



Structured expert judgment with the Classical Model –  
experiences of an NBD facilitator

Willy Aspinall

SLANG

Internet Slang, Chat Texting & Subculture

**NBD**

means

Nice But Dim

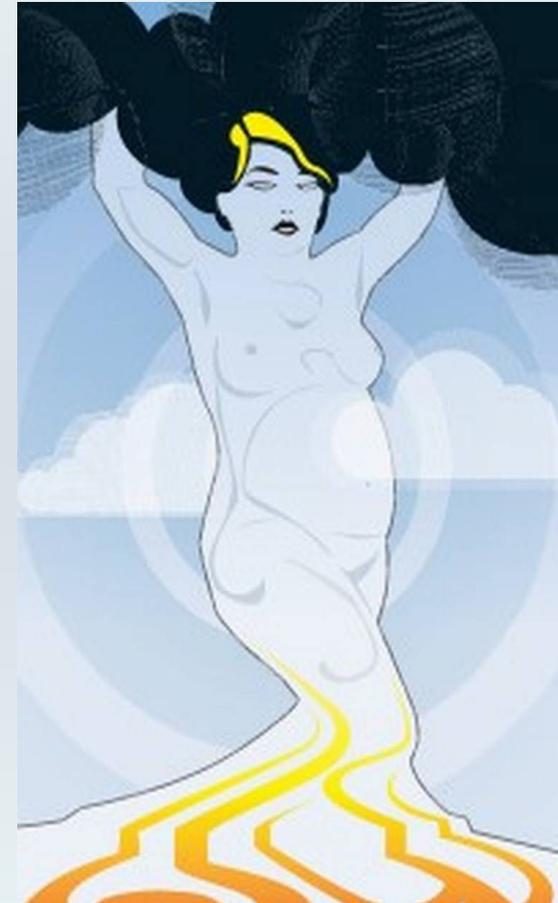


Harry Enfield's TV character

- Summary of this talk

Personal experiences of challenges to the application of the Classical Model, rather than successes .....

..... starting with a big missed opportunity.



**Eyjafjallajökull volcano**

Image by illustrator Matt McCarthy,  
from The Volcanism Blog



1640 BIRMINGHAM	BE 7038	BA 6105	CANCELLED
1645 BARCELONA	AF 1948	DL 8330	CANCELLED
1645 ZURICH	AF 5108		CANCELLED
1645 GENOA	AF 5943	DL 8545	CANCELLED
1645 MARSEILLE	AF 7666	AY 6365	CANCELLED
1645 NICE	AF 7708	AM 8706	CANCELLED
1645 CAIRO	MS 800		CANCELLED
1645 PRAGUE	OK 761	AF 4902	CANCELLED
1650 FLORENCE	AF 5044	AZ 7807	CANCELLED
1655 WARSAW	AF 1046	DL 8586	CANCELLED
1655 STUTTGART	AF 2308	AZ 2658	CANCELLED
1655 LYON	AF 7646	AM 8646	CANCELLED
1655 DOHA	QR 020		CANCELLED
1600 BOLOGNA	AF 2128	AZ 7318	CANCELLED
1600 ST PETERSBURG	AF 2898		CANCELLED
1600 BORDEAUX	AF 7634	AZ 2708	CANCELLED
1600 TOULOUSE	AF 7786	OK 3746	CANCELLED
1600 FRANKFURT	PK 770		CANCELLED
ISLANABAD			
1600 GLASGOW	U2 6986		CANCELLED
1603 BRUSSELS	AF 7185		2T ON TIME
1605 STOCKHOLM	AF 1062	DL 8482	CANCELLED
1605 TUNIS	AF 1284	DL 9598	CANCELLED
1605 LISBON			
1605 LUXEMBOURG			
1605 GENEVA			
1605 MUSCAT			
1605 BREMEN			
1610 MONTREAL-TRUDEAU			
1610 BRISTOL			
1610 LONDON HEATHROW			
1610 ATLANTA			
1615 N DJANENNA	AF 856	KL 2226	CANCELLED
1615 DAKAR	AF 718	DL 8410	CANCELLED
1615 ALGIERS	AF 2454	KL 2184	CANCELLED
1615 NOUAKCHOTT	AF 3028	KL 2284	CANCELLED
1615 MAURITIUS	AF 3532	MK 051	CANCELLED
1615 TUNIS	BIE7287		3 POSTPONED
1615 ANTANANARIVO	MD 051		CANCELLED
1620 AMSTERDAM	AF 2040	KL 2016	CANCELLED
1620 DJERBA	BJ 3193		3 POSTPONED
1620 HAMBURG	LH 4263		CANCELLED
1620 MAURITIUS	MK 045	AF 9	CANCELLED
1620 BUCAREST	RO 304	AF	CANCELLED
1620 HELSINKI	U2 3897		CANCELLED
1625 VIENNA	OS 416		CANCELLED
1630 MEXICO	AF 434		CANCELLED

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**theguardian**

Heathrow airport opened to inbound flights with minutes to spare after 96 hours of test flights resulted in deal

### how the airlines won the battle for the skies

Heathrow airport opened to inbound flights with minutes to spare after 96 hours of test flights resulted in deal



Ash billows from Eyjafjallajökull volcano in Iceland. It caused huge disruption to air transport across Europe. Photograph: Ingolfur Juliusson/Reuters

The Icelandic volcanic ash crisis, 2010



**An Invitation  
from  
the President of Iceland  
Ólafur Ragnar Grímsson**

In the middle of the Atlantic, at the crossroads of European weather systems, the youngest country on Earth has recently reminded the world how, through a combination of a volcanic eruption and enormous quantities of glacial ice, the forces of nature can produce huge ash clouds, impacting on nations far away, even disrupting for a while the travel plans of millions in different continents. For the first time since modern aviation became the pillar of international transport, a volcanic eruption has reminded all of us that our technological and economic systems must take into account the will of nature and how the Earth is capable of ultimate surprises.

Aviation stakeholders must now understand and adapt to this kind of potential disruption. Eyjafjallajökull has become a symbol of this situation, and thus it is appropriate to invite aviation leaders, experts and policy-makers to assemble at the recently established Keilir Aviation Academy at Keflavík International Airport, to discuss the lessons learned and how technology, rules, regulations and aviation training must be improved.

For us in Iceland it is important to make a contribution of this type to the constructive international dialogue that is now needed. Therefore we invite you all to participate in the Atlantic Conference on Eyjafjallajökull and Aviation. It will certainly be a worthwhile experience.



