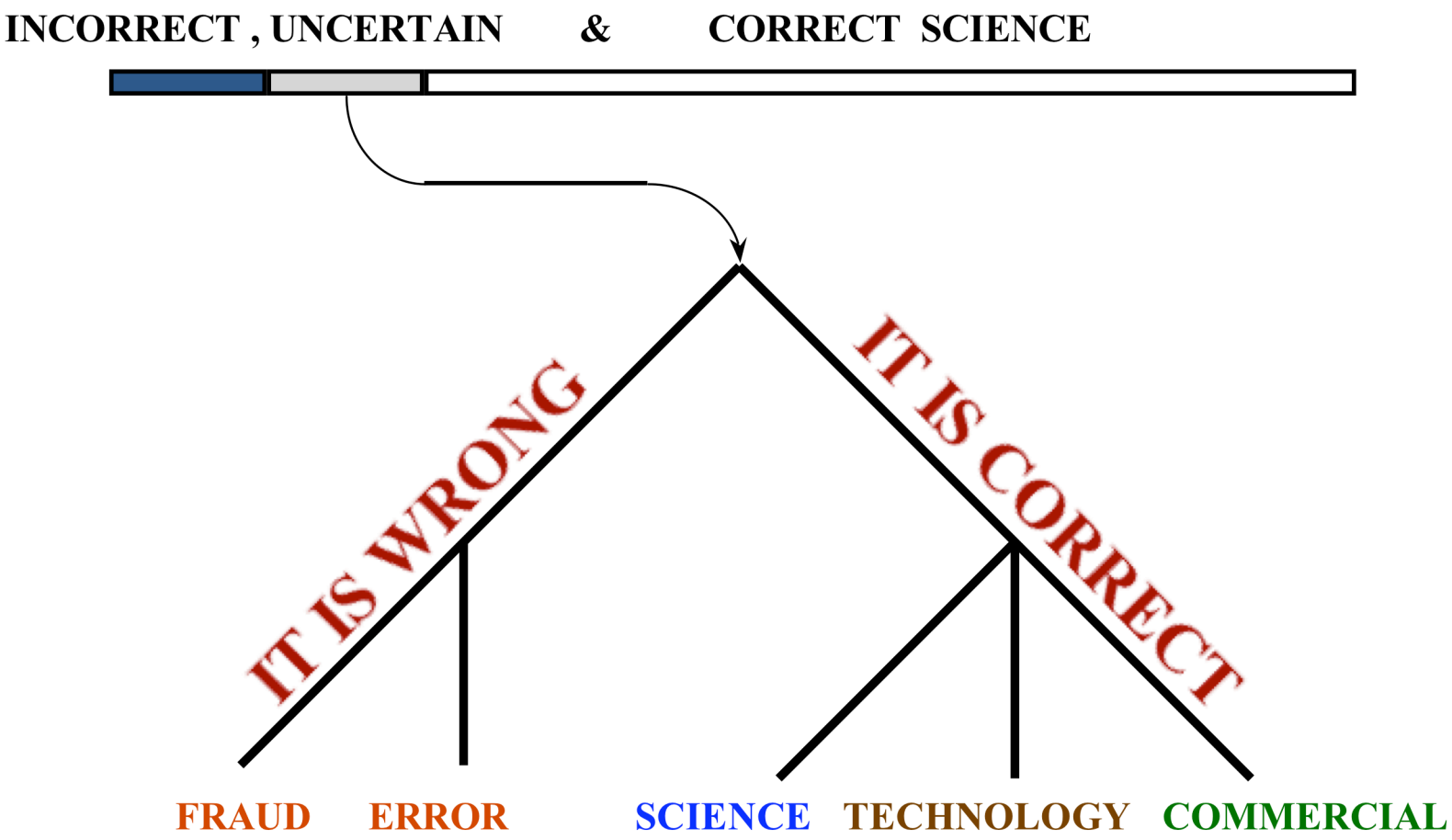
Experimental Summary

Each of the types of results individually indicates that nuclear reactions occur in diverse experiments at modest temperatures.

The database is robust & the observed effects must be due to nuclear reactions !!

