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March 2, 2002

Comments on Reported Nuclear Emissions During Acoustic Cavitation

D. Shapira, M. J. Saltmarsh

Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN

01 March 2002

Abstract

We have repeated the experiment of Taleyarkhan et al.¹ in an attempt to detect the emission of neutrons from d-d fusion during bubble collapse in deuterated acetone. Using the same apparatus, a more sophisticated data acquisition system, and a larger scintillator detector, we find no evidence for 2.5-MeV neutron emission correlated with sonoluminescence from the collapsing bubbles. Any neutron emission that might occur is at least three orders of magnitude smaller than that necessary to explain the tritium production reported in Ref. 1 as being due to d-d fusion. We demonstrate that proper allowance for random coincidence rates in such experiments requires the simultaneous measurement of the complex time-varying singles rates.

Introduction

In a recent paper, Taleyarkhan et al.¹ reported the possible observation of d-d fusion events occurring in collapsing bubbles formed by cavitation in deuterated acetone. An acoustic standing wave, frequency 19.3 kHz, was used to provide alternating compression and tension in the liquid. Cavitation bubbles were seeded by pulses of neutrons from a 14-MeV pulsed-neutron generator (PNG) phased to the acoustic wave, but with frequency divided by 100. This note summarizes the results of an attempt to reproduce some of these experimental results with the help of some of the original authors. We repeated their original experiment using all of the same equipment, with the exception of the neutron detector, for which we substituted a much larger one (5.7 liters) based on NE213, and a significantly more sophisticated data acquisition system. The published experiment¹ used fast sampling oscilloscopes to record coincidences between pulses from a phototube designed to detect light (SL) emission from sonoluminescent bubbles, and a plastic scintillator/phototube combination for detecting neutrons.

Our experiment focused on the detection of nuclear emissions from the sonoluminescent bubbles. No attempt was made to verify the reported tritium production. We note that these levels of tritium – if due to d-d fusion – would have been accompanied by easily detectable levels (10^6 /s) of neutron emission. This is the same strength as the 14-MeV neutron generator used.

Setup for the repeat experiment

The physical setup for our experiment, shown in Fig. 1, was essentially identical to the original experiments, except that the large n- γ detector was used and located as shown. The deuterated acetone flask, approximately 6.5 cm in diameter, was enclosed within a plexiglass box with 6-mm walls. In addition, there was a pack of refrigeration materials 3 cm thick between the deuterated acetone and the plexiglass wall. The data acquisition system was very different, involving conventional particle-counting systems rather than sampling scopes.

The discriminator threshold for the sonoluminescence was set up as specified by the authors of Ref. 1, i.e., at about the same triggering level used on their sampling scope. There was no defined threshold for their neutron detector as the raw signals were merely displayed on an oscilloscope. Our detector threshold, set by a fast discriminator, was calibrated by comparison with the pulse height spectrum from a Pu-Be source available during the experiment. The relative response to a Pu-Be source and a ^{60}Co source was checked prior to the experiment. The ^{60}Co Compton edge (equivalent to a 1-MeV electron)

was found to be at a fraction 0.29 of the Pu-Be edge. The threshold used in the experiment was set at an equivalent electron energy of 280 keV. Using published² curves of light output, we estimate our threshold to have been at an equivalent proton energy of 1.4 MeV, thus below the threshold for 2.5-MeV neutron detection. A rough estimate of detector efficiency was made by approximating our detector as a slab of area 310 cm², and average thickness 18 cm. The mean free path of a 2.5-MeV neutron in NE213 is ~ 5 cms so the probability of an n-p scattering (0.65) is just given by the total cross-section ratios for H and C corrected for the relative abundance in NE213. Correcting this to allow for our finite threshold (0.44) gives an estimated efficiency of 0.3. We judge the uncertainty of this estimate to be about a factor of 2.

Geometry in SL/n- γ coincidence experiment

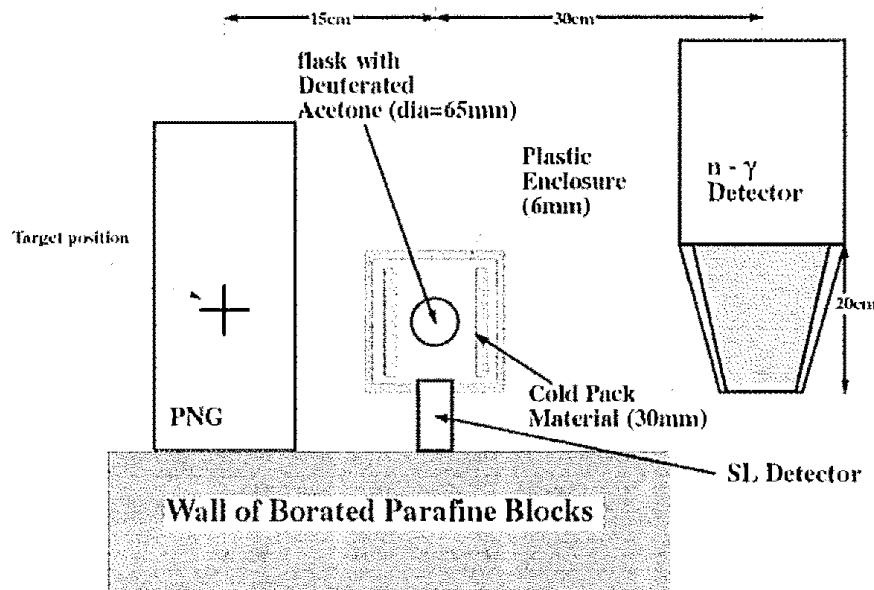


Fig. 1. A rough outline of the detector and shielding arrangement used in the experiment.

The cavitation apparatus was operated by the original authors of Ref. 1. The frequency of the trigger pulse for the PNG (193 Hz) resulted in a period of about 5.2 ms.

We measured both the SL/n- γ coincidences and the time dependence of the singles rates in both detectors during the 5-ms period between successive neutron pulses from the PNG. The time of any event (singles or coincidence) was measured relative to the start of each PNG firing using a 1-MHz clock. The time resolution was 1 μ s. A coincidence window of $\pm 10 \mu$ s was set to record SL/n- γ events, and a TAC was used to measure the time separation of the SL and n- γ signals within this 20- μ s window with a resolution of about 10 ns.

The pulse width from the PNG was measured as $\sim 12 \mu$ s. The data rates seen by the electronics during the PNG pulse were extremely high ($> 10^6/\text{sec}$) and resulted in unacceptable counting losses in the period immediately after the start of the neutron pulse. To avoid this, a blocking signal was used to veto all counts from the n- γ detector for 20 μ sec

after the onset of the PNG trigger pulse. In addition, the event rate from n- γ singles (i.e., with no SL coincidence) was reduced by looking only at every eighth pulse, thereby reducing the dead time for the data acquisition systems to <5% in the worst case. The division by 8 was not applied to the pulses used to identify the coincidences. The n- γ discrimination output was recorded so that a suitable cut could be made after the fact. All the results here refer to the total counts (no n- γ discrimination) in order to correspond to the coincidence setup in Ref. 1.

Experimental results

In a 65-minute run with cavitation, 51 coincidences between pulses from the SL detector and the n- γ detector were observed, a number consistent with the expected random rates. Figures 2 and 3 show the time distribution of singles and coincidences relative to the start of the PNG trigger pulse. Note that the coincidence event timing is defined by the neutron signal. The SL events occur in four distinct regions

- A. During the PNG neutron pulse (0-19 μ s).
- B. In a 30- μ sec burst immediately after the PNG pulse (20-61 μ s).
- C. In a zone of high n- γ background between 62 and 539 μ s.
- D. In a series of short (5- μ sec fwhm) bursts spaced every 52 μ sec (the acoustic wave period).

The observed singles count rates in the n- γ detector within these four regions are quite different, as can be seen by the time spectra shown in Figs. 2 and 3. These rates must be measured to calculate the expected random coincidence rates within the 20- μ sec coincidence window. Table 1 shows the results of such calculations. Note that the n- γ events in region A were almost entirely eliminated by the 20- μ s blocking pulse. In the absence of this blocking pulse, essentially 100% of the SL signals in region A would be in coincidence with an n- γ count, increasing the predicted random coincidence events by about 409. These coincidences would also exhibit a peaked time structure defined by the shape of the PNG pulse, unlike the others that are scattered randomly throughout the 20- μ s coincidence window.

Table 1.

Region	n- γ (c/s)	Probability of random coincidence	SL events	SL/ng coinc (random)	SL/ng coinc (observed)
A	89	0.0018	409	$0.72 \pm .04$	1
B	3915	0.0783	424	33.20 ± 1.61	29
C	953	0.0191	47	$0.89 \pm .13$	1
D	153	0.0031	6983	$21.37 \pm .26$	20
TOTALS				56.2 ± 1.6	51 ± 7

The number and time distribution of the coincidence events (see Figs. 2 and 3) agree with the calculated random rates.

The experiment was repeated without cavitation. In a 58-minute run, only 4 coincidences were observed, consistent with the expected random rate.

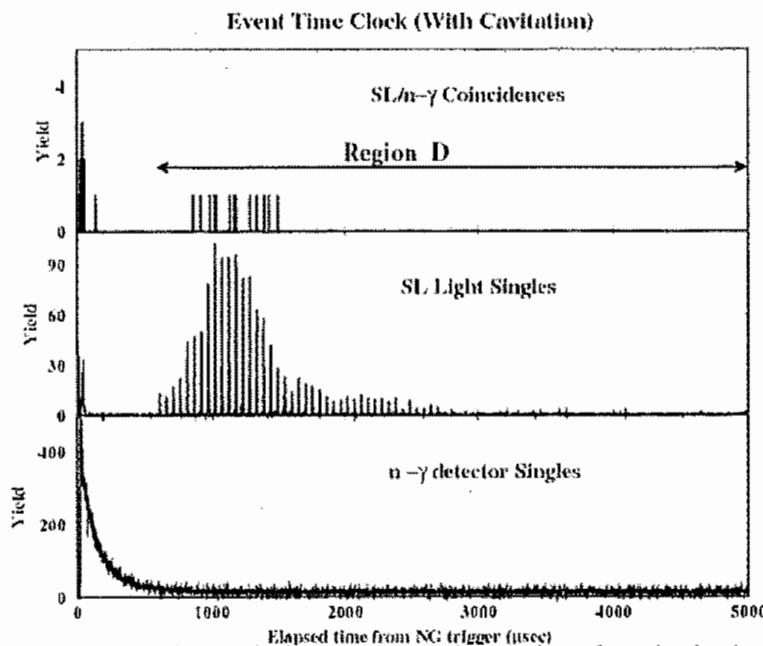


Fig. 2. Event occurrence time relative to PNG trigger time for n/γ singles, SL light emission singles, and the SL/ $n-\gamma$ coincidences.

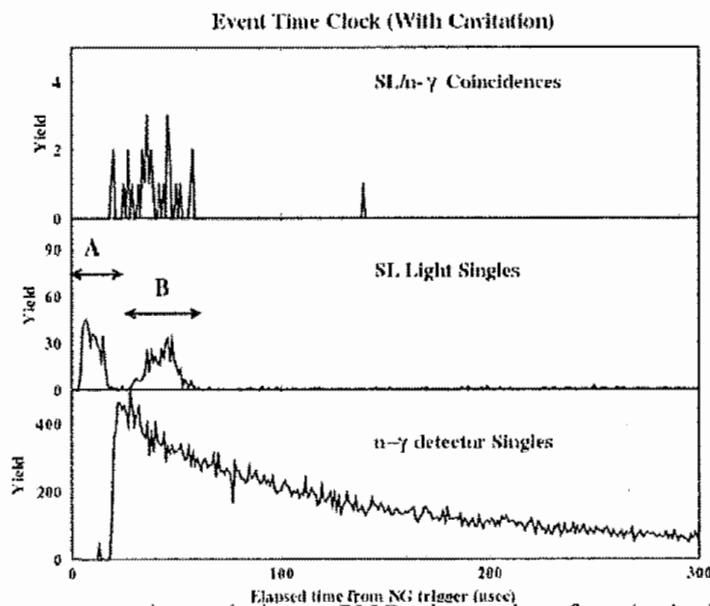


Fig. 3. Event occurrence time relative to PNG trigger time for n/γ singles, SL light emission singles, and the SL/ $n-\gamma$ coincidences shown with an expanded time scale.

Taleyarkhan et al.¹ report seeing more neutrons in their singles data during runs with cavitation as compared to those without. We have re-analyzed our data to check for this and note a statistically significant difference ~ 1000 counts ($\sim 1\%$ of the total) in the period immediately after the PNG pulse (20-300 μ s) in our $n-\gamma$ singles rate. Our data do

not show the time distribution of this excess to be correlated with the observed SL emissions.

Using our estimate of detector efficiency for 2.5-MeV neutrons ($\sim 30\%$), applying the solid angle factor appropriate for the detector geometry (3×10^{-2}), and allowing for transmission through the acetone, refrigeration material, and enclosure walls (35%), we estimate the net efficiency for detection of 2.5-MeV neutrons emitted from the acetone to be $\sim 3 \times 10^{-3}$. Thus, we would have detected an excess of $\sim 10^6$ counts in the singles spectrum shown in Fig. 2 if d-d fusion at the rate of 10^6 events/sec were occurring, as reported in Ref. 1.

Conclusions

We conclude that there is no evidence of any real coincidences in this experiment. Furthermore, there is a substantial random coincidence rate, which must be properly allowed for in any attempt to measure coincidences. As the background rates seen by both detectors are very time dependent, it is essential that these time dependencies be measured at the same time as the coincidences in order to properly evaluate the background rates.

Any excess neutron production was at least 3 orders of magnitude less than that required to explain the tritium production rate reported in Ref. 1 as being due to d-d fusion.

The time dependence seen in the SL singles is fascinating, and is worth further study.

Acknowledgements

We thank R. P. Taleyarkhan, C. D. West, and J. S. Cho for their help in setting up the sonoluminescence experiment, and note that they do not support our conclusions. Research at the Oak Ridge National Laboratory is supported by the U.S. Department of Energy under contract DE-AC05-00OR22725 with UT-Battelle, LLC.

¹ R. P. Taleyarkhan, C. D. West, J. S. Cho, R. T. Lahey, Jr., R. Nigmatulin, and R. C. Black, *Science*, in press.

² J. A. Harvey and N. W. Hill, *Nucl. Instrum. Methods*, **162**, 507 (1979).



What's New

by Bob Park

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Friday, March 1, 2002

1. BUBBLE FUSION: A COLLECTIVE GROAN CAN BE HEARD.

A report out of Oak Ridge of d-d fusion events in collapsing bubbles formed by cavitation in deuterated acetone, is scheduled for publication in the March 8 issue of Science magazine. Taleyarkan et al. observe 2.5 MeV neutron peaks, evidence of d-d fusion, correlated with sonoluminescence from collapsing bubbles. Pretty exciting stuff huh? It might be, if the experiment had not been repeated by two experienced nuclear physicists, D. Shapira and M.J. Saltmarsh, using the same apparatus, except for superior neutron detection equipment. They found no evidence for 2.5 MeV neutron emission correlated with sonoluminescence. Any neutron emission was many orders of magnitude too small to account for the tritium production reported by the first group. Although distinguished physicists, fearing a repeat of the cold fusion fiasco 13 years ago, advised against publication, the editor has apparently chosen not only to publish the work, but to do so with unusual fanfare, involving even the cover of Science. Perhaps Science magazine covets the vast readership of Infinite Energy magazine.

2. NUCLEAR TESTING: NUCLEAR WEAPONS DESIGN RESUMES.

Since 1992, the policy has been to maintain existing weapons under a Science-Based Stockpile Stewardship Program. But the Bush Administration has announced plans to resume design work on new warheads. This is expected to undermine nuclear non-proliferation, and lead to a resumption of testing. Speaking of testing, last week WN put the nuclear test range 100 miles from the Yucca Mountain repository. Several readers corrected our geography. Actually, the Nevada Test Site lies adjacent to Yucca Mountain. The nearest site, Buggy, is only 12 miles from Yucca, plenty far enough to rule out seismic problems, but close enough to arouse public concern.

3. DOOMSDAY CLOCK: IT'S NOW TWO MINUTES CLOSER TO MIDNIGHT.

The symbolic clock was reset to 11:53, the closest to midnight since 1998, after both India and Pakistan tested nuclear weapons ([WN 12 Jun 98](#)). Scientists on the panel that controls the hands said the 9/11 terrorist attacks were not the major factor in setting the clock closer to midnight. Rather, it was the lack of progress toward nuclear disarmament. If the U.S. actually resumes nuclear testing, the clock will presumably be set much closer.

4. FALLOUT: "EVERYONE HAS BEEN EXPOSED TO FALLOUT FROM TESTING."

So what? A wildly irresponsible study from the Center of Disease Control estimates that fallout from testing will result in 11,000 cancer

deaths. Would you believe zero? Atmospheric testing was dumb, and any testing now is dumber. But the CDC study assumes a linear, no-threshold model, which is clearly wrong. There is no evidence that low levels cause cancer and some evidence that low radiation levels may stimulate the body's protective mechanisms.

Bob Park can be reached via email at opa@aps.org

THE AMERICAN PHYSICAL SOCIETY and THE UNIVERSITY OF MARYLAND

Opinions are the author's and are not necessarily shared by the American Physical Society or the University, but they should be.