© Hermann Sigurðsson (2010)



**Keilir  
Aviation  
Academy**

**Atlantic Conference on  
EYJAFJALLAJÖKULL AND AVIATION**

Keflavik Airport, Iceland, September 15.-16. 2010

**Second Day of Conference  
Thursday, 16 September 2010**

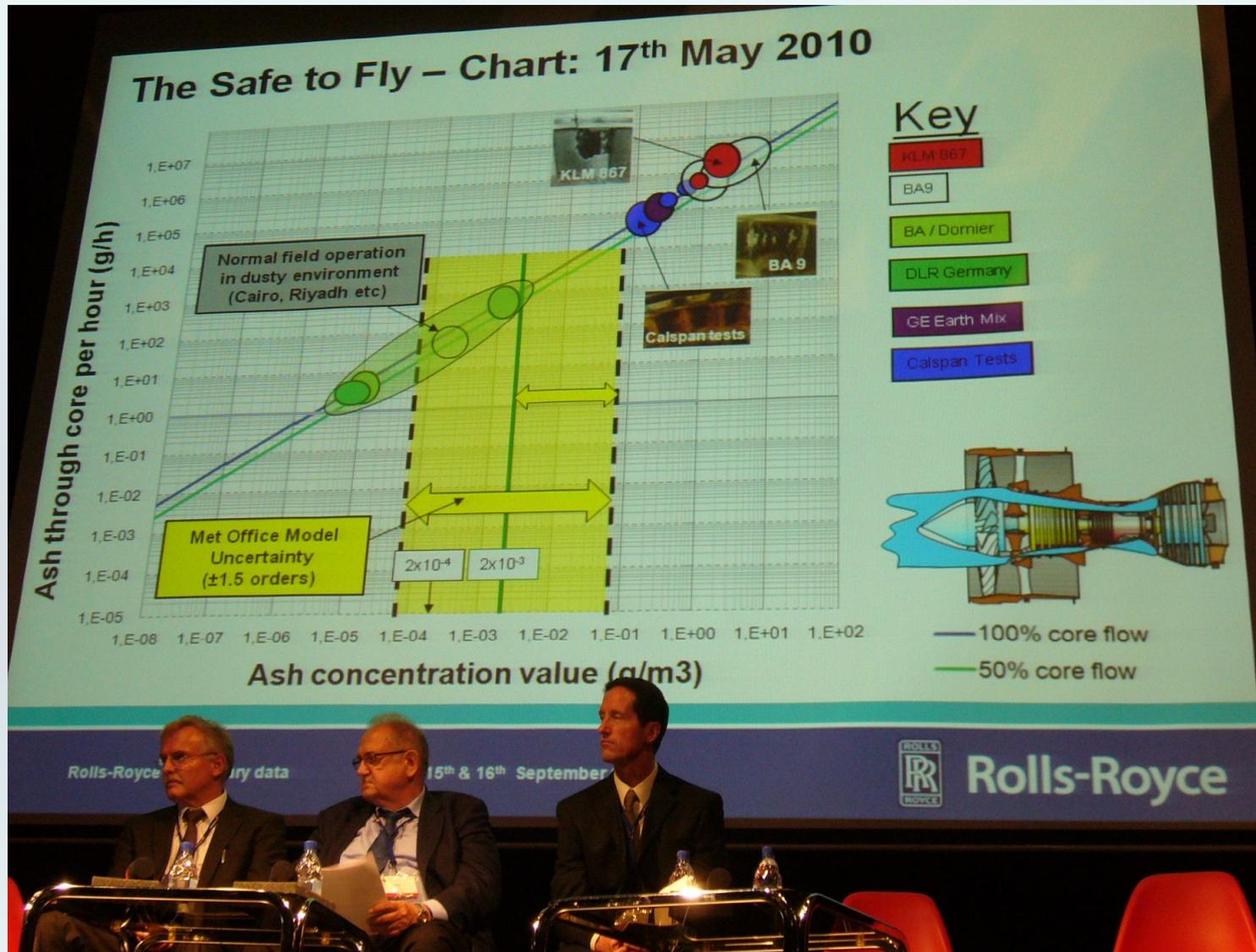
**09.00**

**SIXTH SESSION - Eyjafjallajökull - Scientific Dimension  
– Volcanic Eruptions**

*Chairman: Dr. Haraldur Sigurdsson, Volcanologist and Prof.  
Emeritus, University of Rhode Island, USA.*

**Probabilistic assessment of volcanic risks**

*Dr. William Aspinall, Geophysicist and Professor University of  
Bristol, UK.*



“Safe to Fly – Chart” presentation by Rolls-Royce at Atlantic Conference.  
*Note implied quantitative uncertainties on incidents and test data.*

# Volcanic Ash and Aircraft Engines

**BATA Volcanic Ash Workshop – 15 October 2013**

Rory Clarkson

Engine Environmental Protection  
Rolls-Royce

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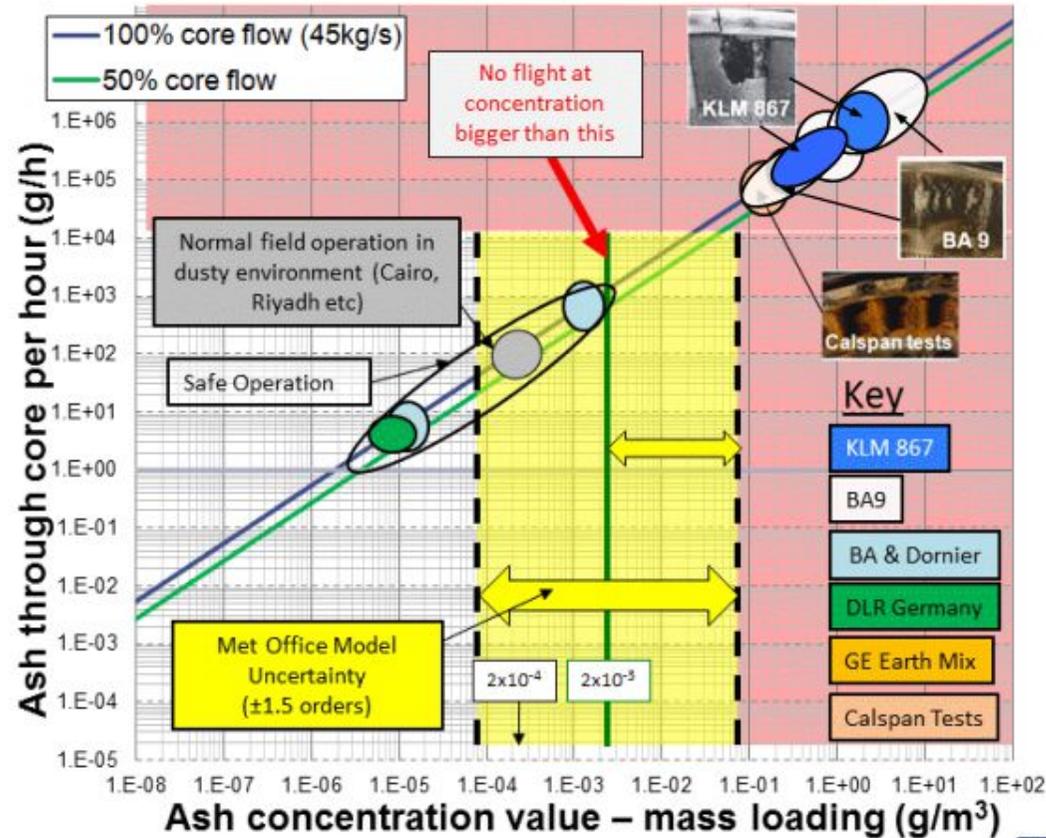


Follow-on presentation in 2013 .....