- Measurements of Large Excess Heat
- Systematics Seen for Heat Production
- Helium can be Produced
- Heat-Helium can be Correlated
- Tritium can be Produced
- Neutrons Measured in Bursts
- Observations of X-and γ-Rays
- MeV-Energy Particles Measured
- Observations of Sound Impulses
- Craters in Cathodes Measured
- Hot Spots Measured on Cathodes
- New Elements Measured

Initially: The Situation was Very Uncertain



The ICCF Series of Conferences

AMERICA	EUROPE	ASIA
1. Salt Lake City	2. Como Italy	3. Nagoya Japan
4. Maui Hawaii	5. Monaco	6. Sapporo Japan
7. Vancouver	8. Lerici Italy	9. Beijing China
10. Cambridge	11. Marseilles France	12. Yokohama Japan
14. Washington DC	15. Rome Italy	13. Sochi Russia
		16. India
		17. Korea Aug 2012

Other Conferences

12 in Russia, 6 in Japan, 5 in Italy and many sessions at various society conferences

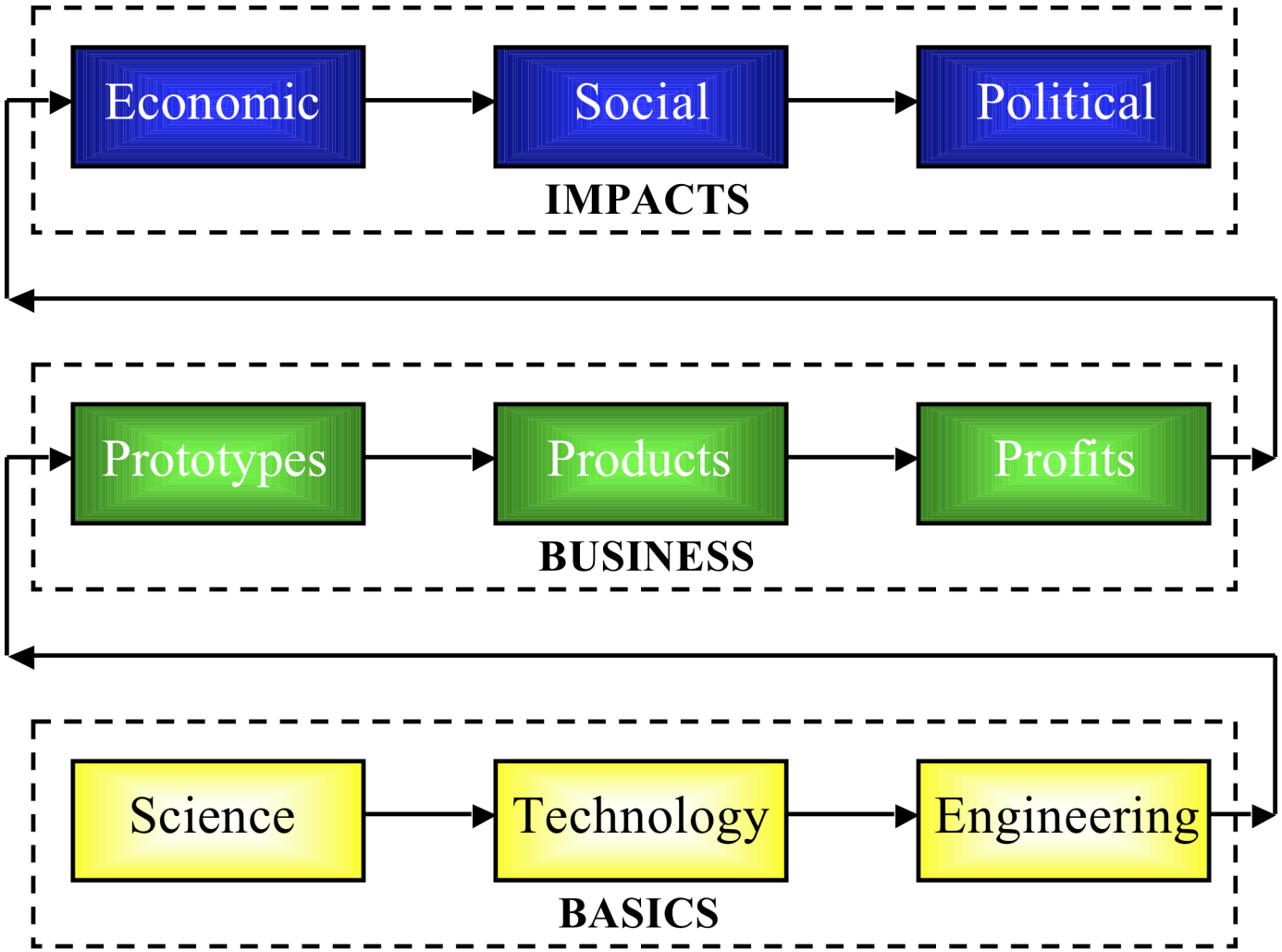
Characteristics of
Low Energy Nuclear Reactions

Experimentally, it is known that LENR offer:

Little Dangerous Radiation	**Safe**
Little Residual Radioactivity	**Clean**
No Greenhouse Gases	**Green**
Small energy sources	**Distributed**

Individually, these attributes are important.
Together, they might be historic.
Can LENR be commercialized????