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

November 25, 2002

MEMORANDUM FOR JOHN MARBURGER

CC: KATHIE OLSEN
SHANA DALE
PENROSE ALBRIGHT
BILL GAINES

FROM: AMY FLATTEN *AHF*

SUBJECT: Additional Material for Your Meeting with Dr. Rice: U.S.-Russia
Memorandum of Understanding on Fundamental Properties of Matter

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Attachments

Tab A: Talking Points

Tab B: Proposed Language for the JCM Joint Communiqué (Cleared by OSTP)

Tab C: "What's at Stake" (Submission from DOE)

**U.S.-Russia Memorandum of Understanding
in the area of
Fundamental Properties of Matter**

Talking Points:

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DEPARTMENT OF STATE
OFFICE OF LANGUAGE SERVICES

(Translation)

U.S.-Russia Joint S&T Committee meeting
December 5,2002

Russian proposed language for Joint Communiqué

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U.S.-Russia Joint S&T Committee Meeting

December 5, 2002

Proposed Language to be included in Joint Communiqué

(U.S. Revision)

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U.S.-Russia Cooperation on the Fundamental Properties of Matter

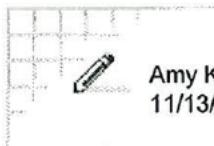
"What's at Stake"

Prepared by DOE
November 25, 2002

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Amy K. Flatten
11/13/2002 01:06:52 PM

Record Type: Record

To: John H. Marburger/OSTP/EOP
cc: Kathie L. Olsen/OSTP/EOP
Subject: Quick clearance before you leave town

Hello Dr. Marburger,

Normally I would put this in a more formal memo, but due to the tight timeframe, I thought email would be more expedient. I have also left hardcopies of this and the related document(s) on your chair.

(b) (5)

I have left hard copies on your chair, (and attached soft copies below) in the event I miss you in person. I would also welcome the opportunity to speak about this before you depart if you would like to do so.

Please let me know if there's anything else you may need

Thanks so much,
Amy

- Russian proposed language



Russia.FPMlanguage.do

- U.S. revised FPM language-draft



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- Proposed agenda - draft



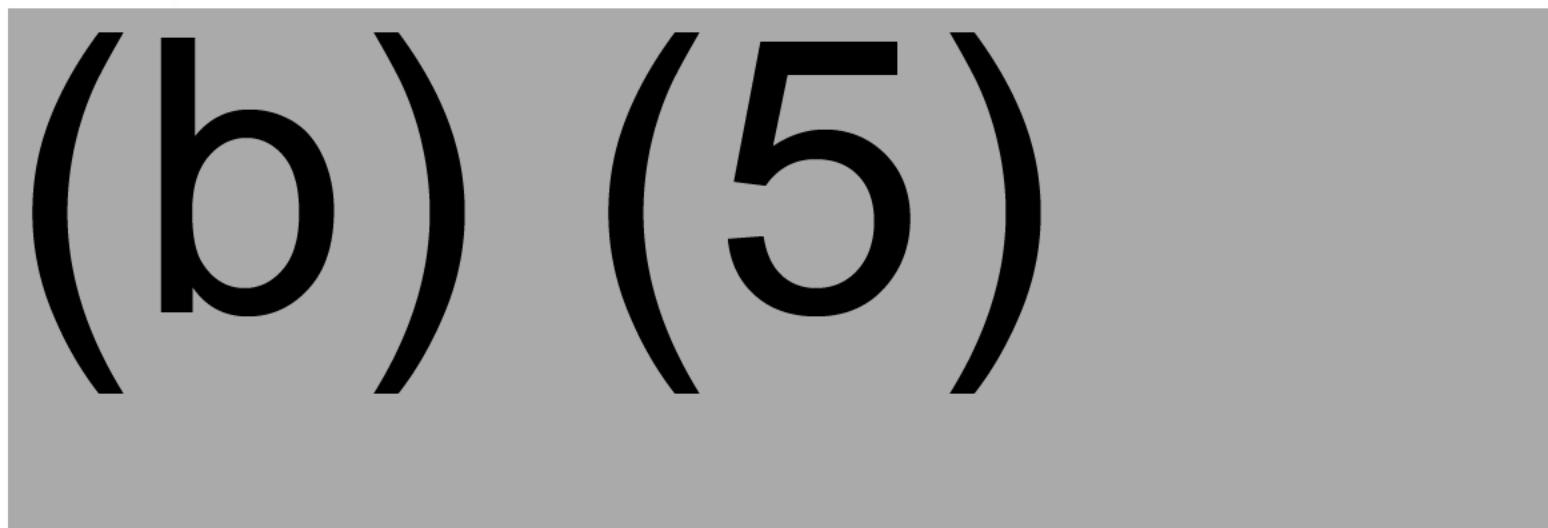
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Russian proposed language for Joint Communiqué



U.S.-Russia Joint S&T Committee Meeting

December 5, 2002

Proposed Language to be included in Joint Communiqué

(U.S. Revision)

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Draft Agenda

U.S. - Russia Joint Committee on Science and Technology

December 5, 2002
Washington, D.C.

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September 27, 2002

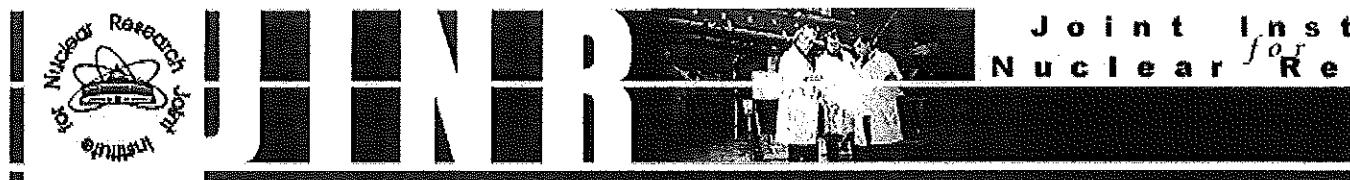
MEMORANDUM FOR JOHN MARBURGER

FROM: AMY FLATTEN

CC: KATHIE OLSEN
WILLIAM GAINES

SUBJECT: U.S.-Russia Memorandum of Understanding on Between DOE and the
Joint Institute of Nuclear Research (JINR)

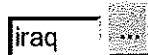
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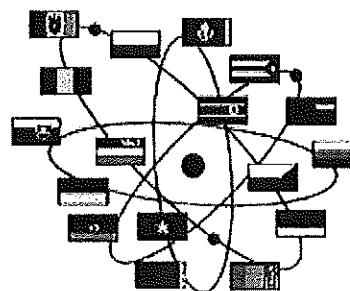


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EXECUTIVE OFFICE OF THE PRESIDENT
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WASHINGTON, D.C. 20502

September 12, 2002

MEMORANDUM FOR JOHN MARBURGER

THROUGH: KATHIE OLSEN *KLO*

FROM: AMY FLATTEN *AFF*

CC: PENROSE ALBRIGHT

SUBJECT: U.S.-Russia Memorandum of Understanding on Fundamental Properties of matter

A. Overview:

The State Department (OES/STAS) has begun the Circular 175 clearance process to request authority to negotiate and sign a Memorandum of Understanding (MOU) on the Fundamental Properties of Matter (Tab A). It was hoped that this new MOU would be available for signing in December 2002, during the upcoming U.S.-Russia Joint Committee Meeting that will be co-chaired by you and Russia's First Deputy Minister Kirpichnikov.

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Attachments

Tab A: Draft MOU

Tab B: Letter to Secretary Abraham from Russian Ministers Klebanov and Rumyantsev

Tab C: Joint Statement by Presidents Bush and Putin

2 11:00pm From-

T-283 P.05/06 F-283

Unofficial Translation

July 8, 2002

Mr. Spencer Abraham
Secretary
U.S. Department of Energy

Dear Mr. Abraham,

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(SEE REVERSE SIDE)

(b) (5)

Mr. Secretary, please accept our reassurances in our the most highest appreciation.

I.I. Klebanov

/s/

Minister of Industry, Science and
Technologies of the Russian Federation

A.Yu. Rumyantsev

/s/

Minister of the Russian Federation on
Atomic Energy

C.C.:

Mr. John H. Marburger, III
Science Advisor to the President and
Director, Office of Science and Technology
Policy



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The President's Trip to Europe and Russia

For Immediate Release
Office of the Press Secretary
May 24, 2002

Joint Statement on People-to-People Contacts

Joint Statement by President George W. Bush and President Vladimir V. Putin on U.S.-Russian People-To-People Contacts

In keeping with the spirit of cooperation between our two countries, we affirm the importance of strengthening contacts between our societies and citizens. We are confident that direct links between our cities, states and regions, businesses, educational, research, and medical institutions, and non-governmental organizations increase communication and promote understanding and trust between the United States and Russia.

Over the past decade, direct ties between Americans and Russians have grown rapidly, and they continue to broaden and deepen, including through joint business ventures and trade and economic relationships, academic and cultural exchanges, and cooperative efforts aimed at protecting the environment and developing new medical technologies and cures for the most deadly diseases. Such cooperation now goes beyond programs, projects, and agreements financed by our governments; our primary role in the future should be to support this trend by removing legal, bureaucratic, and other impediments. Recognizing the mutual benefits of travel for our private and official visitors, the United States and Russia are committed to streamlining visa practices and taking additional steps to facilitate travel. To this end, we have agreed to reduce substantially visa fees for participants in student and school exchanges.

We note that government-supported partnerships between American and Russian institutions are flourishing: they include 94 Russian-American sister cities, 8 hospital partnerships, and 37 university partnerships. In addition, more than 100 U.S.-Russian community and institutional partnerships have been forged between local governments, judges, businesses, professional associations, and other non-governmental groups.

We also recognize the strong ties between American and Russian regions and cities, especially the Russian Far East and the U.S. West Coast. Thanks to existing intergovernmental agreements, Native American and Russian citizens can visit their relatives in Alaska and Chukotka visa-free. In an effort to stimulate more of these regional ties, we have just begun a new program which will use U.S.-Russian partnerships to facilitate cooperation, strengthen civil society and media, and improve the business climate in the Russian Far East and the Volga Federal District.

Government-supported exchange programs that send Russians to the United States and Americans to Russia have also grown exponentially over the past decade. Under these programs, more than 50,000 Russian students, scientists, legislators and others have been hosted by families and communities in all 50 American states. Last year alone, about 1,000 Russian entrepreneurs visited the United States to exchange experiences and develop mutually profitable ties with their American hosts; these business exchanges are set to increase significantly this year. Meanwhile, thousands of American scholars, scientists, business people, health care professionals, language teachers, and other experts from many walks of life have spent time in virtually every region of Russia, working side-by-side with their Russian colleagues.

We will also continue to support our partnership in the critically important area of health care. Our priorities are fighting such infectious diseases as tuberculosis, improving maternal and child health in order to reduce maternal and child mortality, and combating cardiovascular disease. The United States and Russia are committed to preventing the spread of HIV/AIDS. In three regions in Russia, we are currently carrying out health education programs aimed at high-risk populations. We are pleased to note that funding will now be provided for an HIV/AIDS prevention program in a fourth site - St. Petersburg and Leningrad Oblast. In addition, joint programs for the treatment of tuberculosis within the framework of the World Health Organization are now underway in a number of Russian regions.

We will promote further expansion of contacts in such areas of cooperation as information technology, the natural and social sciences, and areas of fundamental research, such as fusion energy and high-energy physics.

A viable and independent media sector is an integral component of democracy in both our countries. Accordingly, we initiated the Media Entrepreneurship Dialogue in November. This dialogue has brought together American and Russian media professionals in a business-to-business partnership to exchange experience in resolving problems facing the media, including those of ensuring the development of commercially viable independent media. We welcome the successful

development of this dialogue. We also welcome a new partnership starting this year that will bring together Moscow State University's journalism school with an American school of journalism to develop curricula and materials used for training media managers and journalists.

The availability and use of the Internet in both the United States and Russia has increased dramatically in recent years, greatly facilitating communication between our two peoples. Both governments will do all in their power to create the conditions for information to flow freely within and between our two countries.

Both of our countries are rich in the vast territories they cover and in the diversity of their populations. Respecting the spiritual, cultural, and ethnic legacies of our nations, we affirm our commitment to universal values in the sphere of human rights and religious freedoms. We will seek to promote a climate of mutual tolerance and respect between different creeds and beliefs. To advance these goals, new initiatives are being developed to support Russian and American non-governmental organizations.

Our governments intend to promote further cultural interchange between our two countries, including the organization of exchanges between national museums, theaters, operas, ballets, orchestras, and individual artists. In addition, we will seek to promote activities that will enable American and Russian scholars, artists, and ordinary citizens to learn more about one another's history, language, and culture. We encourage the establishment of new contacts between American and Russian organizations such as the agreement between the State Hermitage Museum and the S. Guggenheim Foundation.

Through the centuries, Russia's great poets, novelists, painters, composers, and scientists have made brilliant contributions to world civilization, and Americans find their own lives enriched by learning more about this cultural legacy. Similarly, Russians have shown a great interest in learning more about American contributions to the arts and sciences. Increased appreciation of each other's cultures will help advance relations between our two nations into the future.

#

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EXECUTIVE OFFICE OF THE PRESIDENT
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WASHINGTON, D.C. 20502

December 3, 2002

MEMORANDUM FOR JOHN MARBURGER

COPY: KATHIE OLSEN
FROM: AMY FLATTEN *MFR*
SUBJECT: Background Information for Carnegie Meeting Regarding Global Science Forum Proposals from Various Countries

In preparation for the Carnegie meeting, enclosed are some initial proposals that various countries would like to informally share prior to the upcoming Global Science Forum (GSF) meeting in Paris, January 29-30, 2003. The "proposal development and review" process for new GSF activities is usually fairly long and rigorous. Consequently, at the next GSF meeting in January 2003, (b) (5)

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Consequently, (b) (5)

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Possible New Topics for the OECD Global Science Forum

An informal paper by the OECD secretariat

November 12, 2002

At the Eight Meeting of the Global Science Forum (January 29/30, 2003) delegates will probably want to approve 1-3 new activities (or at least select topics for detailed analysis). The new projects would be undertaken together with the Forum's ongoing work:

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A Draft Proposal for a OECD Global Science Forum Consultation on the
International Aspects of Bioethics and Research Using Human Stem Cells

Prepared by the Delegation of Australia to the GSF in consultation with the OECD secretariat

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A Draft Proposal for a OECD Global Science Forum Activity on
The Status and Prospects of Energy R&D for the 21st Century

Prepared by the the OECD secretariat in consultation with the French Delegation to GSF

This is a proposal for an OECD activity to produce findings and recommendations on the status, prospects and resource needs for research and development on energy technologies for the future. The proposed work would benefit government and industry decision-makers, planners, and programme managers. It would also contribute to the general debate about energy choices for the future.

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Received 3/4/02

cc: Shana
Silvie

School of Medicine
Department of Pharmacological Sciences

Dr. John Marburger,
Science Advisor to the President and
Director, Office of Science and Technology Policy
Executive Office of the President
Eisenhower Executive Office Building
Washington, D.C. 20502

Dear Dr Marburger

Sack

February 18, 2002

The White House Commission on Complementary and Alternative Medicine Policy, appointed two years ago, will be making its final report to President Bush March 7th. I testified before WHCCAMP last spring and am writing to share my concern that the recommendations in this report, if implemented, will have adverse consequences for public health.

WHCCAMP is composed of proponents of alternative medicine, convinced that its value was established by traditional use and that it should now be integrated into clinical practice. Most academic physicians, like myself, maintain that the safety and efficacy of alternative modalities should be evaluated by randomized controlled trials. In my testimony and in an op-ed piece in Newsday, I described the dangers of dietary supplements, a mainstay of alternative medicine, which result in serious injury annually to thousands of Americans. Editors of major medical journals testified that decisions involving medical treatment must be based on solid scientific evidence, an element generally lacking in claims made in support of alternative medicine. Legislation to protect the public, including amendment of DSHEA, is urgently required. Unfortunately, WHCCAMP did not include this recommendation in their final report.

In advising President Bush regarding WHCCAMP's report, I urge you to consult our former colleague, Jordan Cohen (AAMC), and other leaders of the Institute of Medicine so that President Bush will be accurately informed regarding this important issue.

With best regards,

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Arthur P. Grollman M.D.
Evelyn Glick Professor of Experimental Medicine

p.s. I look forward to hearing your talk next week at the "Copenhagen in Washington" Symposium and hope to see you and Carol at the Danish Embassy reception.

Enc (3)



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Alternative Medicine Meets Science

There is no alternative medicine. There is only scientifically proven, evidence-based medicine supported by solid data or unproven medicine, for which scientific evidence is lacking. Whether a therapeutic practice is "Eastern" or "Western," is unconventional or mainstream, or involves mind-body techniques or molecular genetics is largely irrelevant except for historical purposes and cultural interest. We recognize that there are vastly different types of practitioners and proponents of the various forms of alternative medicine and conventional medicine, and that there are vast differences in the skills, capabilities, and beliefs of individuals within them and the nature of their actual practices. Moreover, the economic and political forces in these fields are large and increasingly complex and have the capability for being highly contentious. Nonetheless, as believers in science and evidence, we must focus on fundamental issues—namely, the patient, the target disease or condition, the proposed or practiced treatment, and the need for convincing data on safety and therapeutic efficacy.