# Rolls-Royce Activities 2010-2013

11

- Engine 'Safe-to-Fly' Chart - 2012 Revision



 Rolls-Royce

Apart from addition of photos, essentials of graph are unchanged and, as far as is known, no formal development of quantifications of uncertainty.

# My view

- *De facto* (if not *de jure*) flight operational risk ‘standard’ for loss of airworthiness safety is no higher than  $10^{-8}$  per sector.
- One can conjecture plausible scenarios with consequence factors:
  - Plane passes inadvertently through ash for more than a few minutes (e.g. night-time)
  - Actual ash concentration in plume is higher than forecast/monitored
  - Dispersion model fails to forecast wind bringing two plumes together
  - Modern engine technology vulnerability is higher than last generation engines

The probabilities and hence joint scenario probabilities are ill-defined – even unknown. But if jointly they  $\gg 10^{-8}$ , then the “normal” flight safety margin is eroded.

No-one could, or would, say how the decision to fly would be defended *post hoc*, in the absence of any uncertainty quantification.....

A “deal” was done ....



As far as I know (and I was involved), no effort was made to quantify all related uncertainties with structured expert judgment, some parties did not even want to discuss this option. Thus I believe the basis of the “deal” was flawed.

Volcano Betting - Insurance for your holiday. - Windows Internet Explorer

http://www.paddypower.com/bet/novelty-betting/novelty-bets/Weather

Volcano Betting - Insurance for your holiday.

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- > Alien Existence
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- > Leaving Cert Specials
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- > World Heritage Sites
- > Wayne Baby Boom
- > Jog in the Bog
- > Playstation Specials

Sports Novelties

Lottery Specials

## London Heathrow - July

Results Calculator

### Markets Offered

25 Markets Show

> London Heathrow - July	> London Heathrow - August
> Manchester - July	> Manchester - August
> Birmingham - July	> Birmingham - August
> Dublin - July	> Dublin - August
> Glasgow - July	> Glasgow - August

### London Heathrow - July

Thursday 24th June 2010, 22:00

London Heathrow - July Hide

Singles Only. Applies to 2010. Applies to the airport having an unscheduled closure (no flights allowed to land or depart) for at least one hour on the chosen date. Must be confirmed that closure is due to volcanic ash by an official airport spokesperson. PP decision is final. Maximum payout per customer for ALL Volcano Holiday Hedging markets is 5000 euro/pounds. Telephone Betting Phone Ireland: 1800 721 821 Phone UK 08000 565 265 Rest of the World +353 1 4040100

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DEALER STANDS ON  
INSURANCE PAYS 2

PLAY  
MINI BLACKJACK

CLICK HERE

Select a Game Below

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Done Internet 100%

Meanwhile, others were ready to make money on the uncertainties!

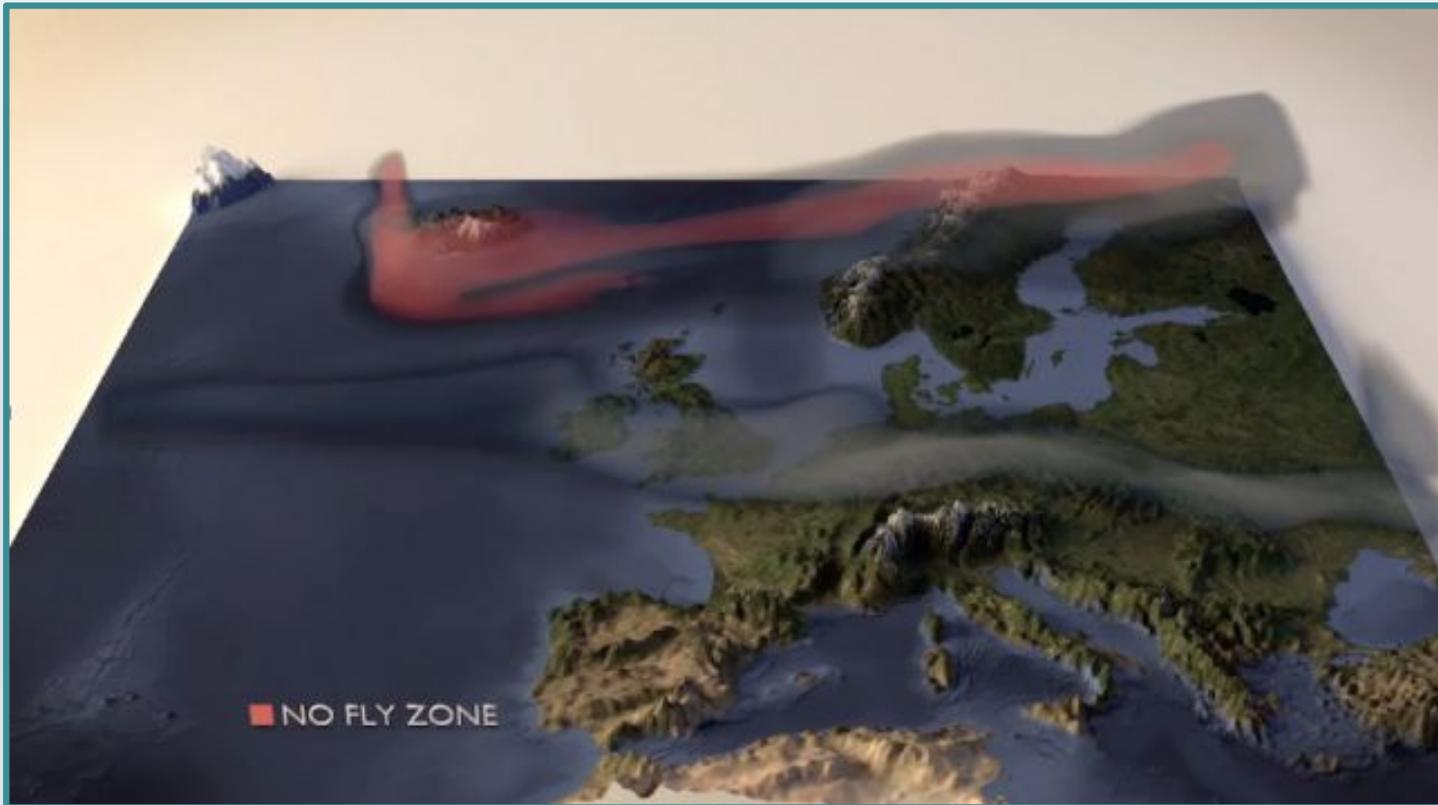
**Slide 11**

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**WPA1**

Willy, 06/07/2017

- Current modelling capabilities



The Barcelona Supercomputing Center (BSC) FALL3D volcanic ash dispersal model. Aim is to merge model forecasts with ATM data (airports, routes, FIRs and flights) at Volcanic Ash Advisory Centres to evaluate impacts based on user-defined criteria: e.g. concentration threshold and maximum engine dose.

BUT, as far as is known, the latter and their uncertainties have not been established (at least publicly).