The Possible Evolution of LENR



Two Major Parts of the Field Now

Electrochemical Loading of Deuterons into Palladium.

The initial Fleischmann-Pons approach
Most work in the field has been in this class

Gas Loading of Protons into Nickel

Work began by Piantelli in early 1990s
Approach used by Rossi in recent years

BIG Unresolved Questions about LENR

Are the reactions only nuclear, only atomic or both?

Is there one mechanism active or are there multiple processes?

Do the reactions occur only on the surface of materials or also in the bulk (volume) of the materials?

What, if anything, is common to electrochemical and gas loading experiments that have exhibited excess power and heat?

What is the root cause of experimental irreproducibility?

What external factors can be used to initiate and control LENR?

D.Nagel

Investigation of Anomalous Heat Observed in Bulk Palladium

Gustave C. Fralick (Project Lead),
John D. Wrbanek, Susan Y. Wrbanek,
Janis M. Niedra (ASRC) and Marc G. Millis
with
David J. Spry, Roger Meredith
and Jim Mazor (TFOME/Sierra Lobo)

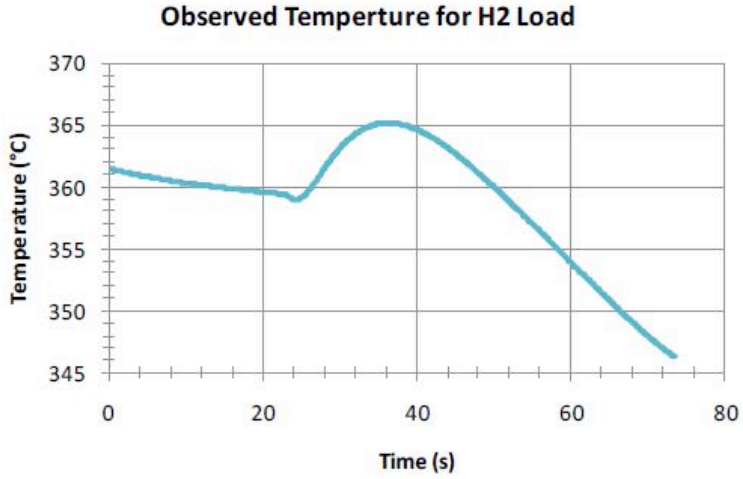
NASA Glenn Research Center
Cleveland, Ohio

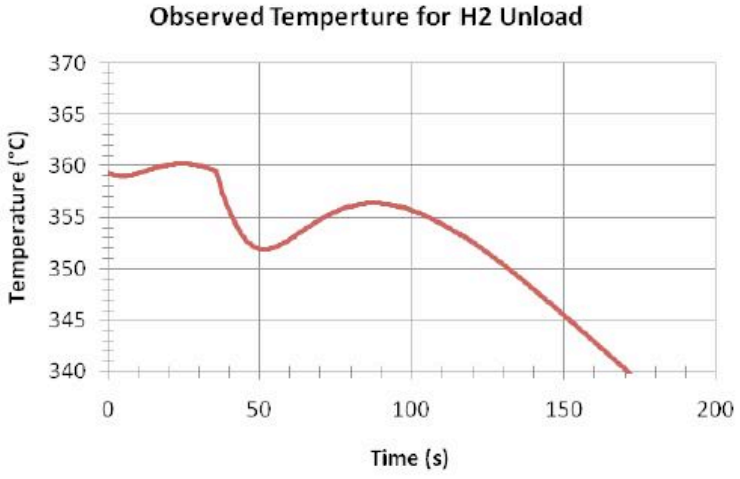
RESULTS (Preliminary): Temperatures vs. Time