Despite the increasing use of alternative medicine (also termed *complementary, integrative, or unconventional medicine*) in the United States and throughout the world, most alternative therapies have not been evaluated using rigorously conducted scientific tests of efficacy based on accepted rules of evidence. The lack of properly designed and conducted randomized controlled trials is a major deficiency. For some published studies, serious concerns have been raised regarding methodological quality. A National Institutes of Health expert panel concluded that current evidence is inadequate for development of practice guidelines for alternative therapies, largely because of lack of relevant outcomes data from high-quality clinical trials.¹ However, some advocates of alternative medicine argue that many alternative therapies cannot be subjected to the standard scientific method and thus, instead must rely on anecdotes, beliefs, theories, testimonials, and opinions to support effectiveness and justify continued use.

Regardless of the origin or type of therapy, the theoretical underpinnings of its mechanism of action, or the practitioner who delivers it, the critical questions are the same. What is the therapy? What is the disease or condition for which it is being used? What is its purported benefit to the patient? What are the risks? How much does it cost? And, perhaps most important, does it work? For virtually all medical therapies and interventions, whether conventional or alternative, determination of effectiveness and recommendations for clinical application should be based on the strength of the scientific evidence using explicit criteria for grading the quality of evidence^{2,3} (Table) and ratings for technology assessment⁴ (ie, "established," "promising," "investigational," "doubtful," or "unacceptable.")

While acknowledging that many therapies used in conventional medical practice also have not been as rigorously evaluated as they should be, we agree that most alternative medicine has not been scientifically tested.⁵ However, for alternative medicine therapies that are used by millions of patients every

day and that generate billions of dollars in health care expenditures each year, the lack of convincing and compelling evidence on efficacy, safety, and outcomes is unacceptable and deeply troubling. We believe that physicians should become more knowledgeable about alternative medicine and increase their understanding of the possible benefits and limitations of alternative therapies. By doing so, physicians will be able to serve as more useful sources of information for their patients and advise them appropriately. As with conventional therapies, advice should be based on data and scientific information rather than anecdotal information, misperceptions, or preconceived or unfounded notions about effectiveness or lack thereof.

This theme issue of *JAMA* and the annual coordinated theme issues of the 9 American Medical Association Archives Journals published this month on alternative medicine represent a planned, concerted effort by the editors of these scientific journals to address some of these issues by providing physicians and other health care professionals with clinically relevant, reliable, fresh scientific information on alternative therapies. In response to our call for papers on alternative medicine,⁶ we received more than 200 manuscript submissions to *JAMA* and many more manuscripts were received by the Archives Journals. The result, after our usual rigorous review process, is publication of more than 80 articles and editorials on alternative medicine in our 10 scientific journals, including 18 randomized trials and systematic reviews, on more than 30 different topics, and from more than 16 different countries.

This issue of THE JOURNAL includes 6 randomized clinical trials that evaluate the use of 6 diverse alternative medicine therapies for treatment of common clinical conditions. The results are intriguing. Bove and Nilsson⁷ report that chiropractic spinal manipulation is not effective for episodic tension headache. Cardini and Weixin⁸ found that moxibustion (stimulation of an acupuncture point by heat generated from burning a specific herb) is helpful for correction of breech presentation in late pregnancy. Bensoussan and colleagues⁹ document that a Chinese herbal medicine formulation improves symptoms of irritable bowel syndrome. Shlay and coinvestigators¹⁰ demonstrate that acupuncture is no more effective than amitriptyline or placebo for relieving pain due to human immunodeficiency virus-related peripheral neuropathy. Heymsfield and coworkers¹¹ determined that *Garcinia cambogia*, a common component of commercial weight-loss products, lacks efficacy as an

Categories for Rating Quality of Scientific Evidence for Effectiveness of an Intervention*

Quality of Evidence
I. Evidence obtained from at least 1 properly randomized controlled trial
II-1. Evidence obtained from well-designed controlled trials without randomization
II-2. Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than 1 center or research group
II-3. Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.
III. Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

*Information is from Lawrence et al.²

Dr Fontanarosa is Senior Editor, *JAMA*, and Dr Lundberg is Editor, *JAMA*. Reprints: Phil B. Fontanarosa, MD, American Medical Association, 515 N State St, Chicago, IL 60610 (e-mail: phil_fontanarosa@ama-assn.org).

antibesity agent. In a preliminary study, Garfinkel and co-workers¹² report that a yoga-based intervention appears to hold promise for relieving some symptoms of carpal tunnel syndrome. In addition, a systematic review by Wilt and colleagues¹³ suggests that saw palmetto extracts improve urologic symptoms in patients with benign prostatic hyperplasia.

Perhaps just as important as the results of their studies, these investigators demonstrate that alternative medicine therapies and interventions can and should be evaluated using explicit, focused research questions¹⁴ along with established and accepted rigorous research methods¹⁵ (eg, appropriate controls, effective blinding procedures, adequate power, state-of-the-art techniques for systematic reviews); incorporating measurable, objectively assessed end points (eg, blinded assessment); and reporting meaningful patient-centered outcomes.

Two other studies in this issue provide additional new information on alternative medicine. In a replication of their previous nationally representative survey,¹⁶ Eisenberg et al¹⁷ report that the prevalence of use of at least 1 of 16 specific alternative therapies during the previous 12 months has increased significantly (from 33.8% in 1990 to 42.1% in 1997), that the estimated number of visits to alternative medicine practitioners increased dramatically (from 427 million in 1990 to 629 million in 1997), and that only 38.5% of those who used alternative therapies discussed them with their physician. Total out-of-pocket expenditures associated with use of alternative medicine in 1997 were estimated at \$27 billion. In an analysis of data from malpractice insurers from 1990 through 1996, Studdert and colleagues¹⁸ found that claims against chiropractors, massage therapists, and acupuncturists generally occurred less frequently and usually involved less severe injury than claims against medical doctors. The authors also summarize the legal issues and principles for physicians to consider when advising or contemplating referral of patients to alternative medicine practitioners.

Taken together, the articles published in this issue of THE JOURNAL and in the Archives Journals' theme issues on alternative medicine add a substantial amount of new information and scientific data on alternative therapies to the peer-reviewed mainstream medical literature. However, given the burgeoning use of alternative medicine therapies, the increasing numbers of patients who consult both medical doctors and alternative medicine practitioners, and the increasing number of insurance companies and managed care organizations offering programs and benefits for alternative medicine,¹⁹ the need for additional, carefully conducted, high-quality research is essential.

Priority for research funding for alternative medicine should be given to investigations of relevant clinical problems for which well-designed studies have shown encouraging results for alternative therapies, especially for conditions that are common and those for which conventional medicine has not been effective. Attention should be given to evaluation of safety and efficacy, but also to examining the effectiveness of a treatment strategy, with consideration of community practice settings, patient expectations and compliance, and cost-effectiveness.²⁰ Collaborative research, especially among the federally funded centers for alternative medicine research in the US and with international alternative medicine research centers, may improve efficiency in answering important research questions. We encourage high-quality, rigorous research on alternative medicine and invite authors to submit their best papers for our objective evaluation and consideration for publication.

However, until solid evidence is available that demonstrates the safety, efficacy, and effectiveness of specific alternative medicine interventions, uncritical acceptance of untested and unproven alternative medicine therapies must stop. Alternative therapies that have been shown to be of no benefit (aside from possible placebo effect) or that cause harm should be abandoned immediately. Physicians, insurance plans, medical centers and hospitals, managed care organizations, and government policymakers should base decisions regarding incorporation of and payment for alternative medicine therapies on evidence-based research and objective cost-effectiveness analyses¹⁹ rather than on consumer interest, market demand or competition, well-publicized anecdotal reports, or political pressures from well-organized and influential interest groups.

Ultimately, answering fundamental questions about efficacy, safety, appropriate clinical applications, and meaningful outcomes for all medical therapies, including those considered alternative medicine, requires critical and objective assessment using accepted principles of scientific investigation and rigorous standards for evaluation of scientific evidence. For patients, for physicians and other health care professionals, and for alternative medicine practitioners—indeed, for all who share the goal of improving the health of individuals and of the public—there can be no alternative.

Phil B. Fontanarosa, MD
George D. Lundberg, MD

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VIEWPOINTS

Controls Needed on Herbal Medicines

By Arthur P. Grollman

THE PUBLIC takes for granted that the Food and Drug Administration reviews and approves all medicinal products. As a result, millions of Americans take herbal medicines in the belief that potentially serious health risks are not involved. Unfortunately, their trust is misplaced. Thanks to heavy lobbying by the botanical and dietary supplement industries, Congress enacted the 1994 Dietary Supplement Health and Education Act, which allows herbs labeled as dietary supplements to be marketed without chemical analysis or prior testing for safety.

Unlike makers of prescription and over-the-counter drugs, manufacturers of herbal remedies are not required to report adverse effects of their products to the FDA. Misleading advertising of herbal medicines is rampant, and adulteration of Chinese herbs with toxic metals and other dangerous substances is common. In the eyes of many physicians, pharmacists and researchers, the 1994 law is an "accident waiting to happen." Although the majority of Americans continue to rely on prescription and over-the-counter drugs to treat illness, more and more of them are using herbal medicines. Last year, sales of herbal remedies totaled \$15 billion. To complicate matters, herbs are being added to an ever-increasing array of foods and beverages. This summer, Blue Light, a New York company, voluntarily recalled 13 varieties of herbal-drink products containing Aristolochia, a proved human carcinogen.

In the past, journalists were among the first to alert the public to hazardous drugs. Media exposure repeatedly brought pressure on an often reluctant Congress to enact drug-safety legislation and to support the FDA. Remarkably, the press rarely publicizes risks associated with herbal medicines. The public-health consequences associated with herbal "dietary supplements" are alarming and demand congressional action.

The inability of the FDA to safeguard public health is reflected by the sharp rise in the number of reports to poison-control centers of adverse effects of herbs and other dietary supplements. These reports reached 17,000 last year, up from



Martin Kozlowski

6,200 in 1998. Thanks to the 1994 law, the serious harm caused by herbal remedies is largely hidden.

For example, a decade ago, more than 100 otherwise healthy young women in Belgium developed irreversible kidney failure requiring dialysis or organ transplants. Half of them subsequently developed kidney cancer. These women had one thing in common: They all received a "cocktail" of "slimming" drugs containing Chinese herbs at the same weight-reduction clinic.

The toxic product was identified as *Aristolochia* (also known as birthwort), an herb used for centuries in traditional folk medicine. This "Chinese herb nephrotoxicity syndrome" later was reported in other countries, including the United States. In April, seven years after *Aristolochia* was banned in most of Europe, the Food and Drug Administration finally sent warning letters to pharmacies, manufacturers and consumers. Nevertheless, *Aristolochia* remains available in the United States as a component of several over-the-counter products used by naturopaths and chiropractors to treat symptoms of arthritis.

Consider the case of ephedra (*ma huang*), an herb used for millennia in traditional Chinese medicine. The chemical structure, pharmacology and toxic effects of ephedra alkaloids are similar to those of epinephrine (adrenaline), methamphetamine ("speed") and phenylpropanolamine (PPA). Given its stimulating and appetite-suppressing properties, ephedra has been adopted as an energy pill and as a mainstay of weight reduction programs. In recent years, more than 3,000 adverse effects have been attributed to the use of this herb. Since less than 1 percent of people experiencing severe side effects from dietary supplements report them to the FDA, it is estimated



Arthur P. Grollman, a physician, is a professor of pharmacological sciences and medicine at the State University at Stony Brook.

See HERBAL on A24

Herbal Medicine Controls Needed

HERBAL from A23

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that more than 100,000 Americans have had adverse reactions to ephedra. These reactions include cardiac arrhythmias, hypertension, psychosis, seizures and death.

An article in the prestigious New England Journal of Medicine, reported that PPA use was associated with an increased number of hemorrhagic strokes in young women. Another article in the same issue confirmed FDA reports of ephedra toxicity. The FDA issued a warning about PPA, leading pharmacies promptly to remove all over-the-counter drugs containing this chemical. But action was not taken to protect the public from the herb ephedra. In fact, the FDA's earlier efforts to require warning labels and to set dosage levels for the use of ephedra were effectively blocked by the supplement industry.

Possibly the greatest health risk posed by herbal medicines involves their potential interaction with prescription drugs. For example, St. John's Wort, widely used in the United States and Europe to treat depression, is metabolized by the same pathway as almost half the drugs taken by Americans for the treatment of hypertension, heart failure, asthma and AIDS. Taken alone, St. John's Wort is relatively innocuous, but in combi-

nation it quickly renders life-saving drugs ineffective. Herbs contain hundreds of chemical components; predictably, other drug-herb interactions have begun to emerge.

An herbal such as gingko biloba raises the risk of bleeding following surgery. But would patients taking that herb recognize this complication and alert their physicians? Given the paucity of warnings on herbal labels, probably not. We ignore at our peril the well-documented scientific reports of herbal toxicities. Congress should act promptly to amend the 1994 law so that manufacturers of all dietary supplements, including herbal remedies, are required by law to obtain pre-marketing approval by demonstrating the safety of their products to FDA.

Where public health is concerned, prevention of harm must remain paramount. It is imperative that journalists, consumers and health providers join to insist that Congress restore legal safeguards taken away by the 1994 law that would prevent marketing of herbal products without prior proof of safety. In addition, as recently suggested by the U.S. Office of the Inspector General, manufacturers should be required to include warning labels prepared according to FDA specifications and to forward to the FDA all reports of adverse events. The public interest should supersede that of the botanical medicine industry.

The Future of Medicine

In my 55 years as a physician, I've seen my share of what modern medicine can do. During the 40 years when I was a pediatric surgeon, I saw 95% mortality rates for congenital defects transformed into 95% survival rates because of what surgery can accomplish. As U.S. Surgeon General, I saw effective prevention and treatment techniques beat back the mortality from tobacco use and AIDS. And now, as an 85-year-old, my life has been prolonged and kept active by wonder drugs unknown to my parents. So it's been somewhat surprising in this era of triumph for modern medicine to see the rapid growth of alternative/complementary medicine, which is used by as many as one in three Americans. Although most of those still refrain from informing their regular physicians about that use, there is a growing tendency among physicians to acknowledge and even embrace certain forms of alternative/complementary medicine.

Changes in the use of the terms "alternative" and "complementary" suggest the shape of this shift. At first, it was called simply "alternative medicine," reflecting a dissatisfaction with regular medicine as well as a cultural rebellion against the biomedical community. In more recent years, several studies indicate that there has been a shift from "alternative" therapies to "complementary" therapies, adopted not in opposition to regular medicine but in alliance with it. And increasingly those who use one of the many forms of complementary medicine are not treating a specific medical problem. Rather, they are practicing prevention in ways they find more congruent with their philosophical values or lifestyle.

Now I think we may be seeing another refinement, one that is taking us from "complementary" to "safe and effective." For some people, the appeal of alternative medicine lies in its alternative stance, and as some of these therapies enter the mainstream, some of these individuals may seek other alternative practices. But more and more Americans are demanding greater certainty from alternative or complementary products as an increasing number of press reports document health problems resulting from certain natural products and complementary practices. Thus, the baby-boom health consciousness that led to the resurgence of alternative/complementary medicine now turns toward solutions that rest more heavily on science. We went through a somewhat similar passage a century ago, when dissatisfaction with regular medicine and a growing consumer market in health products led to the widespread use of a variety of nostrums and patent medicines; some no doubt helpful, some merely enjoyable, and some downright dangerous. At that time, journalists and the public pressed for scientific research to support proper branding and safety, culminating in the Pure Food and Drug Act of 1906. Much later, evidence of effectiveness was added to the list. Some among the sellers and buyers of health products objected at first to the intrusion of research-based evaluation into the health market, but soon both came to profit from increased consumer confidence in those health products.

For too long, the natural health products industry has kept its distance from medical research and from clinical medical practice, focusing instead on the short-term marketing advantages derived from keeping herbal and nutritional remedies exempt from any Food and Drug Administration (FDA) review of efficacy. A wiser approach would be for the natural products industry to work with medical research, including the FDA, so that consumers and medical practitioners could be warned about potential harm and assured that the claimed health benefits were really there. Although the growth in the use of alternative/complementary medicine is likely to continue, recent surveys and market data confirm a growing American concern about safety. In this new climate of national wariness and concern for personal safety, those interested in selling and buying natural products associated with complementary medicine will be better off in the long run if reliable research is able to certify their safety and efficacy. As America's baby boomers become senior citizens, the health care system needs the relief provided by effective prevention of disease and disability. There is a potential role for some complementary therapies and natural health products in preparing us to meet the challenges of the 21st century. But it can only be played if that industry and its proponents are prepared to meet real scientific and regulatory tests of safety and effectiveness.

C. Everett Koop

C. Everett Koop is the Elizabeth DeCamp McLernon Professor of Surgery at Dartmouth Medical School and a former Surgeon General of the United States.

The natural
products industry
should work with
medical research
and the FDA.



LAFAYETTE COLLEGE

Department of Biology

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Department of Biology

Dr. John H. Marburger
Director, Office of Science and Technology Policy
The White House
Washington, D.C. 20502

January 2, 2002

Dear Dr. Marburger:

I am delighted to know from Dr. Leonard M. Rosenfeld, Assistant Dean, Thomas Jefferson University, Philadelphia, that you have agreed to write a brief introduction for the Pennsylvania Academy of Science's forthcoming book/monograph titled, Science, Technology, and National Security. The monograph is expected to be published in July/August of this year. As per request of Dr. Rosenfeld, I am enclosing herewith a copy of the book outline for your use. Please send your material and a black and white photograph to me with a copy to Dr. Rosenfeld at your earliest convenience, if possible, on or before January 31, 2002.