# UK Hazards from a Large Icelandic Effusive Eruption

## Effusive Eruption Modelling Project Final Report

Project workers:



Funders:



Cabinet Office



Department for Transport



Government Office for Science



Department of Health



Department for Environment Food & Rural Affairs



However, as a consequence of the Eyjafjallajökull episode, work was commissioned on potential hazards from a Laki-type eruption for the UK National Risk Register, with extensive SEJ on volcanological uncertainties:

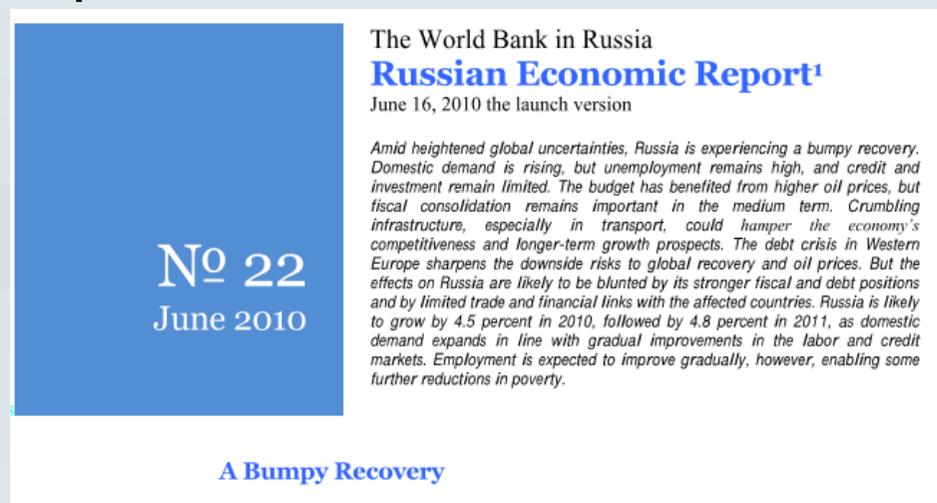
### Executive Summary

In response to the recent introduction of large, long-lasting gas-rich volcanic eruptions to the UK National Risk Register (risk H55) a modelling project has been conducted to improve our understanding of potential hazards to the UK from such an eruption on Iceland. A precautionary "reasonable worst case" eruption scenario based on the 1783-1784 CE Laki eruption has been determined using the results of an expert elicitation of scientists. This scenario has been simulated 80 times using two different atmospheric chemistry and transport models (NAME and EMEP4UK) over 10 years of meteorology (2003-2012).

**Authors:** Claire Witham<sup>1</sup>, Willy Aspinal<sup>2</sup>, Christine Braban<sup>3</sup>, Jane Hall<sup>4</sup>, Sue Loughlin<sup>5</sup>, Anja Schmidt<sup>6</sup>, Massimo Vieno<sup>3</sup>, Bill Bealey<sup>3</sup>, Matthew Hort<sup>1</sup>, Evgenia Ilyinskaya<sup>5</sup>, John Kentisbeer<sup>3</sup>, Elin Roberts<sup>3</sup>, Ed Rowe<sup>4</sup>.

Other failures (by me) to get the Classical Model engaged:

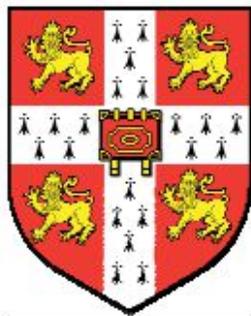
Major London insurer of geo-political risks in Russia



Big pharma company – drug development selection criteria

*Lesson: need “buy in” from senior management*

# An unfinished elicitation: risks from arsenic in the air



**ACHIEVING CONSENSUS:**  
AN ANALYSIS OF METHODS TO SYNTHESIZE EPIDEMIOLOGICAL  
DATA FOR USE IN LAW AND POLICY

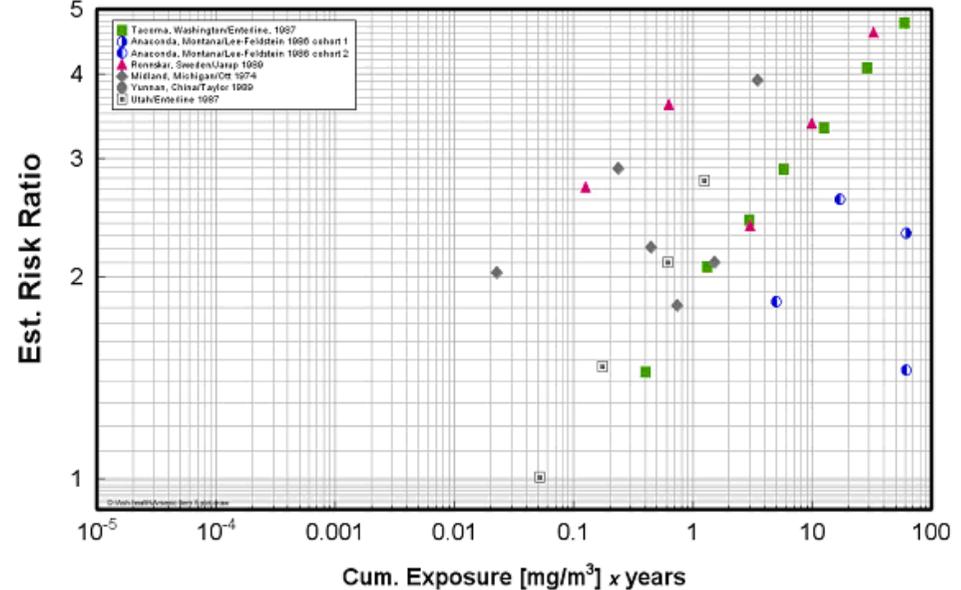
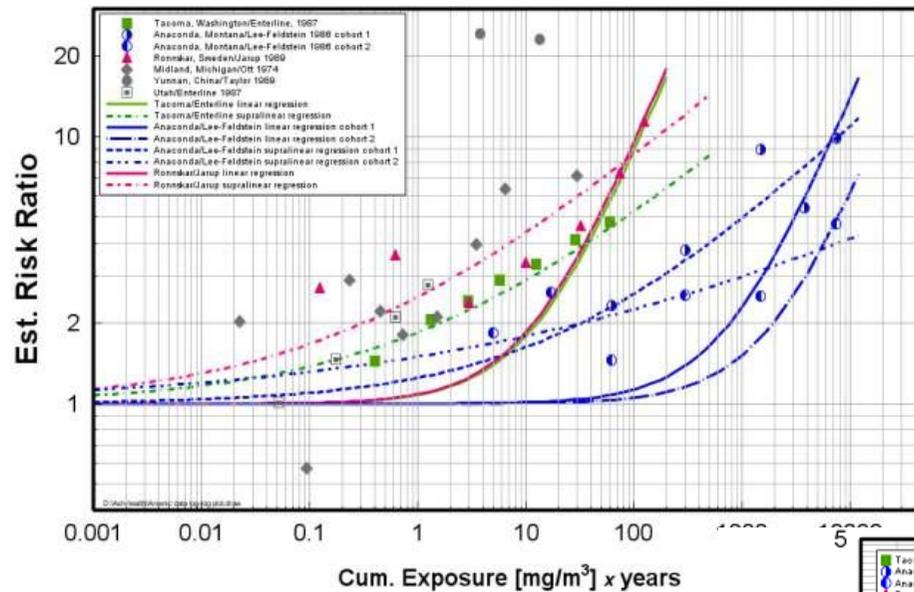
**JOSEPH M. HANZICH**  
PEMBROKE COLLEGE