Loading

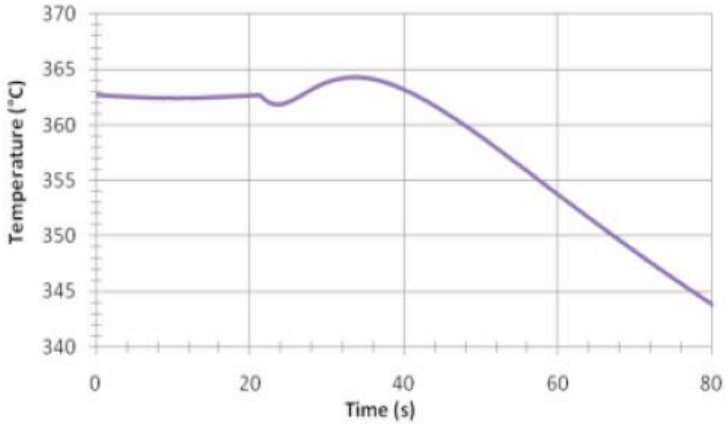
Unloading

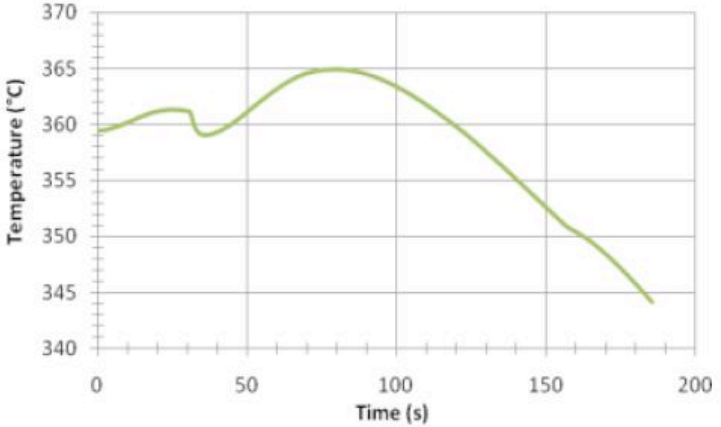
Hydrogen





Deuterium





Short list, not complete, of main experiments devoted to Excess Heat generation.

Only qualitative aspects, best results (improvement/innovations in red colour)

Authors Affiliations	Year	Ex.Power(W) Gain%	Temp. (°C)	Experiment type	Notes
Fleisch.&Pons Univ. SLC USA	1989	.01-1W 2-5%	30°	Electrolysis Pd/Pt LiOD .1M	Rod Isoperibolic Calorimetry
Mc. Kubre SRII, USA	1990	.1-3W	30°	Electrolysis Pd/Pt LiOD .1M	Rod Flow Calorim
A. Takahashi UNIV. Osaka Japan	1991	5-60W 25%	30°	Electrolysis Pd/Pt LiOD .1M	Plate (25x25x1mm) Flow Calorim

Takahashi Replication					
Celani-I De Ninno-I Mellove-USA	1992	1-8W 2-8%	30°	Electrolysis Pd/Pt LiOD .1M	Plate Flow Calorim Batch probl. Part. replic.
Piantelli Univ. Siena Italy	1993	5-40W 10-50%	350°	Gas H2 Press. <1bar	Rod Therm. emission
Arata Univ. Osaka Japan	1993	2-20W 20%	40°	Ibrid. DSC Elettr&press (1000bar)	Sub-micro Pd Powder Flow Calorimetry
Kunimatsu Toyota-Japan	1994	1-10W	40°	Electrolysis Pd/Pt LiOD 1M	Rod Isoperibolic Calorimetry

Preparata Leda-Italy	**1995**	**1-20W 5-50%**	**50°**	**Electrolysis Pd/Pt LiOD 0.005M**	**Long and thin Pd wires Isoperibolic Calorimetry**
Celani INFN-Italy	**1995**	**2-20W 5-60%**	**40°**	**High Power Pulsed Electr. J>150kA/cm^2**	**Pd wires, thin Isoper. and Flow Calor.**
Miley Univ. Chicago-USA	**1997**	**1-10W 200%**	**40°**	**Electr. H2 Nano-beads: Plastic-Ni-Pd multilayer**	**Isoper. and Flow Calor.**
DeNinno-Violante-Prep ENEA-Italy	**2000**	**0.05-0.5W 100%**	**40°**	**Electr. Pd/Pt LiOD**	**Thick film, l=1m self-destruc.**