Thank you again for your interest. With regards,

Sincerely yours

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Shyamal K. Majumdar, Ph.D.
Editor-in-Chief
Pennsylvania Academy of Science
Kreider Professor of Biology

cc: Dr. Leonard M. Rosenfeld
Co-editor
Thomas Jefferson University

February 8, 2002

Title: SCIENCE, TECHNOLOGY, AND NATIONAL SECURITY

Editors: **S.K. Majumdar** (Lafayette College); **Leonard M. Rosenfeld** (Thomas Jefferson University); **E.W. Miller** (Pennsylvania State University); **Shelton S. Alexander** (Pennsylvania State University); **Michael F. Rieders** (National Medical Services, Inc.); and **Assad I. Panah** (Pittsburgh University)

Foreword – Science, Technology and National Security – A Pennsylvania Perspective: Success by Innovation – Mark Schweiker, Pennsylvania Governor, Harrisburg, PA 17120, with Kevin Delicker, Special Assistant to the Governor.

Message – Dr. John H. Marburger, Director, Office of Science and Technology Policy, The White House, Washington, D.C. 20502 (**Expected to Receive in Mid February, 2002**)

Introduction - Arthur Rothkopf, President of Lafayette College, Easton, PA, 18042 and Former Assistant Secretary of the U.S. Department of Transportation

Opening Remarks

Preparing America for the 21st Century – Congressman Curt Weldon, Chairman of Readiness Sub- Committee, U.S. House of Representatives, Seventh District, PA, 2452 Rayburn House Office Building, Washington, D.C. 20515-3807

Section 1

Biological and Chemical Warfare: Technology, Detection, and Preparedness

Biotechnology and Biological Warfare: A Review with Special Reference to the Anthrax Attack in the U.S. – Shyamal K. Majumdar, Professor of Biology, Jeremy Tchaicha, Andrea C. Donaghy, and Christina M. Marc, Department of Biology, Lafayette College, Easton, PA 18042, E-mail: majumdas@lafayette.edu

Biological Threats from Plant Products–Rajat K. Chaudhuri, Professor of Plant Molecular Biology, Calcutta University, 35, Ballygunge Circular Road, Calcutta 700019, India, E-mail: (b) (6)

Marine Toxins and their Toxicological Significance: An Overview–Anupam Sarkar, Scientist, Chemical Oceanography Division, National Institute of Oceanography, Dona Paula, Goa – 403004, India, E-mail: (b) (6)

Issues in Homeland Security: Forensic Evidence in Real or Perceived Exposure to Chemical Substances– Michael F. Rieders, President, National Medical Services, Willow Grove, PA 19090, E-mail: (b) (6)

Sarin Gas Attacks in Japan and Forensic Investigations– A Case Report - Yasuo Seto, Chief of Fourth Chemistry Section, National Research Institute of Police Science, 6-3-1, Kashiwanoha, Chiba 277-0882, Japan, E-mail: seto@nrips.go.jp

Vaccines and Civilian Security Against Biological Weapons – Carolyn F. Mathur, Professor of Biology, York College of Pennsylvania, York, PA 17405-7199, E-mail: (b) (6)

Preparing for and Responding to Conventional and Unconventional Terrorism: A Survey – Phillip Dehne, Assistant Professor of History, Department of History, St. Joseph College, 245 Clinton Avenue, Brooklyn, NY 11205, E-mail: pdehne@sjcny.edu

Preparing for Bioterrorism: Putting Together Science with Technology – Walter Tsou, Commissioner, Department of Public Health, City of Philadelphia, 1101 Market Street, Suite 480, Philadelphia, PA 19107(Expected to Receive in Mid February, 2002)

Emergency Preparedness Responses: Pennsylvania’s Plan – Bruce Kleger, Director, State Laboratory, Pennsylvania Department of Health, P. O. Box 500, Exton, PA 19341 (Expected to Receive in Mid February, 2002)

Section 2

Weapony Test Monitoring

Monitoring for Foreign Nuclear Explosions: The Challenge of Covering All Environments - Lawrence Turnbull, Senior Scientist, Central Intelligence Agency, 5502 Avon Court, Springfield, VA 22151, E-mail: (b) (6)

Seismic Monitoring for Underground Nuclear Explosions – Shelton S. Alexander, Professor of Geophysics, Department of Geoscience, 537 Deike Building, The Pennsylvania State University, University Park, PA 16801, E-mail: (b) (6)

Non- seismic Monitoring for Underground Nuclear Explosions – Shelton S. Alexander, Professor of Geophysics, Department of Geoscience, 537 Deike Building, The Pennsylvania State University, University Park, PA 16801, E-mail: (b) (6)

Monitoring for Radionuclide Emissions from Nuclear Explosions – Lawrence Turnbull, Senior Scientist, Central Intelligence Agency, 5502 Avon Court, Springfield, VA 22151, E-mail: (b) (6)

Monitoring the Atmosphere and Space for Nuclear Explosions Using Satellite Based Sensors - Lawrence Turnbull, Senior Scientist, Central Intelligence Agency, 5502 Avon Court, Springfield, VA 22151, E-mail: (b) (6)

Section 3

Technology and National Security

The Evolution of Modern Digital Communications Security Techniques – Jim Omura, 601 Fourth Street, #123, San Francisco, CA 94107 E-mail: (b) (6) Paul Baran, 83 James Avenue, Atherton, CA 94027, E-mail: (b) (6) and James Spilker, Jr., Department of Electrical Engineering, Stanford University, 85 Roan Place, Woodside, CA 94062, E-mail: (b) (6)

The Role of Science and Technology in the Service of Arms Control and Nonproliferation – Ronald E. Mattis, Associate Professor of Engineering, University of Pittsburgh, Bradford, 300 Campus Drive, Bradford, PA 16701-2898, E-mail: rem23@imap.pitt.edu, and Edward J. Lacy, Deputy Assistant Secretary of State, Rm. 4953, US Department of State, Bureau of Verification and Compliance, Washington, D.C. 20520

Technology and the Concept of U.S. National Security – David Jablonsky, Colonel (Retired), United States Army, United States Army War College, Department of National Security and Strategy, Carlisle, PA 17013-5241

Logistics and National Security – Jean-Paul Rodrigue, Assistant Professor, Department of Economics and Geography, Hofstra University, Hempstead, NY 11549, E-mail: ecojpr@hofstra.edu, and Brian Slack, Department of Geography, Concordia University, Montreal, Quebec, Canada, H3GIM8.

Aesthetics of Weapons Use – Major James Cook (Retired), Department of the Air Force, HQ USAFA/DFFY, Colorado Springs, Suite 6137 USAF Academy, Colorado 80840-6256

Science, Technology, and Public Policy: The Cooperative Threat Reduction Experience – William F. Burns, Major General, (Retired), Former Special Envoy to Russia for Nuclear Dismantlement, 320 Union Hall Road, Carlisle, PA 17013-8300, E-mail: (b) (6)

info only

A MAGYAR KÖZTÁRSASÁG OKTATÁSI MINISZTERE

Budapest, February 25, 2002

H.E. John H. Marburger III
Assistant to the President for Science and Technology
Director, Office of Science and Technology Policy
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Washington, DC 20502

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Dear Dr. Marburger:

It has been a privilege and a pleasure to meet with you in Boston at the AAAS 2002 Annual Meeting on February 15, 2002. May I thank you for the time and attention you devoted to our talks and issues of common interest.

I listened with a great interest to your Topical Lecture on the new features of the US science and technology policy in this new, "after the September 11th" era. It was helpful, and a kind of good coincidence that we had our meeting just after your lecture. I believe that our exchange of thoughts and views on different topics might serve as a good "ignition spark" for the future cooperation between our two countries and government administrations in the field of science and technology – both policy-making and research cooperation.

I understand that – despite the differences in scale and historical/cultural background between the United States of America and the Republic of Hungary -- we are facing a number of common problems nationally and globally, and in a number of cases we have similar blueprints for the solutions. I think, wherever it is possible, joining our intellectual resources and "know-hows" in science and technology endeavor saves us not only financial resources but leads to a better problem solving as well.

As I mentioned to you during our conversation, we have just started to implement a new National Research and Development Program, which might be an interest to your S&T program planners and executors, as well as R&D policy-makers. Hungary's participation in the European Union's 5th R&D Framework Program also might carry some value-potential for the American research community, since through a triangle cooperation Hungarian scientists can serve as "European nods" for your research groups.

During the 1990s, as a result of the bilateral Science and Technology Cooperation Agreement signed in the follow-up of then US President George Bush' visit to Hungary in July 1989, the US-Hungarian Science and Technology Joint Fund was created with the support of the two Governments. Through this scheme more than 300 cooperative projects have been generated in the past more than a decade. Due to this cooperative program a strong network of US-Hungarian scientists have been created, which can be easily "reactivated" both bilaterally and multilaterally.

cc: Silvel

From our side we might learn from your experience of how to engage industry more strongly in government-supported research, or use universities more extensively as "lighting tower" institutions of our science base. Moreover, science teaching and "popularization" also might serve as platforms for our future cooperation, starting with exchanging information and going as far as executing joint projects in those fields.

It would be of interest to me to know how you see the possible fields and priorities of our future cooperation. It seemed to me that on many issues - if not all - our philosophy is very close to each other's. That is why I believe that there is much room for joint thinking and acting in the future.

May I confirm my words of invitation by this letter: whenever you happen to travel to Europe, you are more than welcome in Hungary. Please, let me know your travel schedule (if any) in advance, and I will be happy to have a program meeting your interests be arranged for you.

As a memento of our meeting, please find enclosed a photo taken in the Boston Sheraton Hotel's Conference Room. Finally, a personal remark: I do not remember whether I mentioned it or not when talking to you that I was a visiting professor at Texas A&M University between 1983 and 1985. I think, it never hurts with you or others of the present US government administration mentioning one's Texan "roots".

Please accept the assurances of my highest consideration.

Truly yours,

(b) (6)

Dr. József Pálinkás



Enclosure: Photo





CHARLES M VEST, PRESIDENT

ROOM G-208
77 MASSACHUSETTS AVENUE
CAMBRIDGE, MASSACHUSETTS 02139-4307
617-253-0148

February 12, 2002

VIA FAX 202-326-8960

Association for Women in Science
1200 New York Avenue, NW, Suite 650
Washington, DC 20005-6169

Dear Colleagues:

I am very disappointed not to be with you this evening, but I plead *force majeure*. There are few things that could have kept me away from this event, but one of them has occurred — the birth in Washington of our second grandchild. A few of you know how excited I was when our first granddaughter was born three years ago. Well, there has been no diminishment the second time around. I am with my family this evening.

I am grateful that you permitted me the opportunity to have this letter read.

Being elected a Fellow of AWIS is a singular honor that holds particular personal meaning for me. I was humbled to read the names of previously elected Fellows and proud to count among them many personal friends and people whom I admire. I particularly want to congratulate you on having honored several largely unsung heroes and heroines.

The quest for full inclusion and leadership of women in science is a quiet revolution of our times — quiet, yet tectonic in the restructuring of science and society in the new century.

Had it not been for the remarkable opportunity afforded me by Professor Nancy Hopkins and our other colleagues among the senior women faculty in MIT's School of Science, it is unlikely that I would be among your honorees this evening. Their work stands as a watershed for MIT and, much more broadly, for the world of science. It was an honor for me to have assisted in supporting them.

Many of us in my generation blithely assumed that if we concentrated on increasing the numbers of women undergraduate students and even graduate students that all would soon be well for women in academic science and engineering. The reality has proven to be much more complex.

The standard academic administrator's approach to thinking about the progress of women in science and engineering has mostly involved measuring the change over time in the relative numbers of women and men in these fields. It is the old "pipeline" approach — looking at how many engage in science and math from elementary school through college, graduate study, and faculty position. As you all know, there are "leaks" in the pipeline, with the number of women relative to men getting smaller and smaller at each higher level, and at each level, the problem is blamed on the level below. Most of all, we focus on worrying about the lower end of the pipeline — the situation in our K-12 system. This is how the discussion tends to go. It is a very important discussion, but a limited one.

And then . . . *for me* . . . along came the study prepared by Professor Hopkins and her colleagues. Their report was signed by all but one of the tenured women professors in our School of Science. They produced new information, some of which was quantified but all of which detailed remarkably consistent accounts of marginalization and discouragement — and this from women of outstanding scientific and educational achievement.

AWIS Fellows 1996

Bruce Alberts
Stephanie Bird
Anne Briscoe
John Cairns, Jr.
Mary Clutter
Rita R. Colwell
Barbara Filner
Florence P. Haseltine
Caroline Herzenberg
George Hornberger
Emilie Jager
Penelope Kegel-Flom
Vera Kistiakowsky
Shirley Malcom
Constance Morella
Vivian W. Pinn
Sheila Pfafflin
Judith Ramaley
Estelle Ramey
Vera Rubin

Neena Schwartz
Dorothy Skinner
Pamela Surko
Judith Todd
Ellen Weaver

AWIS Fellows 1997

Millie Dresselhaus
Lynne Friedmann
MRC Greenwood
John Gibbons
Bernadine Healy
Neal Lane
Jane Lubchenco
Nina Roscher
Stephen Parker

AWIS Fellows 1998

Anne Petersen
Virginia Upton
Maxine Singer
Ruth Kirchstein
William Wulf
Jaleh Daie
Mary Good
Jack Schmidt
Lydia Villa-Komaroff
Alice Huang

AWIS Fellows 1999

David Baltimore
Frances Cordova
Vernon Ehlers
Helen Free
Pamela Hines
Dominique Homberger
Sharon Long
Marilyn Suiter
Jean Taylor
Mary Alice Yund

AWIS Fellows 2000

Vinton G. Cerf
Helen Davies
Mary Gray
Denise Denton
Ted Greenwood
Nancy Hopkins
Martha Krebs
Cecily Selby
Ronald Smith

AWIS Fellow 2001

Anita Borg
Toni Clewell
Catherine Didion
Judy Estrin
Carly Fiorina
Marye Anne Fox
William Golden
Gail Naughton
William Wells
Lynn Woolsey

Association for Women in Science



AWIS RECEPTION
HONORING THE 2002 AWIS FELLOWS

FEBRUARY 17, 2002
"WOMEN IN SCIENCE DAY"

AS PROCLAIMED BY MAYOR OF BOSTON, THOMAS MENINO



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Charles Vest

President, Massachusetts Institute of Technology

Wanda Ward

*Acting Assistant Director, NSF Social, Behavioral and Economic Sciences
Chief Advisor, Building Engineering and Science Talent*

Association for Women in Science Reception

*Independence Ballroom West
Boston Sheraton*

*Sunday, February 17, 2002
5:00 – 6:30 PM*

Welcome

Catherine Didion
Executive Director, AWIS

Greetings

Jill Sideman
President, AWIS

Remarks

Charles Vest
President, Massachusetts Institute of Technology

Women in Science Day Proclamation

Marie Turley
*Commissioner for Women's Commission
(On Behalf of the Mayor of Boston)*

Presentation of Fellows' Certificates

Robert C. Leif, Ph.D.,
5648 Toyon Road
San Diego, CA 92115-1022
Tel. & Fax: (619) 582-0437
e-mail: rleif@rleif.com
Web: www.newportinstruments.com
Date: February 7, 2002
Subject: Ada

John H. Marburger, III, Ph.D.
Director, Office of Science and Technology Policy
Executive Office of the President
Washington, DC 20502

Dear Dr. Marburger,

Thank you for the invitation at Photonics West to write you concerning Ada. The US has many technological endeavors that have a significant software component. These difficult problems include: the creation of an effective antiballistic missile, maintenance of the integrity of the Internet, and its use to minimize the cost of the Federal Government. The DoD attempted, in the case of its own software, to standardize on Ada. Ironically, this was abandoned, at the time that compilers that had been validated to the level of the first language revision, which resulted in a very significant improvement to the language, particularly in real-time performance and object-oriented programming. However, the DoD did fund a GNU Ada, which is an excellent, complete version of Ada 95. It is available to all including our nation's enemies, who could use it to develop reliable, efficient software for weapons of mass destruction.

<ftp://ftp.cs.nyu.edu/pub/gnat/>

While I was the Corporate Fellow of Coulter Corp., I had a favorable experience with software development for a hematology instrument in Ada and believe that it is an excellent tool. Although, I agree with the recent posting of Richard Riehle (see below), I do not believe that major scientific and engineering decisions should be made on theory, limited personal experience, beliefs, marketing hype, possible future employment, or the common perception that the language of the year is cool. Standard engineering criteria should be applied to the choice of programming languages. The DoD should now have enough experience with both development and maintenance employing Ada particularly the latest version (Ada '95), C, C++, Java, and other programming languages to be able to evaluate the relative

costs and benefits of their use. Function Point (<http://www.dpo.it/english/topics/methods/ifpug-fp.htm>) counting or other metric could be used to quantify the amount of code. The defect rate at first release and the efficiency of defect removal should be quantitated. Sections of code should be selected at random and tested for their readability by programmers who were not involved in their programming. It should be emphasized that the choice of software development standards, such as 2167A or the Software Engineering Institute's (<http://www.sei.cmu.edu>) Capability Maturity Model for Software and Capability Maturity Model Integration are a separate variable from the choice of programming language.