DEPARTMENT OF PUBLIC HEALTH & PRIMARY CARE  
INSTITUTE OF PUBLIC HEALTH  
UNIVERSITY OF CAMBRIDGE

31 JULY 2007

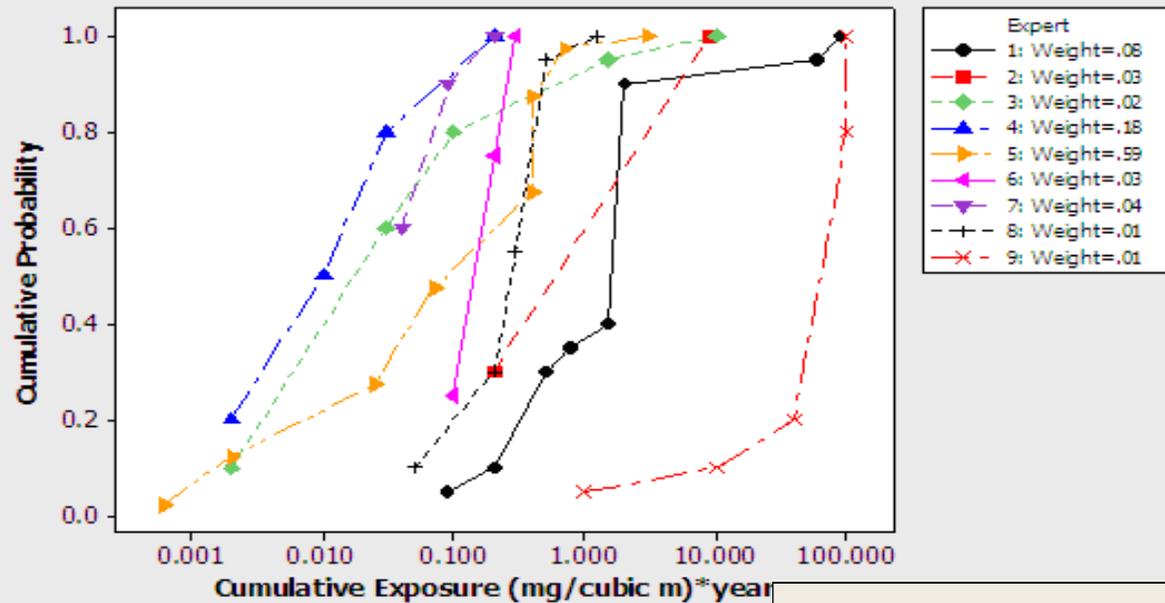


# Estimating dose-response curves for cancer risk from airborne arsenic



Work with the late Joey Hanzich (Cambridge University Env. Epid. MPhil 2006-07) and Dr Peter Baxter at IPH Cambridge

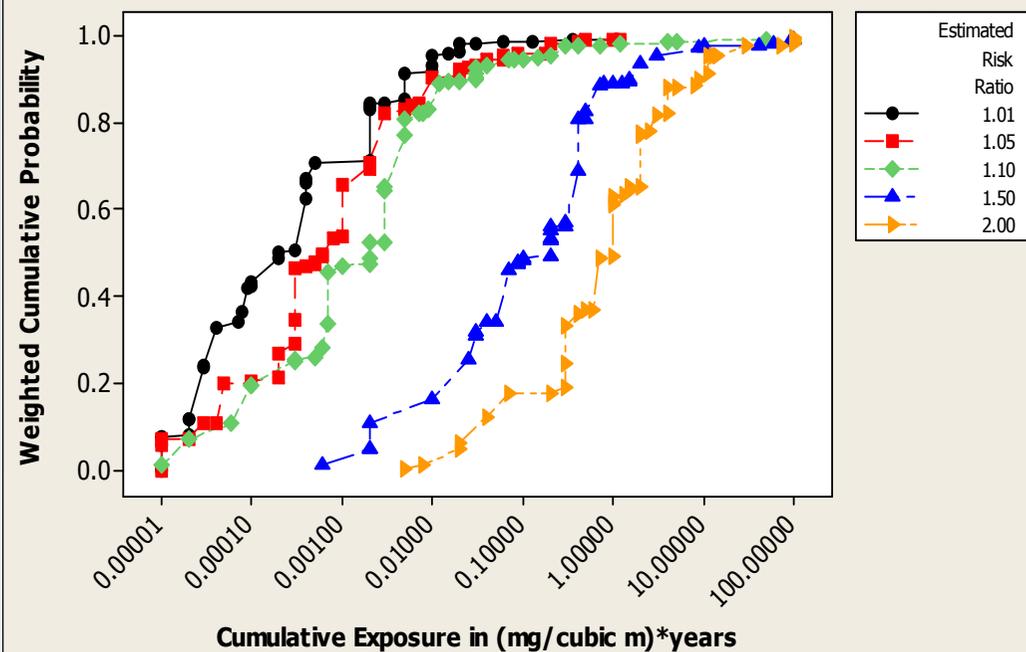
**Risk Ratio 1.5: Cumulative Probability vs Cumulative Exposure by Expert**



**Example self-weighted curves from one individual expert for one risk ratio value.....**

**.... these look a noisy mess, but when combined with Classical Model weights a rational pattern emerges.**

**Weighted Cumulative Probability vs Cumulative Exposure**



# A salutary case

*Big news!*

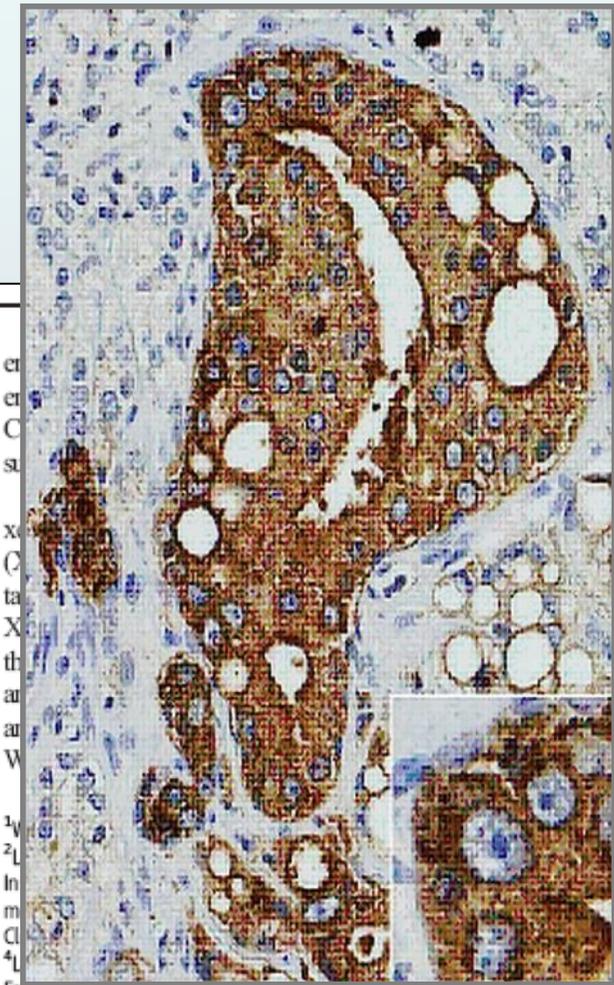
## Detection of an Infectious Retrovirus, XMRV, in Blood Cells of Patients with Chronic Fatigue Syndrome