Arata Univ. Osaka Japan	2002	2-20W 5-20%	30°	Ibrid. DSC Elettr&press (1000bar)	Nano-particle $Zr0_2$-Pd 2 months
Arata Repl.					
McKubre SRII-USA	2003	1-10W 4-15%	30°	Ibrid. DSC Elettr&press.	Confirmed
Celani INFN-Italy	2004	10-20W 200%	300°	Pd thin wire; surface nano-coated, H2, 6bar	Isop. Calor. Only 30minutes later self destructed.
Arata Univ. Osaka Japan	2005	10-30W 15-25%	180°	Nano-particl. $Zr0_2$-Pd D2, 60bar	12 hours

Arata Univ. Osaka Japan	2008	.2-1W infinite (no power iput)	25°	Nano-particl. 3-20nm $Zr0_2$-Pd D2, 60bar	Differential Calorimeter
Celani INFN-Italy	2008	1-5.5W 5-10%	550°	Pd wire nano-coated D2, 6Bar	Diff. Calor. In-situ 400W/g Pd 12hours
Arata Repl.					
Takahashi, Kitamura Toyota, Univ. Osaka Japan	2008	.1-1W infinite (no power input)	25°	D2, 60 bar	Confirmed, Industrial material by Santoku KK (Japan)

Arata method and improvements by Brian Ahern (USA), Takahashi&Kitamura					
Ahern Ames Lab. USA	2009	.5-3W infinite	25°	D2, 60 bar	ZrO_2-Ni-Pd nanoparticles
Celani INFN-Italy	2010	2-26W 3-15%	900°	H2-Ar, (D2), 6 bar Ni wire, nano-coated,	6 days. Power density 1800W/g Ni.
Rossi EFA-Italy	2011	10kW 600%	>100°	Ni nano- powders+X? H2, 25bar	Flow calorim. NO ind. test >6months??
Defkalion Greece	2011	10kW, 2500%	>200°C	Ni nano- powders+Y? H2, 25bar	Flow calorim. NO ind. test >1month??

Celani INFN-Italy	Nov. 2011 Reconfirmed Jan. 2012	10W 15%	>260°	Cu-Ni alloy Micro-Nano coated thin wires	Flow-calorim. Wire from PTC to NTC resistance, related to thermal anomalies
Takahashi-Kitamura Toyota-Univ.Kobe	Dec. 2011 (JCF12 Congress, Japan)	In progress	In progress	Cu8%Ni32%--Zr60% Nano-powder H2, D2	Flow-calorim. EndoT<100°C ExotT>200°C
?	2012	??	??	??	??

Conclusions

***After very turbulent beginning, due to poor reproducibility, the Researchers involved in the Science field of Condensed Matter Nuclear Science, step-by-step, improved the quality and reproducibility of the results obtained.**

Among others, it is pity that excellent experiments, like that performed by NASA, were not made public immediately but after 15 years: the realty of LENR were reconfirmed, even in gaseous environment (D_2) and high temperature (350°C), just after only 9 months from F&P first paper! The, improved quality, reconfirmation of NASA 1989 experiment, performed on Dec 2009, would have the some fate: luckily it was found, by chance, on August 2011.

*** The most innovative experiments were cross-controlled by other groups, with enough specific experience and not linked directly to the Scientist that claims extraordinary results.**

- **Flowing the time, it began evident, specially thanks to Yoshiaki Arata, the role of specific nano-materials (e.g. $ZrO_2$65%-Pd35%) able to absorb large amounts of Deuterium even under mild pressure (60bar).**

*** Thanks to gas environments, instead of initial electrolysis, the possibility to increase the temperature become evident and possible practical applications were planned.**

- **Under gaseous atmosphere, mixture of H_2-Ar, it was possible to detect anomalous excess heat even at wire (Ni, nano-coated at the surface) temperature as large as 900°C. The experiment lasted up to 6 days and other expert Scientist, external to the (Celani) group, made any kind of test they wished.**

- **The recent, extraordinary claims of Rossi and Defkalion group (gain 600% and 2500% respectively, at temperature larger than 100°C and 200°C), until not verified by independent test, as to be regarded with *attention and caution* at the same time. In other words, when we consider the progress made in CMNS studies, we feel that the Rossi-Defkalion claims aren't impossible in principle but they have to be proved in public under strict control, ASAP.**

*** Apart from the Rossi and/or Defkalion claims, the quality of experiments worldwide performed was so high and the results obtained so widespread, that an International program, well funded and based on multidisciplinary approach, has the possibility to build a "device" producing even electricity with very low, overall, emissions.**

* About theory, it is growing the interpretation that such phenomena arise because the "Weak Force" (Larsen-Widom model) instead the previously thought, usual Strong Force. A well know Researchers (A.Takahashi) recently wrote a model were both forces can be active.