Since the current expansion of the DoD will result in some loss of technological resources from the civilian economy, it is essential to minimize the effect of the shift in resources by maximizing the transfer of technology to the civilian economy. My experience with Ada in general, and serving on the AdaSAGE Engineering and Management group of the INEL National Laboratory convinced me that the transition of DoD technology to the civilian market needs improvement. AdaSAGE is a highly efficient database, which ran ten times as fast as Oracle.

Two of the major problems with Ada in Academia were its sponsorship by the DoD and the absence of support from NSF. My contacts with the military at Ada meetings indicated that there was no interaction between NSF and the DoD on transferring this technology. Any new attempt to transfer this technology to the civilian economy should include the Department of Commerce, particularly NSF. Transfer of Ada and other software engineering technology to the NIH, National Institute of Biomedical Imaging and Bioengineering (NIBIB) would serve to both aid medical research and increase the efficiency of the delivery of medical services (<http://www.nibib.nih.gov/>).

Yours respectfully,

Robert C. Leif, Ph.D.

(b) (6)

Richard Riehle [richard@adaworks.com] posted on Comp.Lang.Ada Mon 2/4/2002

I ran into a Raytheon engineer at a conference last year who proudly announced that one of his responsibilities was to "rip out all that old Ada code and replace it with C++." I somehow managed to contain my fury at such an idiotic concept, and tried to engage him in a dialogue about this. During that dialogue, he admitted that Ada is probably a better language, but everything anyone could do in Ada, could

also be done in C++. Since C++ was more popular, it made sense to him that Ada was obsolete. "In a few years you won't even be able to get an Ada compiler," is the current silliness being promoted by those who are have decided to "rip out all that old Ada code ... "

So, even as we hear them recite the refrain, "Ada is probably a better language," we hear also the bumper sticker slogan, "It can be done as well in C++."

The cost of converting Ada 83 code to C++ will be greater than that of converting to Ada 95. The long term cost of maintaining the C++ code will be substantially greater than maintaining the equivalent Ada code. The ability to port C++ code to the next generation of hardware will be greater than porting ISO standard Ada to that hardware. If those who are touting the economics rationale for using C++ instead of Ada were to actually do an economic analysis of this decision, they would likely be shocked by the probably cost of C++ over Ada.

The claim is that anything one can do in Ada one can also do in C++. This is probably true, just as anything you can do in C++ someone else can do in Assembler. It is a matter of selecting the right tool for the right job, and Ada is the right tool for jobs where safety and dependability are the key factors. I raised this issue. "Oh, we simply avoid using those parts of C++ that are unsafe." This is one of those arguments that cannot be won through reason. Once the decision is made, regardless of how absurd it might be, the decision-makers are committed to it.

Many centuries ago, a King was leading his forces against the great Sultan, Saladin. The journey to the battle was short and the King ordered the oxen-drawn water carts to remain where they were since it would be too slow to bring them along. The journey took longer than expected and the King's advisors suggested they return to get the water carts since thirst was beginning to become a problem for the knights. This King was not to be told he made a bad decision and ordered his troops to press on. The Sultan decimated the King's troops, thereby turning the tide of history such that, even today we are reaping the rewards of that Twelfth Century King's stubborn tenacity to an ill-considered decision. The problems we will see as the result of the decision to abandon Ada in favor of more error-prone tools will not be immediate. They will be problems that will persist long after those who have made them have gone on to other jobs or retired. Not only do such decisions fail to use our tax dollars well, they risk little disasters that probably would not occur if more sound decisions had been made in the first place. At this point, pride will not let the decision makers turn back for water.

Richard Riehle

31 May 2002

Dr. John H. Marburger

(b) (6)

Dear Dr. Marburger,

I am writing you at the suggestion of Scott Chubb. Scott is my nephew and a Stonybrook PhD in condensed matter physics. His dissertation concerned hydrogen in metals. Scott has been my mentor in this area of physics and in my efforts to try to understand cold fusion.

I am a retired physicist with an AB degree from Princeton and a PhD from UNC in Chapel Hill, NC. My dissertation was in gas discharge physics and concerned an experimental study of Penning discharges. My career was at the Naval Research Lab, where I worked for over 30 years for Dr. Herbert Friedman in the Space Science Division. I am a Fellow of the APS and of the American Geophysical Union. My theory training has been limited, but most of my theory courses were taught of Nathan Rosen, who was the Rosen in the Einstein, Podolsky and Rosen paper on conflicts between Relativity and Quantum Mechanics.

Like most physicists I was initially very skeptical of the Fleischmann and Pons claims for deuterium nuclear fusion, as achieved by the electrolysis of heavy water using a Pd cathode. However, when I learned that Fleischmann was a member of the Royal Academy and that he and Pons had done hands-on experiments, it seemed to me worth closer observation. I would have put the chances for reality around 10^{-6} until Scott described to me how many-body physicists treated electrons in a solid and how a many-body deuteron system treated in the same manner might in the large crystal limit have no barrier to fusion. We started collaborating, and published these ideas in a paper title "Cold Fusion as an Interaction between Ion Band States" in *Fusion Technology* in 1991. I also started attending the International Cold Fusion Conferences. I have just returned from the latest of these conferences, namely ICCF9, which was held last week in Beijing, China. I prepared some notes on 2 of the presentations made at the conference for Scott and for Dr. Asraf Imam, both of NRL. Neither was able to go to the Conference. Scott thought that you might find these notes and the corresponding Abstracts of interest.

The first of the 2 papers commented on is by Arata and Zhang. It concerns Fleischmann and Pons type radiationless deuterium fusion using a Pd-bottle type cathode. In past work the interior of the bottle cathode has been filled with Pd-black. A bottle cathode of this type was operated by McKubre et al. at SRI International prior to the ICCF8 conference 2 years ago. It was found to produce excess heat at the same level (~ 10 W, ~ 40 MJ) as a control cathode operated at Osaka University in Japan. A post-run sample of the intergranular gas was collected and analyzed by mass spectrometer. It was found to contain unmistakable and significant quantities of tritium, as identified by Dr. Clarke at McMaster University in Hamilton, Ontario. The results were published in *Fusion Science and Technology* last September, and verify that a nuclear process had occurred. Arata and Zhang have had repeated success in generating long duration but modest amounts of excess heat using Pd-black in their bottle cathodes. The new work used an oxidized Zr,Pd alloy instead of Pd-black. It is the first of their studies that have showed excess heat using something other than Pd-black.

As you may or may not know, the cold fusion community has been split between a "conservative" group, which has been concerned primarily with radiationless deuterium fusion, and a broader group that thinks that there is evidence for transmutations. The conservative group has tended to discount the transmutation claims and has been frightened by the "T" word, especially since some of the claimants have said that even light water electrolysis could cause transmutations. It was easy to blame contamination. I was of the "conservative" school prior to ICCF8 about 2 years ago. However, observations by Mengoli of the unique decay signature of ^{48}Sc in a deuterium titanium system were hard to explain away. In thinking about the problem I came to the realization that the same physics applied to the deuterium fusion case could be applied to the transmutations case. Both interactions require the presence of a many-body Bloch function hydrogen system, and both depend on principles recognized by Julian Schwinger. Schwinger stated that "In the very low energy cold fusion, one deals essentially with a single state, described by a single-wave function, all parts of which are coherent. A separation into two independent, incoherent factors is not possible, and all considerations based on such a factorization are not relevant." The radiationless deuterium fusion case seems to depend on a self-interaction within the many-body system, whereas the transmutations depend on an interaction between a many-body hydrogen system and an impurity atom. A fusion reaction can energize both cases.

One of the papers that was presented at ICCF9 was a transmutation study by Iwamura and coworkers at Mitsubishi. Two of the authors began their studies on "cold fusion" for Mitsubishi in 1993. They were co-authors of a paper in ICCF4 identifying a neutron burst emission from a degassing deuterided Pd specimen.. The new work was co-authored by 4 investigators, which would seem to indicate that the Mitsubishi program is the product of an ~36 Person Year effort. In their new studies they seem to have achieved good repeatability of a transmutation process. They present strong evidence for the transmutation reaction $^{131}\text{Cs} + 4 \text{ D} \rightarrow ^{141}\text{Pr}$ using a permeation deuterium flow. The study seems to have been a very thorough. In addition to repeatability, the paper identifies the essential elements without which no transmutation occurs. They also show that a parallel process occurs when Sr is substituted for Cs, leading to a ^{196}Mo product. My notes on the group's presentations include material not present in the published Abstracts. I have sent notes and Abstract to Scott and Imam, and am enclosing copies with this letter.

In contrast to the Mitsubishi group's 36-PY effort, the current US government supported effort is less than 2 persons. I think the current effort is much too small to match the interesting physics involved and the technological potential. It would be helpful if the APS and/or the National Academy Sciences were to review the last decade's work on "condensed matter nuclear science".

Sincerely,

(b) (6)

Talbot A. Chubb

(b) (6)

30 May 2002

Imam,

Re. Arata and Zhang paper



Maybe you can find out what is really going on..

Re. Iwamura et al. papers

- * Details presented in Iwamura's talk, not present in the Abstract include:
 - Stepwise decrease in Cs accompanied by stepwise increase in Pr with time. Pr started from zero. During the runs the permeation process was interrupted twice for in-situ measurements, and there was a final in-situ measurement.
 - Pr reached something like 4×10^{14} atoms/sq cm after 2 weeks
 - D₂ pressure on Cs side was 760 Torr. I think vacuum was on the support side.
 - 1000 Angstrom of Pd and CaO applied by sputtering. Not clear to me whether they were separate layers.
 - Cs applied by electrolysis. No other surface atoms showed on initial XPS.
 - Surface metals were also analyzed by K-edge absorption using synchrotron x-ray source
 - MS analysis was by SIMS
 - Just loading specimen with deuterium does not work. Permeation (fluxing) required.

- CaO,Pd layer required.
 - Does not work with H₂.
 - Good repeatability. Tried many times
 - ¹⁴¹Pr (5/2) and (3/2) detected. (nuclear spins?)
 - Protocol includes heating-up sample.
-
- Similar study with Sr carried out 3 times
 - Mass spectrum of product Mo reflected mass spectrum of Sr. Mass 96 dominates.
 - Build-up of 6×10^{14} Mo atoms/sq cm takes about 3 weeks, instead of the 2 weeks for Pr.
 - Commensurate excess heat = 0.0018 W for 1 week. (1090 J)
 - Both Cs and Sr increased mass by 8 and charge by 4.
 - Cs and Sr were chosen because of low work function. I think CaO was chosen empirically. ??
 - Note that these observations fit the LENR prescription for fusion-energized nucleon addition reactions, though why 2 heliums are added instead of one is unclear. (See attached Letter to Editor.) The basic requirement is to have deuterons in a band state bound within a large number of host metal unit cells. The containment volume must be large enough that energy minimization favors a coherent, combined wave function, with a correlation-avoidance description of overlap between band state deuterons and an "impurity atom", rather than an incoherent tunneling-through-barrier description.

Talbot

(b) (6)



LETTERS TO THE EDITOR

Hybrid Car Test Drive

I recently test drove the Toyota Prius with a "hybrid" powertrain (52/45mpg). I've waited over twenty-one years for this test drive, since I sent that letter to all the automakers in 1979 suggesting the design. The design was called the "Alpha 1."

While I cannot take credit for the introduction of the hybrid (I got the idea from an article in *Mother Earth News*), what made the ride most satisfying is the fact that every one of the twenty or so auto manufacturers who replied advised me such an automobile could not be created.

More importantly, the hybrid experience only proves that one should not believe those who claim technological advances cannot be achieved. Specifically, when new energy is developed we'll be able to replace the gasoline engine with an on-board battery charger that needs no fuel.

The next breakthrough test drive will be in the "Alpha 1" powered by a Zeropoint™ energy converter!

John Miranda
North Bergen, New Jersey



Time of Frustration

This is a time of frustration for those of us who are working on cold fusion. The reality of Fleischmann and Pons (FP) cold fusion has been clearly established, as shown in the appended list of experiments: Techniques that always produce excess heat have been developed in Japan and transferred to the U.S., excess heat has been observed at levels far exceeding experimental error, and the helium-4 nuclear product has been measured and found to match the expectation value of 24 MeV of observed excess heat per helium-4 atom produced. Side reaction products helium-3 and tritium have been observed at levels far exceeding possible error and at quantities that cannot exist without a nuclear reaction having occurred. Also, substantial evidence has accumulated for non-Fleischmann and Pons nuclear interactions, including transmutations. Nonetheless, the scientific community refuses to look at the results, and research languishes.

In this letter I want to discuss my changed views as regards areas related to "cold fusion" transmutation physics. Helping to change my mind was the observation of scandium-48 decays by Mengoli in a deuterium cold fusion experiment. The key point involves the relationship between localized and non-localized forms of many-body physics. In particular, transmutation physics reactions require a mixed many-body/local atom form of interaction, rather than a form of many-body self-interactions that is exclusively non-local. The point is that when a delocalized (many-body) band state involving deuterons or protons shares a volume with a localized, impurity atom or nucleus, the many-body state can interact with the impurity nucleus in a nuclear fashion and extract nuclear material from the impurity atom nucleus. In the near room temperature environment the extracted nuclear matter should become wavelike. This means that it can serve as feedstock for a fusion reaction, in which no high energy particles are released. In the scandium case a deuteron extracted from an "impurity" titanium atom would have reacted with wavelike deuterium, producing wavelike helium-4 and localized scandi-

um-48. More generally, the fusion product could be any of: helium-4, or helium-3, or tritium. With a many-body proton feedstock, wavelike deuterium could also be a product.

The above type of fusion event could be just the start of a more complex nuclear reaction process. The energized nuclear product could feed some of its nuclear reaction energy back into the daughter impurity atom to which it remains coupled, leading to fissioning of the daughter nucleus. This mode of de-exciting the product state would compete with transfer of reaction energy to the lattice, as occurs in FP cold fusion. A piecemeal transfer of energy to the fissioning atom would explain why the highly radioactive products of neutron-capture nuclear fission are avoided. The ironic point is that the very first paper Scott Chubb published on FP type deutron fusion envisioned a reaction between wavelike deuterium and a localized product state ("impurity"). So, my guess is that most of transmutation cold fusion reactions will be found to be combined fusion-fission reactions. My prediction is that the helium fusion products will be present whenever cold fusion transmutation or fission products are observed.

The split (FP vs. transmutation) character of the cold fusion field was very apparent at the ICCF8 meeting. The unifying theme chosen for the ICCF9 meeting is coherence. Coherence is certainly one aspect of all many-body fusion processes. However, a requirement for a partitioning of the point character of the reactive hydrogen feedstock is a more specific common feature for cold fusion nuclear reactions. Coherence does apply. Coherence requires that what happens at each of the point-particle locations occurs simultaneously at all of the point-particle locations during the fusion reaction. The partitioning requirement can be viewed as an expression of Felix Bloch's periodicity symmetry principle.

These "intuitive picture" arguments can be made pretty rigorous for the FP self-interaction case, once the partitioning concept is accepted. No attempt has been made to quantify the arguments in the transmutation case, but Miley's observations of fission products that are from both endothermic and exothermic fissions essentially requires a coupling to an exothermic reaction. The fusion-fission combination seems the obvious possibility.

It will be interesting to see which of the two types of cold fusion will produce the first practical energy source for domestic heaters.

Talbot Chubb
Arlington, Virginia

List of Experiments:

Since the initial cold nuclear fusion announcement¹ there has been substantial laboratory progress in establishing the reality of cold fusion excess heat produced by radiationless d-d nuclear fusion in the deuterium-palladium system. Selected experimental achievements are listed below.

1. Increasingly clear observations of excess heat in heavy water electrolysis experiments using palladium cathodes. Early work is well-summarized in Charles Beaudette's new book,² *Excess Heat: Why Cold Fusion Research Prevailed*. [1989-1991]
2. Fleischmann and Pons discovery of hours-long heat production in Pd cathodes after electrolysis turn-off.³ This phenomenon is called "heat after death." [1993]

3. Mass spectrometer observations of helium-4 in the electrolysis off-gas in experiments by Miles,⁴ B. Bush, McKubre, and Tanzella.⁵ Results were presented by McKubre at the Western Regional Meeting of the American Chemical Society, Ontario, California in October 1999, and also at the ICCF8 Meeting in Lerici, Italy in May 2000. Observed helium was quantitatively measured and shown to have been produced at a rate of 1 helium atom per 24 MeV of released heat. [1993, 1999]
4. Arata and Zhang development of the DS-cathode,⁶ which has produced watts of excess heat ten times in a row when used with the Arata and Zhang protocol.⁷ [1994]
5. Successful transfer of the Arata and Zhang DS-cathode technology developed at Osaka University to the McKubre laboratory⁸ at SRI. [1999]
6. Observation of heat and helium-4 generated in D₂-loaded 0.5% Pd-on-carbon catalyst, observed by Case⁹ and verified by McKubre *et al.*⁵ [1998, 1999]
7. Observation of by-product helium-3 by Arata and Zhang⁹ and with great clarity by Clarke and McKubre *et al.* during study of materials from previously run DS-cathodes. Helium-3 was repeatedly observed at a helium-3/helium-4 ratio greater than 10000 times ambient value.¹⁰ [1997, 2000]
8. Observation of tritium in gas from a post-run DS-cathode, as measured by the build-up of helium-3 in stored chemically-purified hydrogen samples by Clarke, Oliver, and McKubre *et al.*¹⁰ [2000]

References

1. Fleischmann, M. and Pons, S. 1989. "Electrochemical" Induced Nuclear Fusion of Deuterium," *J. Electroanal. Chem.*, 261, 301. Hawkins, M. was added to the list of authors.
2. Beaudette, C. 2000. *Excess Heat: Why Cold Fusion Research Prevailed*, Oak Grove Press, South Bristol, ME.
3. Pons, S. and Fleischmann, M. 1994. "Heat After Death," *Trans. Fusion Technol.*, 26, 87.
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AquaFuel-type Patent

In IE No. 9 (p. 44), you say, "Why didn't anyone notice this before?" about AquaFuel. My patent is simpler: I use an acid to produce free radicals from grass, sugar, or other hydrocarbons. Each free radical dissociates more than 10,000 water atoms to produce O and H₂. This is more than over-unity.