Vincent C. Lombardi,<sup>1\*</sup> Francis W. Ruscetti,<sup>2\*</sup> Jaydip Das Gupta,<sup>3</sup> Max A. Pfost,<sup>1</sup> Kathryn S. Hagen,<sup>1</sup> Daniel L. Peterson,<sup>1</sup> Sandra K. Ruscetti,<sup>4</sup> Rachel K. Bagni,<sup>5</sup> Cari Petrow-Sadowski,<sup>6</sup> Bert Gold,<sup>2</sup> Michael Dean,<sup>2</sup> Robert H. Silverman,<sup>3</sup> Judy A. Mikovits<sup>1†</sup>

Chronic fatigue syndrome (CFS) is a debilitating disease of unknown etiology that is estimated to affect 17 million people worldwide. Studying peripheral blood mononuclear cells (PBMCs) from CFS patients, we identified DNA from a human gammaretrovirus, xenotropic murine leukemia virus–related virus (XMRV), in 68 of 101 patients (67%) as compared to 8 of 218 (3.7%) healthy controls. Cell culture experiments revealed that patient-derived XMRV is infectious and that both cell-associated and cell-free transmission of the virus are possible. Secondary viral infections were established in uninfected primary lymphocytes and indicator cell lines after their exposure to activated PBMCs, B cells, T cells, or plasma derived from CFS patients. These findings raise the possibility that XMRV may be a contributing factor in the pathogenesis of CFS.

**C**hronic fatigue syndrome (CFS) is a disorder of unknown etiology that affects multiple organ systems in the body. Patients with CFS display abnormalities in immune sys-

tem function, often including chronic activation of the innate immune system and a deficiency in natural killer cell activity (1, 2). A number of viruses, including ubiquitous herpesviruses and



Frederick, Frederick, MD 21701, USA. Advanced Technology Program, National Cancer Institute–Frederick, Frederick, MD 21701, USA. <sup>6</sup>Basic Research Program, Scientific Applications International Corporation, National Cancer Institute–Frederick, Frederick, MD 21701, USA.

\*These authors contributed equally to this work.

†To whom correspondence should be addressed. E-mail: judym@wpinstitute.org

# XMRV Expert Elicitation Workshop

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**International panel in Ottawa, Canada**

McLaughlin Centre for Population Health Risk Assessment

# Target Question Grouping

## Questions

## Subject Area

1-7

Prevalence

8-11

Risk Parameters

12-15

Latency

16-22

Routes of Transmission

23-25

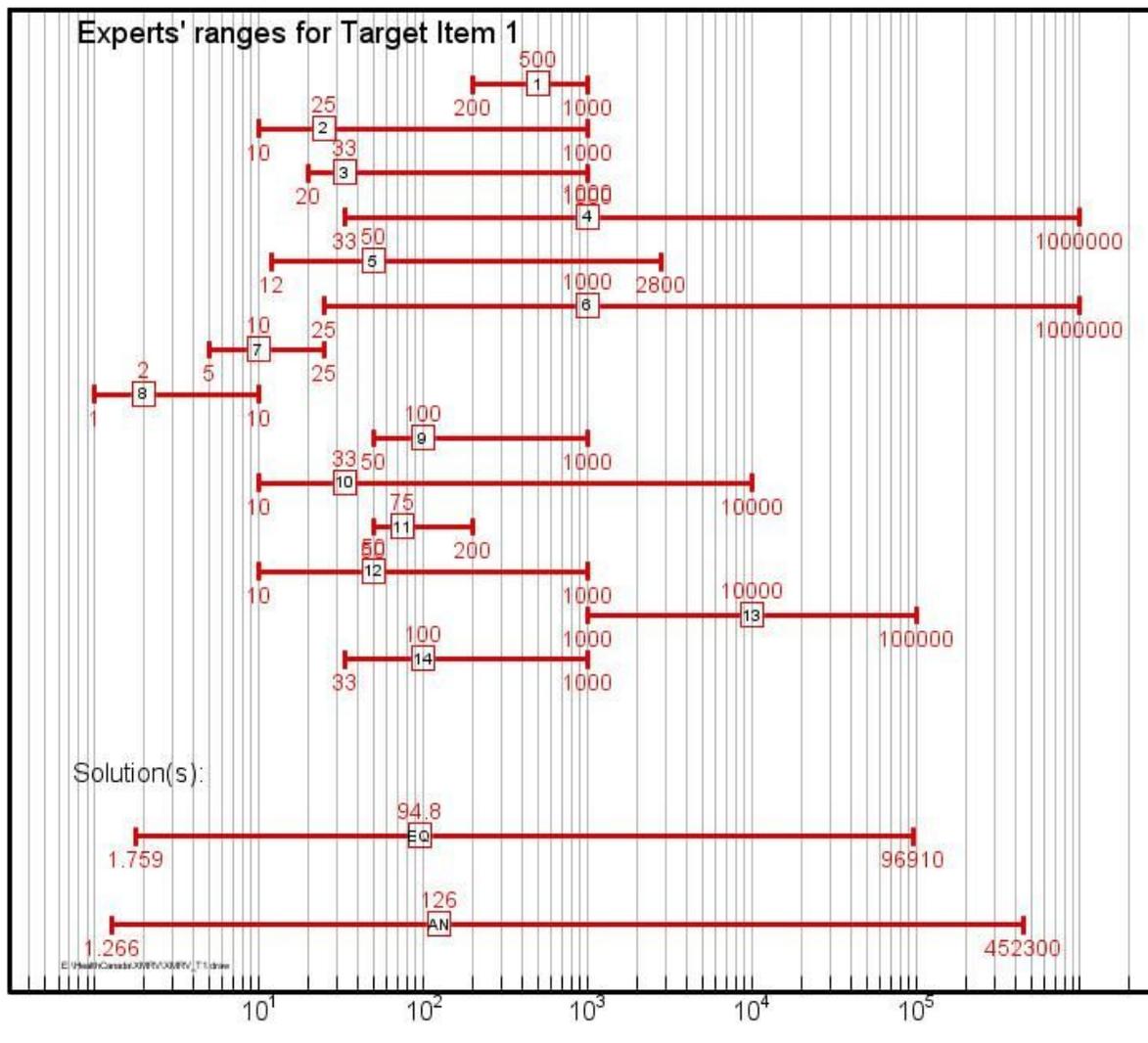
Risk Mitigation

26-30

Disease Relationships  
(causal and non-causal)

# Target Questions 1, 3-6

A set of target questions that asked about the current prevalence of XMRV infection in the world (1), Canada (3), USA (4), UK (5) and France (6) in the general adult population? (1 in xxxxx)



Weighted DM:

- 1 in 126
- Range: 1.2-452,300

# Prevalence: Target Questions 1, 3-6

A set of target questions that asked about the current prevalence of XMRV infection in the world (1), Canada (3), USA (4), UK (5) and France (6) in the general adult population? (1 in xxxxx)