O.M. Baycura
 Campbell, California

Editor's Note: Orestes M. Baycura holds U.S. Patent #5,100,642, "Method of Generating a Fuel from Water and a Compound Containing Free Radicals." Abstract:

A fuel composed of water, a compound in which free radicals have been generated and a solute that stabilizes the free radicals while the fuel is in the liquid state but which releases the free radicals when the fuel is separated (vaporized) so that the free radicals then dissociate the water to form hydrogen gas in sufficient concentration to support combustion. The most readily available compounds in which free radicals can be generated to provide the fuel are hydrocarbons and carbohydrates. Free radicals may be generated in solids (e.g., sugar) by charring and grinding the sugar then mixing with acid. Free radicals may be generated in liquids by adding an acid. Polar liquids such as alcohols, aldehydes, and ketones have been found to be the most effective stabilizers.



Fogged Film Ignored

Back in 1989, a researcher at my alma mater (*Editor's Note*: University name withheld by request) was trying to duplicate the Pons-Fleischmann experiment. She left the loaded Pd cathode on some film in her desk drawer, and *a la* Mdm. Curie, later discovered the film fogged. Her director would not let her progress further for fear of embarrassment if it were not true. Lots of schools were getting bad press at that time regarding cold fusion experiments. I think she quit in protest and went to another school.

Wil Wakely
 San Diego, California

Editor's Reply: This is a wonderful anecdote, since many cold fusion researchers have found such fogging. It is too bad that the normal curiosity of scientists was not allowed the free reign it deserved. —EFM



Truth in Media?

I am writing in response to Dr. Mallove's editorial in Issue 34. You obviously feel cheated and shunned by mainstream media due to the fact that cold fusion has not been promoted in a positive light. As a veteran television producer, I share your frustration. Over the past fifteen years I have witnessed story after story reported in a biased or "sugarcoated"

Formation of condensed metallic deuterium lattice and nuclear fusion

By Yoshiaki ARATA, M. J. A.[†] and Yue-Chang ZHANG

Osaka University, 11-1, Mihogaoka, Ibaraki, Osaka 567-0047

(Contributed by Yoshiaki ARATA, M.J.A., March 12, 2002)

Abstract: It was confirmed that nanometer-sized metal powder (atom clusters or simply clusters) can absorb an extremely large amount of deuterium/hydrogen atoms more than 300% against the number density of host metal. Within such clusters, the bonding potential widely changes from the center region to peripheral ones, so that the zig-zag atom-chains are always formed dynamically around the average position of atoms and the degree of filling up of the constituent atoms for the fcc type metal reduces to about 0.64 from 0.74 in bulk metal, i.e., vacant space increases to 0.36 from 0.26. As a result, a large amount of deuterium/hydrogen atoms are instantly dissolved into such host-clusters at room temperature. Furthermore, "metallic deuterium lattice" (or hydrogen one) including locally the "deuterium-lump" with the ultrahigh density is formed with body centered cuboctahedral structure which belongs to a unit cell of the host lattice, while such event cannot be realized at all within bulk metals. It seems that nuclear fusion in solid ("solid fusion") takes place in the highly condensed "deuterium-lump" inside each unit cell of the "metallic deuterium lattice" (or mixed hydrogen one) which is formed inside each cell of the host metal lattice. It is considered, therefore, that each unit cell of the host lattice corresponds to minimum units of "solid fusion reactor". In order to achieve "solid fusion", just the generation of the ultrahigh density "deuterium-lump" (simply "pycnodeuterium-lump") coagulated locally inside unit cell of the host lattice and/or the highly condensed metallic deuterium lattice should be an indispensable condition.

Key words: Metallic deuterium lattice; deuterium-lump; pycnodeuterium-lump; solid-fusion; pycnonuclear reaction; metallic hydrogen; nanometer-sized particles; host atom-cluster.

Introduction. It is well known that hydrogen gas is not conductive to electricity under atmospheric pressure and temperature. However, it transforms into electrically conductive "metallic hydrogen" under extraordinarily high density conditions achieved inside the limited stars. In such high density metallic hydrogen, remarkable mutual interference (collision) of waves occurs in the groups of hydrogen nuclei with a long de Broglie's wave length, which is regarded to cause a remarkable nuclear reaction, and this phenomenon is called "pycnonuclear reaction".¹⁾ Using the p+d reaction ($\rightarrow {}^3\text{He} + \gamma$), it was proposed recently that pycnonuclear reaction should be artificially achieved ("artificial pycnonuclear reaction") in the metallic hydrogen of extraordinarily high density (20 [g/cc]) under ultrahigh-pressure of 10^9 [atm].²⁾ Practically, such dream has a weak point that there is no method of sufficiently reducing

and/or removing "space charges" of ions because of the necessity of hydrogen only as constituent atoms. It is, therefore, necessary to develop the technology of realizing the ultrahigh pressure of 10^9 [atm] pulsating with constancy and repeatedly, which is extremely too difficult in the technological viewpoint. On the other hand, it is very important to consider whether there is another method of realizing metallic hydrogen with extraordinarily high density by extremely reducing space charges of ions without using ultrahigh pressure mentioned above. For instance, we clarified that highly condensed metallic deuterium lattice (or hydrogen one) is produced within a unit cell of host metal lattice as face centered cubic (fcc), because the space charges of ultrahigh density deuterium/hydrogen ions group coagulated locally as "deuterium-lump" (simply "pycnodeuterium-lump") can be strongly reduced by many electrons in this host lattice instead of ultrahigh pressure necessitated in an artificial pycnonuclear reaction men-

[†] Correspondence to: Y. Arata.

tioned above, so that "solid fusion" takes place in the "pycnodeuterium-lumps" coagulated within the condensed metallic deuterium lattice with the "latticequake".⁹⁾ Since such metallic deuterium unit cell is included within the host metal unit cell, the minimum unit of "solid fusion reactor" corresponds to each individual unit cell of the host lattices. These host lattices possessing such function are realized by using nanometer-sized metal powder (host atom-clusters or simply host-clusters), and it was verified that extraordinary amount of hydrogen and/or deuterium atoms are highly condensed more than 300% concentration within such host-clusters. However, it is impossible to achieve such high density conditions in normal bulk metals, because even 100% content cannot be realized (70~80% in general). The authors have developed the following two methods: one is the electrolysis using DS-cathodes⁹⁾ and the other is sono-implantation¹⁰⁾ utilizing ultrasonic energy. These two methods demonstrated the generation of both excess energy and helium (³He and ⁴He) as reaction-products in many long-term experiments using these methods.

Experiment. The concentration of hydrogen/deuterium atoms invading into Pd-metal powder specimens were measured by the following two methods, a) and b). $ZrO_2 \cdot Pd$ powder⁵⁾ was used as metal specimens constructed with nanometer-sized individual Pd particles embedded dispersively into ZrO_2 matrix, which were made by annealing amorphous $Zr_{65}Pd_{35}$ alloy. Namely the specimens are assemblage of individual Pd host-clusters of about 50 Å in diameter as shown in Photo 1.

a) *Measurement of H_2/D_2 gas amount dissolved into the specimens kept in highly evacuated vessel.* We performed experiment through the following two stages. In the first stage, nanometer-sized powder (~50 Å Pd-clusters) was kept for two days inside a high vacuum (about 10^{-7} Torr) vessel made by stainless steel, and then the vessel was immersed in cooling water (22.2 [g]). In the second stage, H_2/D_2 gas was injected into the vacuum vessel with constant gas flow ($v_g = 20$ [cc/min]). In this process, the inner pressure (Pinn [atm]), sample-clusters temperature (T_s [°C]) and cooling water temperature (T (H_2O) [°C]) against elapsed time (τ [min]), as shown in Fig. 1 [A]. Since the injected gas was absorbed instantly into Pd-clusters, the inner pressure showed almost zero (Pinn~0) until the achievement in the saturation of gaseous atoms invading into the clusters, that corresponds to point A (Pinn << 1 [atm]) and point B points (Pinn ~ 3 [atm]) in both Fig. 1 [A] and [B]. Since the total gas volume injected into the vessel (V_g [cc]) is

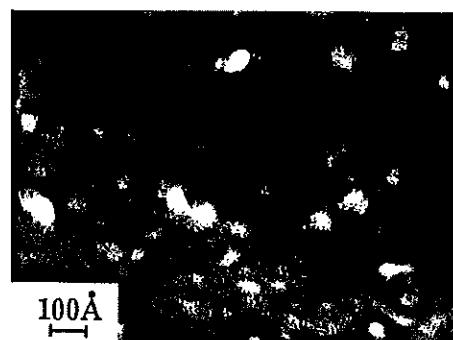


Photo 1. Electron micrograph of nanometer-sized Pd-clusters (~50 Å in diameter) embedded dispersively inside ZrO_2 powder.

given by v_g [cc/min] × τ [min], absorbed gas volume inside the clusters is obtained by $V_{GA} = v_g \cdot \tau_A$ and $V_{GB} = v_g \cdot \tau_B$, respectively (here each τ_A and τ_B corresponds to τ at point A and point B, respectively). As a result, the concentration of gaseous atoms absorbed into host atom-clusters can be obtained as follows: Points A (72 [min], under the condition of $P_{inn} \ll 1$ [atm]) and B (83.5 [min] in $P_{inn} \approx 3$ [atm]) as shown in Fig. 1 [A], corresponds to points A (1440 [cc]) and B (1670 [cc]) in Fig. 1 [B], respectively. Then the absorbed gas volume V_{GA} (1440 [cc] = 1.44 [l]) and V_{GB} (1670 [cc] = 1.67 [l]) correspond to following mol-numbers of gas molecules ($n_{MA} = 1.44$ [l] ÷ 22.4 [l/mol] ≈ 0.0643 [mol] and $n_{MB} (\approx 0.0745$ [mol]), respectively, and/or atoms ($n_A = 2n_{MA} \approx 0.128$ [mol] and $n_B = 2n_{MB} \approx 0.149$ [mol]). Such Pd atom-clusters absorbed a large amount of H/D-atoms as mentioned above, whereas ZrO_2 powder embedding the Pd atom-clusters did not absorb them at all as shown in Fig. 1 [C].

Consequently, when n [mol] and n_H [mol] are given to the absorbed amount of H/D-atoms (n_A : point A, n_B : point B) host-cluster (here $n_H = 0.0585$ [mol] in applied Pd sample), respectively, their atomic ratio is expressed with $n^* = n/n_H$, here, $n_A^* = n_A/n_H$, $n_B^* = n_B/n_H$, and under the inner pressure below 10 [atm], each atomic ratio of n_A^* (= n_A/n_H) and n_B^* (= n_B/n_H) is given as follows:

$$n_A^* = 2.18, \text{ or } n_A^* \geq 200\%, \quad (P_{inn} \ll 1 \text{ [atm]}). \quad [1]$$

$$n_B^* = 2.55, \text{ or } n_B^* \geq 250\%, \quad (P_{inn} \approx 3 \text{ [atm]}). \quad [2]$$

The result demonstrates that H_2/D_2 gases are quickly absorbed more than 200% and 250% in the number density of atoms into Pd-clusters under the condi-

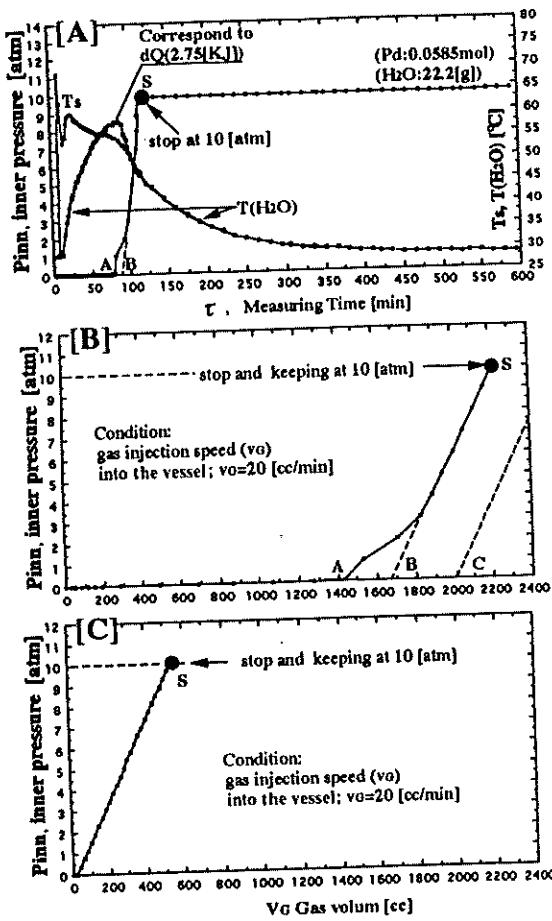


Fig. 1. Absorption characteristics of a gas (hydrogen/deuteriums) into the $\sim 50 \text{ \AA}$ Pd host-clusters and ZrO_2 powder set inside a vessel made by stainless steel, and the vessel is immersed in H_2O -liquid (22.2 g/l). [A] Relation between gaseous inner pressure (P_{inn}), powder temperature (T_s) and chemical reaction energy (dQ) and H_2O -liquified temperature ($T(\text{H}_2\text{O})$) versus measuring elapsed time (τ). [B] Relation between inner pressure (P_{inn}) and absorbed gas volume (V_g) under constant gas injection speed ($v_0 = 20 \text{ [cc/min]}$). [C] Relation between inner pressure (P_{inn}) and gas volume (V_g) injected into the vessel included ZrO_2 powder. As a result, Pd atom-clusters absorbed a large amount of H_2/D_2 atoms as shown in [A] and [B], but ZrO_2 powder did not absorb them as shown in [C].

tions of the considerably less than atmospheric pressure and around three [atm], respectively. Furthermore, an enhancement up to 300% concentration corresponded to C-point (2000 [cc]) as shown in Fig. 1 [B] under such high inner pressure as 100 [atm].

b) *Measurement of weight-change of the specimen by changing H_2/D_2 gas pressure.* It is well known that the weight of the specimen kept within H_2/D_2 gaseous pressure, P_{inn} [atm], increases with the amount of H/D atoms invading into the specimen according to the Sievertz law. The above mentioned Pd

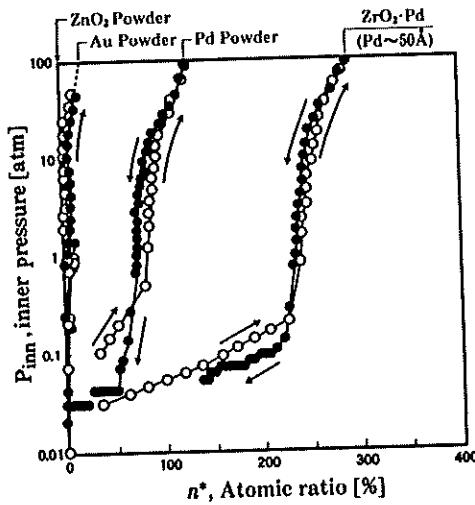


Fig. 2. Relation between hydrogen/deuterium gas pressure (P_{inn} [atm]) and amount of the gaseous atoms invaded into host atom-clusters versus number of host atoms (atomic ratio [%]).

atom-clusters were used as the specimen as well. The weight-change of the specimen was measured and calibrated to the atomic ratio: n^* (= H/Pd, D/Pd = number densities of invading atoms against host atoms).

Fig. 2 shows the relationship between the inner pressure and the atomic ratio. This result demonstrates that 300% H/D atoms were absorbed into Pd-clusters under around 100 [atm]. It was consequently concluded that the results of both Fig. 1 and Fig. 2 were almost the same.

Ultrahigh density metallic deuterium/hydrogen. a) *Metallic deuterium lattice (or hydrogen one).* The formation of condensed metallic deuterium lattice (hereafter, deuterium means deuterium/hydrogen) can be discussed in Fig. 3. Fig. 3 Ⓐ shows Pd fcc (face-centered cubic) lattice as a typical example of host metallic lattice. While Fig. 3 Ⓑ indicates the location of “atomic gap space” inside the host lattice. The location occupied with deuterium/hydrogen atoms corresponds to that of atomic gap space in Fig. 3 Ⓑ, as seen in Fig. 3 Ⓛ ~ Ⓝ. Fig. 3 Ⓝ shows an example of (100%) deuterium location, where the number of deuterium atoms is equal to that of host atoms. In the same way, Fig. 3 Ⓞ, Ⓟ, Ⓠ and Ⓡ indicate deuterium locations in the case of (200%), (250%), (300%) and (400%), respectively. Specifically in Fig. 3 Ⓞ(300%) and Ⓡ(400%), 3 kinds of deuterium atom locations; a), b) and c) are expected. However, the (300%) and (400%) concentration will be realized most likely in the case of a)-lattice and also 300% concentration will be actualized with the mixed state of (200%), (300%) and (400%) lattices. Similarly,

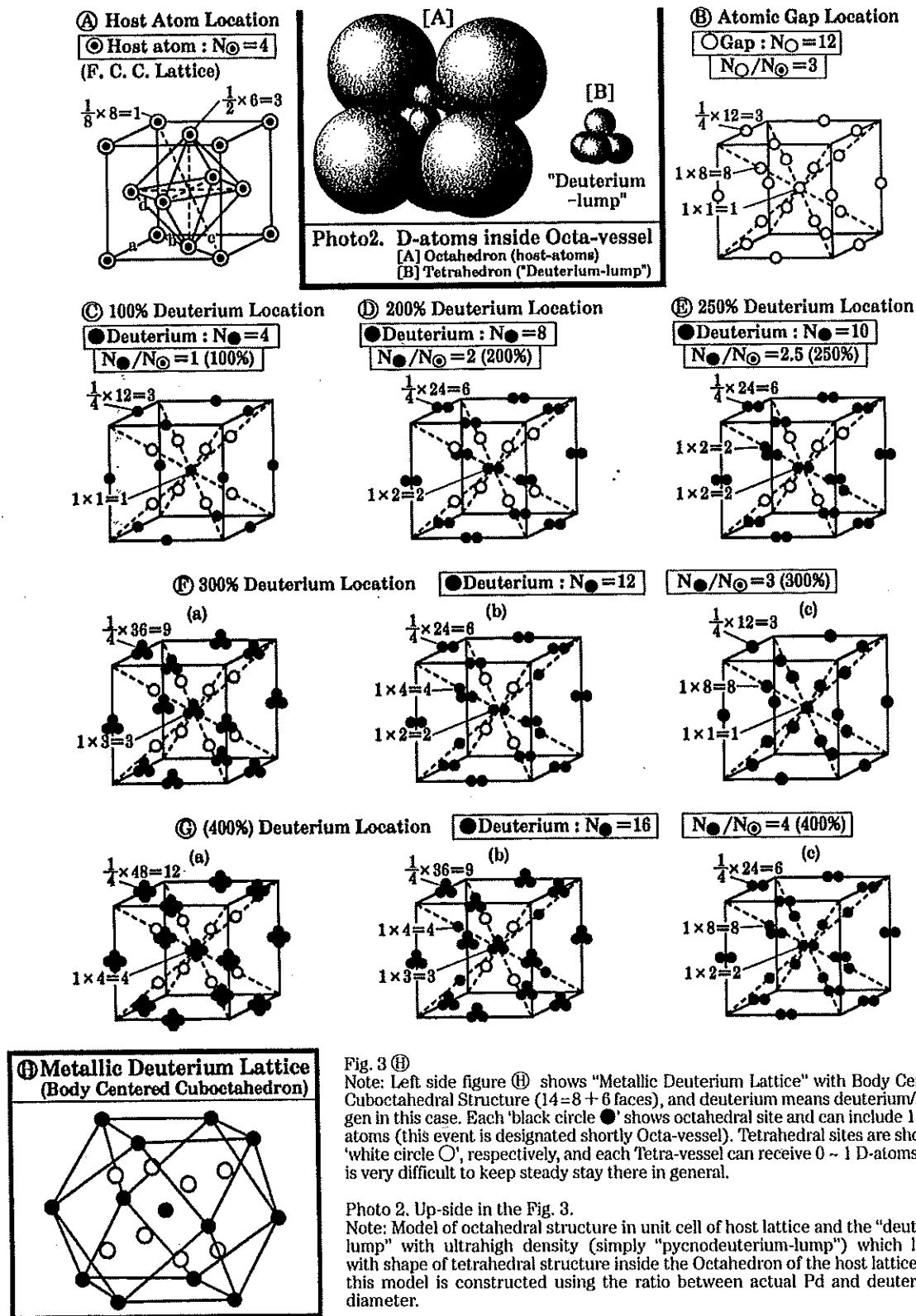


Fig. 3 (H)

Note: Left side figure (H) shows "Metallic Deuterium Lattice" with Body Centered Cuboctahedral Structure ($14 = 8 + 6$ faces), and deuterium means deuterium/hydrogen in this case. Each 'black circle ●' shows octahedral site and can include 1 ~ 4 D-atoms (this event is designated shortly Octa-vessel). Tetrahedral sites are shown by 'white circle ○', respectively, and each Tetra-vessel can receive 0 ~ 1 D-atoms, but it is very difficult to keep steady stay there in general.

Photo 2. Up-side in the Fig. 3.

Note: Model of octahedral structure in unit cell of host lattice and the "deuterium-lump" with ultrahigh density (simply "pycnodeuterium-lump") which located with shape of tetrahedral structure inside the Octahedron of the host lattice. Here, this model is constructed using the ratio between actual Pd and deuterium in diameter.

Fig. 3. Formation of condensed "Metallic Deuterium Lattice" with body centered cubooctahedral structure. Photo 2 is located in upper-side in this figure.

in the case of (250%) as shown in Fig. 3 (E), both the (200%) and (300%) lattices are mixed to realize (250%) concentration rather than the lattice displayed in Fig. 3 (E).

In such a metallic crystal condition, the density of deuterium atoms is extremely higher than that of the host metal as illustrated in Fig. 3 (H), that is, unit cell of the "Metallic Deuterium Lattice" including locally the "pycnodeuterium-lump" was constructed with body centered cuboctahedral structure ($14 = 8+6$ faces) which belongs in the Pd-like fcc host unit cell. Such "pycnodeuterium-lump" coagulated inside the "metallic deuterium lattice" plays a main role causing the "solid fusion" and the unit cell of host lattice plays a supporting role for achieving such reaction; that is, many electrons in this host unit cell strongly reduces the space charge of the "pycnodeuterium-lump". If such strong effect of electrons does not work in the host unit cell, not only "pycnodeuterium-lump" but also the metallic deuterium unit cell cannot be sustained, besides to keep such "pycnodeuterium-lump", pressure with level of 10^9 [atm] must be given to them in unit cell as stated in the introduction.

Each black circle in unit cell of the metallic deuterium lattice as shown in Fig. 3 (H), shows an octahedral site and each white circle is a tetrahedral site. Here, when the spaces of each black and white circle are designated simply as Octa-vessel and Tetra-vessel, respectively, Octa-vessel can include 1 ~ 4 D-atoms and 0 ~ 1 D-atoms in Tetra-vessel. Specifically in the former Octa-vessel, the possibility of occupation of 1 ~ 2 D-atoms is nearly equal as well as for 3 ~ 4 D-atoms, but the probability of occurrence is considerably smaller in the later case of 3 ~ 4 D-atoms than the former case (1 ~ 2 D-atoms).

In general, the deuterium atoms can move within the Tetra-vessel, but not so likely to remain there constantly. If there is a condition that an atom can steadily stay in the Tetra-vessel, 4 atoms more easily can enter and stay inside the Octa-vessel as a "pycnodeuterium-lump". In this case, therefore, such "pycnodeuterium-lump" should be located with the shape of tetrahedral structure inside octahedron (Octa-vessel) as shown in Photo 2 located in the upper side of Fig. 3, and their deuterium density can be estimated as an ultrahigh-density condition with a value of about 10 [g/cc]. This condition corresponds to a density of over 50 times higher than that of a deuterium solid with a hexagonal lattice at an ultra-low temperature, and also it is a level similar to that expected in the artificial pychnonuclear fusion as described in the introduction. Consequently, in such con-

densed "pycnodeuterium-lump" located locally inside the host unit cell with "lattice-quake",³⁾ "solid fusion" should be easily produced. That is a reason why, we should demonstrate that, in the nuclear fusion in solid, each host unit cell will behave as a minimum unit of nuclear fusion reactor.

b) *Formation mechanism of metallic deuterium lattice (or hydrogen one).* It is well known that nanometer-sized particles (host atom-clusters⁶⁾ or host-clusters) display intrinsic different characteristics from those of the corresponding bulk materials. For instance, we consider alloying behaviors of substitutional Cu-atoms within host Au-metal at room temperature, that is diffusion velocity of Cu-atoms within host Au-cluster (~ 50 [\AA]) is more higher than 10^9 times that of Au-bulk metal,⁷⁾ moreover, 300% Cu-atoms instantly can be dissolved into host Au-clusters.⁸⁾ These events have been recognized as "instantaneous alloying effect" in metal clusters. We verified that D/H atoms exhibit more stronger effect within host metal clusters and large amount of D/H atoms more than 300% against the host atoms were absorbed within the host-clusters as already mentioned above.

Since the degree of filling up of constituent atoms in a face centered cubic (fcc) unit cell in bulk metal is 0.74, large relaxation of atomic arrangement (or lattice distortion) in bulk crystals must be required in order to obtain such high density of D/H atoms. In the host cluster, however, it is reported as follows⁹⁾: the degree of filling up of constituent atoms in a unit cell decreases from 0.74 to about 0.64, i.e., vacant space increases from 0.26 to 0.36, and both the local bonding potential energy and the local surface energy widely change from the center region to peripheral ones. Furthermore, the obstacle barrier for diffusion of solute atoms remarkably decreases by softening the phonon mode, and thus the zig-zag atom-chains are always formed dynamically around the average position of atoms.⁹⁾ As a result, solute atoms such as a large amount of D/H atoms instantly diffuse into host atom-clusters, and such conception coincides very well with the experimental date as shown in Fig. 1 and Fig. 2.

The surface zone of bulk metal behaves as a thin two-dimensional host atom-clusters with a few atomic layers, but the volume is extremely smaller than the bulk substance.³⁾ Thus, it is concluded that powder of $\Phi 150$ [\AA] (50 [\AA] in embedded powder) and less in diameter can be utilized as host-cluster. However, the surface zone of powders of 200 [\AA] or more in diameter only behaves as two-dimensional host-clusters, so that they do not work so much as host-clusters although range of

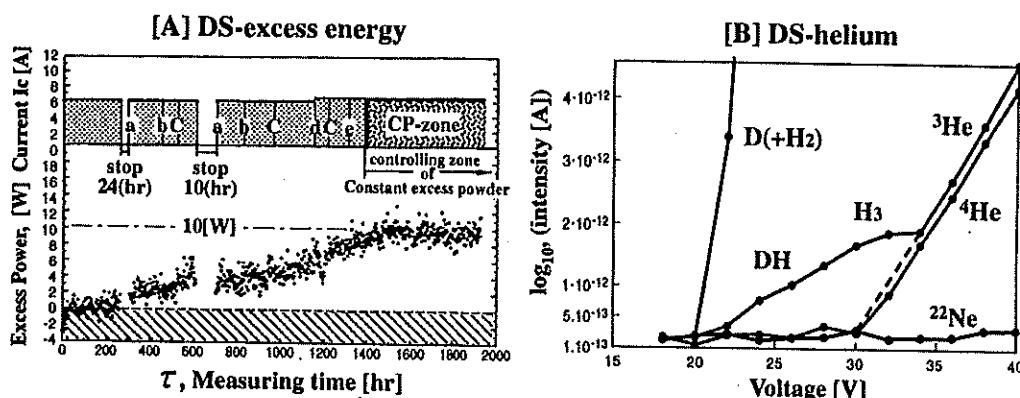


Fig. 4. Excess energy and helium (^3He , ^4He) generated inside "open type DS-cathode" which can measure continuously change of inner pressure inside DS-cathode, and called shortly "DS-excess energy" and "DS-helium", respectively. [A] shows DS-excess energy and [B] shows DS-heliums using "Vi-effect". Note: In left side diagram, a: current stop, b: inner gas test, c: inner gas test, d: added 20 [cc], e: renewed 20 [cc], and CP-zone: controlling zone to get constant excess power.

200~500 \AA looks like a gray zone between cluster and bulk. In our case, nanometer-sized embedded powder with around $\Phi 50 \text{\AA}$ displayed the best results as the host atom-clusters, and thus, we expect that the largest quantity of the "pycnodeuterium-lump" with ultrahigh density inside the unit cell of Metallic Deuterium Lattice with (400%) concentration as shown in Fig. 3 ⑥ should be constructed under condition of such higher pressure of D_2 gas from several hundreds to thousands. Using such Pd host-clusters inside DS-cathode with $D_2\text{O}$ -electrolyte, Fig. 4 demonstrates as one of the newest results revealed definitely generation of "solid fusion"; [A] shows DS-excess energy and [B] shows DS-heliums. On the other hand, we can never expect generation of the "deuterium-lump" and also "solid-fusion" do not take place inside the normal "bulk material".

Conclusion. In the past we reported a series of electrolysis experiments using double structure Pd cathodes containing fine Pd powders, in which substantial productions of excess heat and of helium atoms were observed. In the present paper we have demonstrated that metallic Pd clusters of diameter around 50 \AA can absorb extremely large amount of deuterium/hydrogen with over 300% atomic concentration in the Pd lattice. They occupy octahedral sites in the fcc Pd lattice and form Octa vessels in unit cell of metallic deuterium lattice, in which ultrahigh density deuterium "lumps" are produced. Its density amounts to as high as 10 [g/cc], which cannot be produced by hydrogen/deuterium alone. Thus, such ultrahigh density deuterium lumps ("pycnodeuterium-lumps") provide an unusual environment for $p+d$ ($^3\text{He} + \text{lattice energy}$) and $d+d$ ($^4\text{He} + \text{lattice energy}$) pycnonuclear reactions, and each unit of pycnodeuterium lumps is regarded as a "solid fusion reac-

tor".

Acknowledgments. The authors would like to thank Dr. K. Sugimoto and Dr. T. Yamazaki (Professors Emeritus, University of Tokyo), Dr. H. Fujita (Professor Emeritus, Osaka University), Dr. T. Yokobori, M. J. A. (Professor Emeritus, Tohoku University), and Dr. A. Inoue (Professor, Tohoku University), for their strong interest and kind discussions on this research. They also thank Dr. S. Miyake (Professor, Osaka University), and Dr. M. Futamata (Professor, Kitami Institute of Technology), for their interest in this research.

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**Observation of low energy nuclear reaction
induced by D₂ gas permeation through multilayer Pd film(1)**

- Transmutation of Cs into Pr -

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We observed low energy nuclear reaction induced by deuterium permeation through a multilayer Pd film caused by D₂ gas pressure gradient between each sides of the sample. We installed a device of the X-ray Photoelectron Spectroscopy (XPS) in a D₂ gas permeation apparatus and carried out element analysis of the nuclear products on the surface of the sample without removing it from the equipment (ref.1-3).

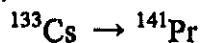
The multilayer Pd film is made by Ar ion beam sputtering method. We add Cs on the surface of the thin Pd film by applying electric field in 1mM CsNO₃ solution. The multilayer Pd with Cs is introduced into the vacuum chamber. At first, all the vacuum chambers are evacuated by a turbo molecular pump and the sample is heated up to 70C. As a first step of observation, the surface of a multi-layer Pd in the vacuum chamber is analyzed by XPS to confirm that no other elements on the surface of the sample are detected except the given element (Cs) and Pd. D₂ gas is introduced into a chamber up to 1atm and deuterium atoms permeate from the D₂ side chamber to the vacuum side chamber. After certain period(from 2 days to 1 week), the D₂ side chamber is evacuated and the surface of the Pd sample is analyzed by the XPS in the chamber. New elements that did not exist on the sample at the beginning of the experiment can be detected. Usually this process is repeated a few times to obtain the data on the time dependence of the given or produced elements.

XPS analysis is performed under the following assumptions; (1) The analyzed region is a circle of 5 mm in diameter and 20 angstrom in depth. The depth corresponds to the average path length of photoelectrons. (2) Atomic number of a detected element is calculated by the ratio of Pd peak intensity and the ionization cross section of the element.

Experimental results are as follows. Cs added on the surface decreased as time passed. On the other hand, Pr that did not exist before the experiment emerged and increased. It is strongly suggested that Cs was transmuted into Pr. We performed several experiments and reproducibility of these experiments is good. In addition

to XPS analysis, we examined the sample after experiments using X-ray absorption near edge structure (XANES) and detected Pr LIII-edge absorption. We, furthermore, analyzed amounts of products of Pr by ICP-MS and obtained the data that Pr existed more than several ng/cm². It can be said that these results clearly indicate that the products on the surface are Pr.

We might write the following expression, as Cs and Pr have only one isotope respectively.



We should notice that 8 mass number and 4 atomic number increases in this process. This result is closely correlated with Sr transmutation experiments that will be presented in the next paper.

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- (1) Y.Iwamura, T.Itoh, and M.Sakano; Proc.of ICCF-8, Lerici (La Spezia), Italy May 21-26, 2000,p141
- (2) Y.Iwamura, M.Sakano and T.Itoh; Proc.of ISEM-10, Tokyo, Japan, May 13-16, 2001, p383
- (3) Y.Iwamura, N.Gotoh, T.Itoh and I.Toyoda; *Fusion Technol.*, 33, (1998) 476

Observation of low energy nuclear reaction induced by D₂ gas permeation through multilayer Pd film(2)

- Transmutation of Sr into Mo -

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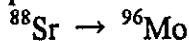
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We observed low energy nuclear reaction induced by deuterium permeation through a multilayer Pd film caused by D₂ gas pressure gradient between each sides of the sample. We installed a device of the X-ray Photoelectron Spectroscopy (XPS) in the D₂ gas permeations apparatus and carried out element analysis of the nuclear products on the surface of the sample without removing it from the equipment(ref.1-3).