<b>Country</b>	<b>Weighted DM median</b>	<b>DM 90% Credible Interval</b>
Canada	1 in 335	1 in 12 → 1 in 305,500
USA	1 in 280	1 in 12 → 1 in 305,500
UK	1 in 450	1 in 12 → 1 in 305,500
France	1 in 450	1 in 12 → 1 in 305,500

**Table. Published studies October 2009 to June 2011**

<b>First author, country</b>	<b>Journal, date</b>	<b>Patients positive for XMRV?</b>
<b>Lombardi, USA</b>	Science, October 2009	Yes (67%)
<b>Erlwein, UK</b>	PLoS One, January 2010 & March 2011 (re-analysis)	No
<b>van Kuppelweld, Netherlands</b>	British Medical Journal, February 2010	No
<b>Groom, UK</b>	Retrovirology, February 2010	No
<b>Swizer, USA</b>	Retrovirology, July 2010	No
<b>Lo, USA</b>	Proc Natl Acad Sci, August 2010	No (but 86.5% MLV)
<b>Hong, China</b>	Virology Journal, September 2010	No
<b>Henrich, USA</b>	J Infect Dis, November 2010	No
<b>Hohn, Germany</b>	PloS One, December 2010	No
<b>Satterfield, USA</b>	Retrovirology, February 2011	No
<b>Furuta, Japan</b>	Retrovirology, March 2011	No
<b>Schutzer, USA</b>	Ann Neurol, April 2011	No
<b>Shin, USA</b>	Journal of Virology, May 2011	No
<b>Knox, USA</b>	Science, May 2011	No

# Detection of an Infectious Retrovirus, XMRV, in Blood Cells of Patients with Chronic Fatigue Syndrome

Vincent C. Lombardi,<sup>1\*</sup> Francis W. Ruscetti,<sup>2\*</sup> Jaydip Das Gupta,<sup>3</sup> Max A. Pfost,<sup>1</sup>

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## REPORTS

### No Evidence of Murine-Like Gammaretroviruses in CFS Patients Previously Identified as XMRV-Infected

Konstance Knox,<sup>1,2</sup> Donald Carrigan,<sup>1,2</sup> Graham Simmons,<sup>3,4</sup> Fernando Teque,<sup>5</sup> Yanchen Zhou,<sup>3,4</sup> John Hackett Jr.,<sup>6</sup> Xiaoxin Andreas M. Kogelnik,<sup>2</sup> Ja

Members of the gammaretrovirus XMRV [xenotropic murine leukemia virus-related virus] were present in the blood of patients from 61 patients with CFS previously identified as XMRV-positive. We used reverse transcription polymerase chain reaction for detection of infectious murine-like retroviruses other than XMRV in these blood samples and in samples from other MLVs in these blood samples and in samples from healthy controls, which would be unlikely. Consistent with laboratory reagents. Our findings suggest that CFS is likely attributable

Xenotropic retroviruses in mice, have the potential of being endogenous, i.e., integrated into the genome, and are able to reinfect cells from the same animal (*xenos*, fore

enteroviruses, have been implicated as possible environmental triggers of CFS (1). Patients with CFS often have active  $\beta$  herpesvirus infections, suggesting an underlying immune deficiency.

The recent discovery of a gammaretrovirus, xenotropic murine leukemia virus-related virus (XMRV), in the tumor tissue of a subset of prostate cancer patients prompted us to test whether XMRV might be associated with CFS. Both of

and reagents (e.g., *Taq* polymerase) (15) with mouse DNA containing MLV-like sequences has been reported.

To investigate these discrepancies in a more direct manner, we performed an extensive virological evaluation of blood samples from two human populations with a clinical diagnosis of CFS (16), many of whom had been diagnosed previously as XMRV-infected. The first (P1) con-

## COMMENTARY

Science sightseeing

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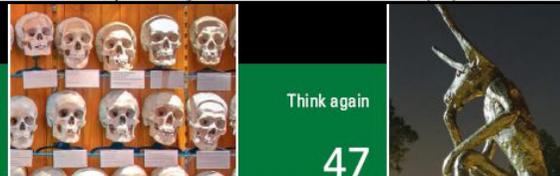
LETTERS | BOOKS | POL

## LETTERS

edited by Jennifer Sills

### Editorial Expression of Concern

IN THE ISSUE OF 23 OCTOBER 2009, *SCIENCE* PUBLISHED THE REPORT "Detection of an infectious retrovirus, XMRV, in blood cells of patients with chronic fatigue syndrome," a study by Lombardi *et al.* purporting to show that a retrovirus called XMRV (xenotropic murine leukemia virus-related virus) was present in the blood of 67% of patients with chronic fatigue syndrome (CFS) compared with 3.7% of healthy controls (1). Since then, at least 10 studies conducted by other investigators and published elsewhere have reported a failure to detect XMRV in independent populations of CFS patients. In this issue, we are publishing two Reports that strongly support the growing view that the association between XMRV and CFS described by Lombardi *et al.* likely reflects contamination of laboratories and research reagents with the virus. In one Report, "Recombinant origin of the retrovirus XMRV" (2), T. Paprotka *et al.* trace the ancestry of XMRV and provide evidence that the virus originated when two mouse leukemia viruses underwent recombination during experimental passage of a human prostate tumor xenograft in mice in the 1990s. A combination of sequencing, phylogenetic, and probability analyses lead Paprotka *et al.* to conclude that laboratory contamination with XMRV produced by a cell line (22Rv1) derived from these early xenograft experiments is the most likely explanation for detection of the virus in patient samples. In the other Report, "No evidence of murine-like gammaretroviruses in CFS patients previously ident



Think again

47

Chicago Tribune

## NEWS

Front Page | News | Sports | Business | Lifestyles | Opinion | A&E

Home > Featured Articles > Xmrv

### Discredited chronic fatigue researcher in California jail

Patients rally around Judy Mikovits, accused of theft

November 22, 2011 | By Trine Tsouderos, Chicago Tribune reporter

Recommend 6 | Tweet 0 | Share 196 | +1 1

Two years ago, researcher Judy Mikovits was riding high atop a wave of promise.

She had published one of the most discussed papers of the year in one of the most prestigious scientific publications in the world.