The multilayer Pd film is made by Ar ion beam sputtering method. We add Sr on the surface of the thin Pd film by applying electric field in 1mM Sr(OD)₂ solution. The multilayer Pd with Sr is introduced into the vacuum chamber. An Experimental Procedure and XPS analysis is similar as a previous paper on transmutation of Cs into Pr.

Experimental results are as follows. Sr added on the surface decreased as time passed. On the other hand, Mo that did not exist before an experiment emerged and increased. It is strongly suggested that Sr was transmuted into Mo. We performed 3 times experiments and reproducibility of these experiments is good. We examined the sample after experiments using X-ray absorption near edge structure (XANES) and detected Mo K-edge absorption, although the detected signal was weak.

In order to investigate isotope distribution, the sample after the experiment is analyzed by the secondary ion mass spectrometry (SIMS). As the result, the isotopic distribution of the detected Mo is different from natural isotopic abundance of Mo. Further, the characteristic feature of the detected Mo shows that mass 96 is largest in the isotopes of Mo for all the cases of the Sr experiments. On the other hand, the major isotope of Sr is mass 88. Therefore it is supposed that the next reaction can explain the results of SIMS analysis.



In the same way as previous paper on Cs experiments, 8 mass number and 4 atomic number increases in this transmutation process.

It should be emphasized that we have a certain rule between given and produced elements, although we do not have a complete theory that can explain the obtained experimental results without assumptions.

- (1) Y.Iwamura, T.Itoh, and M.Sakano; Proc.of ICCF-8, Lerici (La Spezia), Italy
May 21-26, 2000,p141
- (2) Y.Iwamura, M.Sakano and T.Itoh; Proc.of ISEM-10, Tokyo, Japan, May 13-16,
2001, p383
- (3) .Iwamura, N.Gotoh, T.Itoh and I.Toyoda; *Fusion Technol.*, **33**, (1998) 476



Maureen R. O'Brien
05/10/2002 08:55:29 AM

Record Type: Record

To: All OSTP Users

cc:

Subject: FYI #57 - Marburger on Science Teaching

----- Forwarded by Maureen R. O'Brien/OSTP/EOP on 05/10/2002 08:59 AM -----



AIP listserver <fyi@aip.org>
05/09/2002 02:04:22 PM

Record Type: Record

To: fyi-mailing@aip.org

cc:

Subject: FYI #57 - Marburger on Science Teaching

FYI

The American Institute of Physics Bulletin of Science Policy News
Number 57: May 9, 2002

Marburger Discusses Science Teaching

"Teaching is the most important human activity, because so many things essential for survival need to be learned from others." -
John Marburger, Presidential Science Advisor

John Marburger, the President's Science Advisor and Director of the Office of Science and Technology Policy, spoke about the teaching of science at the National Science Teachers Association Convention in March. He discussed his own science teaching experiences, compared teaching to his previous role as Director of Brookhaven National Laboratory, and answered a Q&A from science teachers, in which he addressed the Administration's budget request for programs to improve math and science teaching. Selected portions of his remarks are quoted below:

"In safety management, you decide what you want to do, plan the work, identify the hazards, authorize the work after everyone agrees on the safest way to do it, and then you check to see if the way the work actually got done was what you expected. If it was not, then you change how you do it the next time so you get better each time you do it. The management experts call this a

'continuous cycle of improvement.' There's a slogan that goes with it: Plan, Do, Check, Act.

"Sound familiar? It sounded to me like the way we do science: Hypothesize, conceive and plan an experiment, perform the experiment, check to see if the result matches expectations, if not change the hypothesis and start over. It works! It works for science, and it works for management, and it ought to work for teaching too. But sometimes the steps are difficult to perform. In teaching, they are often very difficult. But we have to do them.

"President Bush cares passionately about teaching and learning, and he is also a businessman and a successful executive. That's why he established the President's Management Agenda to encourage his agencies to adopt good management principles as they conduct the government's - that is, the people's - business. I agree with the concept that every productive activity can be managed in the same general way, and the core elements of that way are summarized in 'Plan, Do, Check, Act.'"

"Any of us could give a lecture, or write a book, about each one of these challenges, but I would like to conclude with a word about the fourth step in the cycle of Plan, Do, Check, Act. Action has always been the most difficult, but it is also the most important. It is the step that closes the loop; The step that justifies the enormous investments required for the other three. All four steps are linked together. What good is assessment if we do not use the data it produces to make things better? What good is teaching if we do not take pains to discover if people are learning? What good does it do to invest in the accumulation of knowledge if we do not pass it on?

"In our huge system of education, action requires a culture change vastly greater than anything I was asked to do at Brookhaven. But the ingredients are the same. One of those ingredients is leadership. I joined President Bush's team because I was impressed with his willingness to provide leadership in the big issues confronting our society. And his leadership in the improvement of education is matched only by his leadership and determination to win the war against terrorism. He has established a very high level of expectation for us, and it is up to us to take advantage of the conditions he is creating to effect change in this most difficult and complicated system of education."

Marburger also responded to a series of questions submitted by NSTA members. Below are portions of his responses addressing federal programs for math and science education:

"The No Child Left Behind Act requires states to have a highly-qualified teacher in every public school classroom by the end of the 2005-2006 school year.... While reaching this goal will require reform of pre-service training, which is usually conducted in colleges of Education across the country, it will also require more effective in-service training and professional

development for teachers in the classroom already. To help states meet this goal, states, districts and schools will be eligible to receive in 2002 about \$3 billion for teacher training, recruiting and hiring. This represents an increase of more than 30 percent over the 2001 levels of funding. President Bush has proposed to sustain this level of funding in his 2003 budget. Although the categorical Eisenhower program has been eliminated, these funds continue to exist in the state teacher training grants, and may result in the expansion of teacher training and professional development opportunities available to math and science teachers."

"In his Education Blueprint, No Child Left Behind, the President proposed a new type of Math and Science Partnership (MSP) that brings together scientists and mathematicians from institutions of higher education with teachers and administrators from our primary and secondary schools to address what needs to be done to revise and strengthen how these subjects are currently taught in our schools.... It builds on the nation's dedication to educational reform through support of partnerships that unite the efforts of local schools districts with science, mathematics, engineering and education faculties of colleges and universities.... In 2002 the National Science Foundation (NSF) received \$160 million and the Department of Education (ED) \$12.5 million to begin the MSP program. In 2003 the President requests an additional \$40 million for this program for NSF (\$200 million total) while keeping the ED request at \$12.5 million."

Marburger also highlighted other "exciting new or expanded" NSF education programs, including a new Science, Technology, Engineering and Mathematics Talent Expansion Program, a new Robert Noyce Scholarship Program, and requested increases for the Graduate Teaching Fellowships in K-12 Education, Graduate Research fellows, and Integrated Graduate Education and Research Traineeship programs.

The full text of Marburger's remarks at the March 27 NSTA Convention can be found at http://www.ostp.gov/html/02_04_24.html and the Q&A at http://www.ostp.gov/html/02_04_24_2.html.

A number of Members of Congress are working to increase the FY 2003 funding for the Education Department Math and Science Partnerships substantially above the FY 2002 level of \$12.5 million. A future FYI will address these efforts.

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##END#####

MAY-17-2002 16:44

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**NATIONAL AGRICULTURAL RESEARCH,
EXTENSION, EDUCATION, AND ECONOMICS
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APR 26 2002

John Marburger
 Director
 Office of Science & Technology Policy
 Executive Office of the President
 17th Street & Pennsylvania Avenue NW
 Washington, DC 20502

Dear Dr. Marburger:

Thank you for speaking at the National Agricultural Research, Extension, Education, and Economics Conference held March 28-29, 2002 at the Washington Court Hotel in Washington, DC. Your comments on interagency cooperation were greatly appreciated by the Advisory Board, offering additional insight and "real world" expertise necessary for effective planning by USDA and its land-grant partners.

The Advisory Board is currently consolidating the findings of this conference and will be advising Secretary Veneman on the highest priorities for consideration by USDA in their budget deliberations for fiscal year 2004 and beyond.

The *Food and Agriculture Biosecurity Conference* represents part of an ongoing process by the Advisory Board to involve stakeholders in food, forestry, and agricultural issues that, with enhanced research and education, can positively impact their lives over the short- and long-terms. Thanks again for helping agriculture address the many challenges ahead and assure a strong and prosperous food and agricultural system in the 21st century!

Sincerely,

(b) (6)

Victor L. Lechtenberg
 Chair

(b) (6)

Deborah T. Hanfman
 Executive Director

The Advisory Board for food + agriculture research and education was honored to hear you speak on biosecurity issues of importance. Thank you for meeting w/ us and for your frankness + words

TOTAL P.02

MITCHELL E. DANIELS, JR

1/02/02

→ Dr. Jack Markhusen

Good job. We get
a little benefit of
no doubt here. Thanks
only its clear to
your credibility.

Mitch D.

cc: Marcus
Trent
Amy

deputy budget director. In the spending debate, "Mitch Daniels is pretty much running the show, to the exclusion of the others," says Representative Robert T. Matsui (D-Calif.), a senior member of the House Ways & Means Committee.

The strength of the OMB director will be tested when Congress begins reviewing the Administration's budget blueprint in February. Already this year, a projected \$281 billion surplus dipped to \$158 billion in the OMB's latest estimate in August--and that's before the fallout from September 11. Economists expect the red ink to start flowing by 2002. In preparation for tough times ahead, Daniels already has met individually with each Cabinet member to deliver a message of wartime austerity. While the White House, in the case of homeland security, "will break all ties in the direction of 'yes,'" other spending requests will be carefully scrutinized, Daniels has warned colleagues.

That doesn't mean a blank check for anti-terrorist initiatives. The Blade promises to slice and dice any agencies that try to slip in new spending in the guise of war-related emergencies. Administration sources say Daniels is scrutinizing "emergency" requests by the Environmental Protection Agency, the Transportation Dept., and the Smithsonian Institution. Case in point: the Smithsonian's \$35 million request to pay for additional security measures at two museums that have not yet opened. WHIPPING BOY. Some departments already are making plans to sacrifice. The Interior Dept., for one, is considering a plan to outsource half its functions within the next five years. Interior Secretary Gale A. Norton, in a Nov. 26 memo, said 3,500 government jobs will be at stake in the next two years as Interior begins to allow private contractors to compete against the agency for delivery of services. And that's just the beginning if Daniels has his way. He's planning to use the fiscal crunch to push an ambitious reform agenda, including privatization of more federal services, management efficiencies, and consolidation of overlapping programs. One likely target: job-training initiatives. Daniels won't get specific, but other officials predict the Bush budget will boost non-war spending by just 2% to 3%.

Such tightfistedness will further anger Daniels' detractors. Indeed, he has become a whipping boy for critics who are afraid to attack a popular Commander-in-Chief. "Part of the OMB director's job is to be a spear-catcher for the President," says Robert L. Bixby, director of the Concord Coalition, a fiscal watchdog group. "Daniels is exactly the right person to be doing that. But he's thrown a few spears, too."

Despite his vow of civility, Daniels is likely to chuck a few more. This is no time for "business as usual," he warns. And while he is sure to face resistance from bureaucrats and lawmakers, the budget boss says he's willing to risk bruising egos. "Your options are to make the best case you can or throw in the towel before the first bell rings," he says. Ever the fighter, Daniels appears eager for the coming brawl. It looks like it's going to be a bloody one.

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Editorial Desk
Science at the Smithsonian - OMB
The New York Times
12/24/2001

The fate of three outstanding research centers that are part of the Smithsonian Institution remains uncertain as the Bush administration completes its fiscal year 2003 budget. Under a proposal floated initially by the **Office of Management and Budget**, the three centers would be removed from the Smithsonian's jurisdiction and transferred to the National Science Foundation, a federal agency that awards grants for scientific research. That possibility has Smithsonian scientists in a tizzy, as well it might. Although Bush administration officials were justifying the move on management grounds, it is not clear that they have thoroughly explored the likely consequences to the research programs or to the Smithsonian itself.

The three facilities at issue are the Smithsonian Astrophysical Observatory, in Cambridge, Mass., which has done world-renowned research on planets in other solar systems and the large-scale structure of the universe; the Smithsonian Tropical Research Institute, in Panama, which was judged "undeniably the best" in the world by a panel of outside experts; and the Smithsonian Environmental Research Center, on the eastern shore of Maryland, which has conducted valuable studies on nutrient flows in the Chesapeake Bay watershed and on microbial pollution from the ballast water of commercial ships.

What's at stake in the current struggle is a small amount of money in Washington budgetary terms but a symbolically important application of the Bush administration's management philosophy. The administration, quite rightly, has been battling against financing mechanisms that end up creating perpetual

entitlements for favored entities without subjecting them to competition or meaningful merit review. The three Smithsonian centers have been receiving some \$35 million a year in core support, used mostly for staff salaries and upkeep of buildings. On top of that support, scientists at the three centers have competed for and won some \$94 million in research grants from the National Aeronautics and Space Administration, the National Science Foundation and other granting agencies, an indication that the research can hold its own in open competition. But the O.M.B., in internal budget negotiations, proposed switching the \$35 million in core support to the science foundation as well.

The foundation is a careful steward of the welfare of science and would surely do nothing to harm any high-quality programs. But what's disturbing is that the O.M.B. sought to apply its management approach without first consulting any of the interested parties. No one has thoroughly analyzed whether any of the three facilities play an important role in helping the Smithsonian museums mount their exhibitions or in assisting the Smithsonian's educational outreach efforts. Ironically, the Smithsonian itself has just appointed a panel of distinguished scientists to review all its research efforts and make recommendations on how best to manage them. It would seem foolish to act abruptly before that review is completed next year.

This matter is eerily reminiscent of an episode last year when the O.M.B. raised the possibility of switching all astronomy programs that are now financed by the National Science Foundation to NASA. That idea lost steam after the National Academy of Sciences suggested that there was a sharp line of demarcation worth preserving, with NASA supporting astronomy from space, the realm it knows best, and the science foundation financing ground-based astronomy, the realm it knows best. So this year the O.M.B. sought to reverse course and shove more astronomy programs into the science foundation.

No final decisions have been made, and the **Office of Management and Budget** may still change course. Whatever happens administratively, it will be crucial to maintain the excellence of all three Smithsonian facilities. There is no point in disrupting three outstanding research institutes without taking extreme care to make sure that any proposed transfer really makes sense -- and is done smoothly.

.....



Ellis Rubinstein (b) (6)

04/25/2002 04:06:02 PM

Record Type: Record

To: John H. Marburger/OSTP (b) (6)
cc: Alan Leshner (b) (6) >, Crispin Taylor (b) (6) >, Laurel Haak (b) (6) >
Subject: A note of appreciation...

Dear John,

I've been meaning to thank you again for joining the postdocs and administrators at our PostDoc Network Meeting last Saturday. Your comments surprised and touched many in the audience. I'm sure that few expected you to speak so openly about their concerns, not to mention your offer to use your office to try to help work on some of the problems postdocs face.

After the talk, I noted that not only postdocs, but faculty members, administrators, and funding agency officials all clustered around you. Many told me personally that they were thrilled to know you cared about the funding and workforce issues facing postdocs.

I again encourage you to send along the text of your speech. I would hope that you will permit us to extract the sections that directly relate to postdocs and administrators so that we may post them on our website (and provide a link to the full text on the OSTP site, if you would like).

In sum, we're in your debt.

Best regards, Ellis

Ellis Rubinstein
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To: John H. Marburger
From: Gene Whitney
Subject: Notes on Yucca Mountain briefing

Place: Council on Environmental Quality Conference Room

Time: January 4, 2002 10 AM

The purpose of this briefing was to begin mapping out the Administration's political strategy for the process of recommending Yucca Mountain as the designated site for nuclear waste disposal.

The meeting was led by Robert Card, DOE Under Secretary for Energy, Science and Environment. Among several others, the meeting was attended by Andrew Lundquist (OVP), Marcus Peacock (OMB), and a host of staff from DOE, CEQ, OVP, and OSTP (me). There were approximately 25 people in the room.

Handouts (attached) include a one-page list of messages that the Administration would like to emphasize and deliver consistently through the site recommendation process. In addition, there is a 15-page color briefing document. Page 9 of this document provides a nice flow chart of the entire recommendation, licensing, construction, and operation process. One of the key points of emphasis from this meeting is that (b) (5)

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I asked Bob Card if (b) (5)

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I asked both Bob Card and Lake Barrett (Deputy Director, Office of Civilian Radioactive Waste Management) if they could provide you with a personal briefing on technical and/or political issues and they would be delighted to come do that if you would like. In fact, Lake Barrett immediately invited us to visit Yucca Mountain to see it for ourselves. (FYI: Secretary Abraham is visiting Yucca Mountain next Monday, January 7.) It's probably not necessary to visit the site (maybe you've been there), but I would like to at least request the technical briefings.

There was a lot of discussion about various political issues: (b) (5)

(b) (5)

No action items for OSTP. No follow-up meetings scheduled.

High Level Waste Repository Messages

(b) (5)



Site Recommendation Consideration Yucca Mountain, Nevada



An aerial photograph showing the rugged, arid landscape of Yucca Mountain, Nevada. The terrain is characterized by deep, winding canyons and ridges, with sparse vegetation. In the distance, a small cluster of buildings is visible against the horizon under a clear blue sky.

January 4, 2002

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