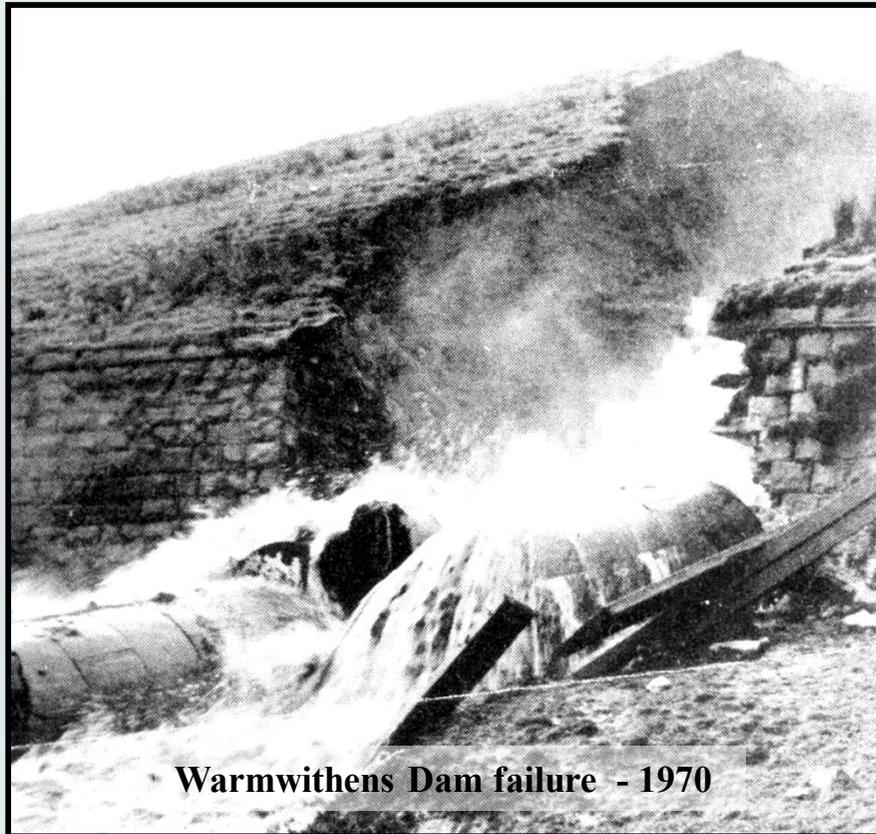
Her team's findings were hailed as a potential breakthrough for an illness — chronic fatigue syndrome — that had long frustrated researchers. She was invited to speak at scientific conferences around the globe. Adoring patients crowded her at her talks.

Downloaded

# Judgment in the face of scientific uncertainty: the last word in rationality...



## Diagnosing elicitation issues - UK reservoir risks



Warmwithens Dam failure - 1970

Last UK dam failure 1970 –  
no casualties

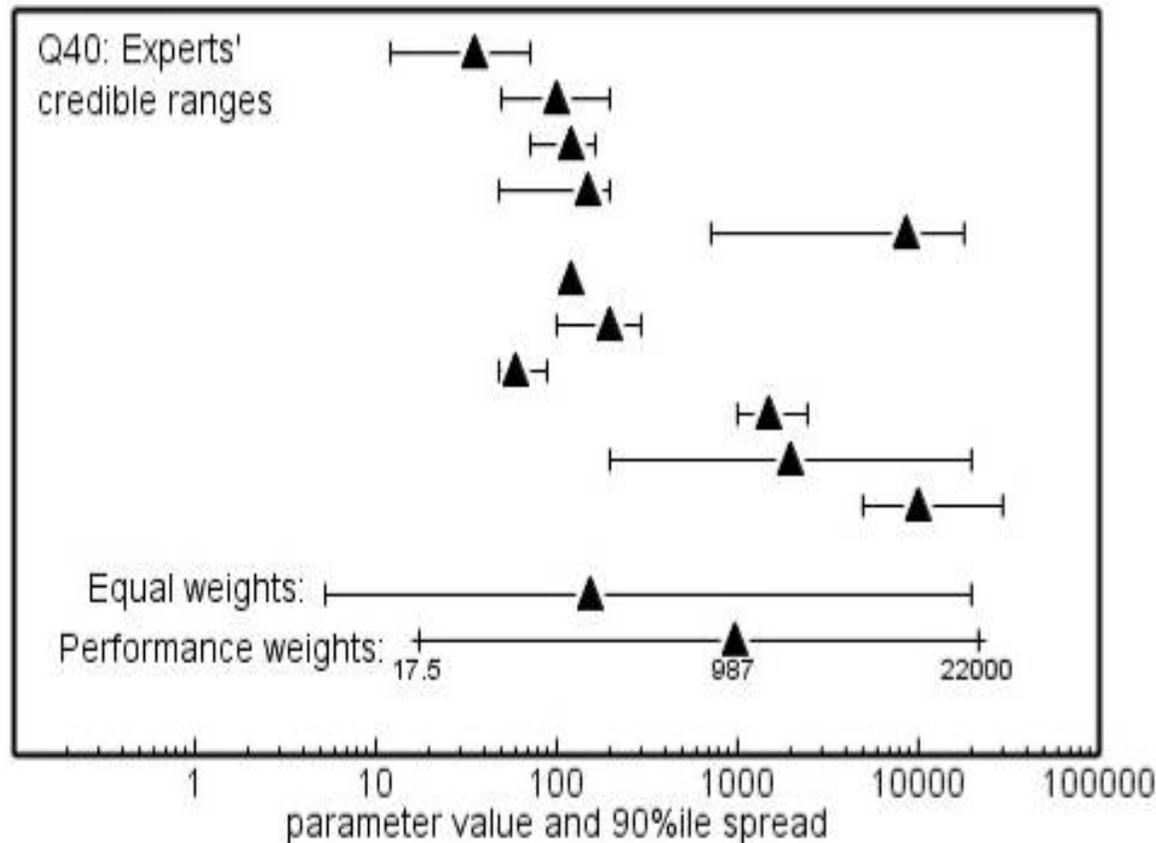


Cowlyd Reservoir inspection party - 1917

Experts, in former times!

## Example of group inconsistency

**Experts' opinions on the time-to-failure (in days from first detection) of the 10%ile slowest cases, and two alternative ways of pooling weighted opinions – Equal weights and Performance-based DMs**

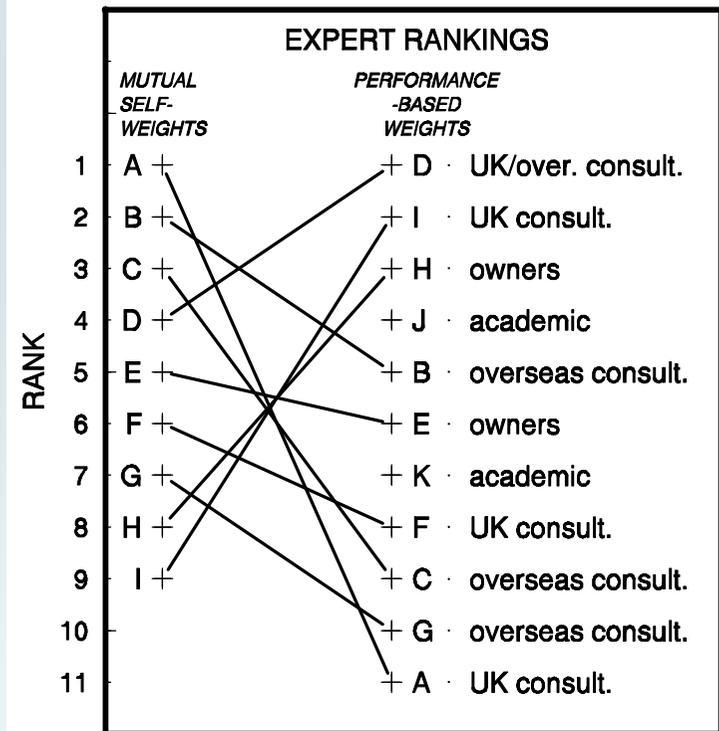
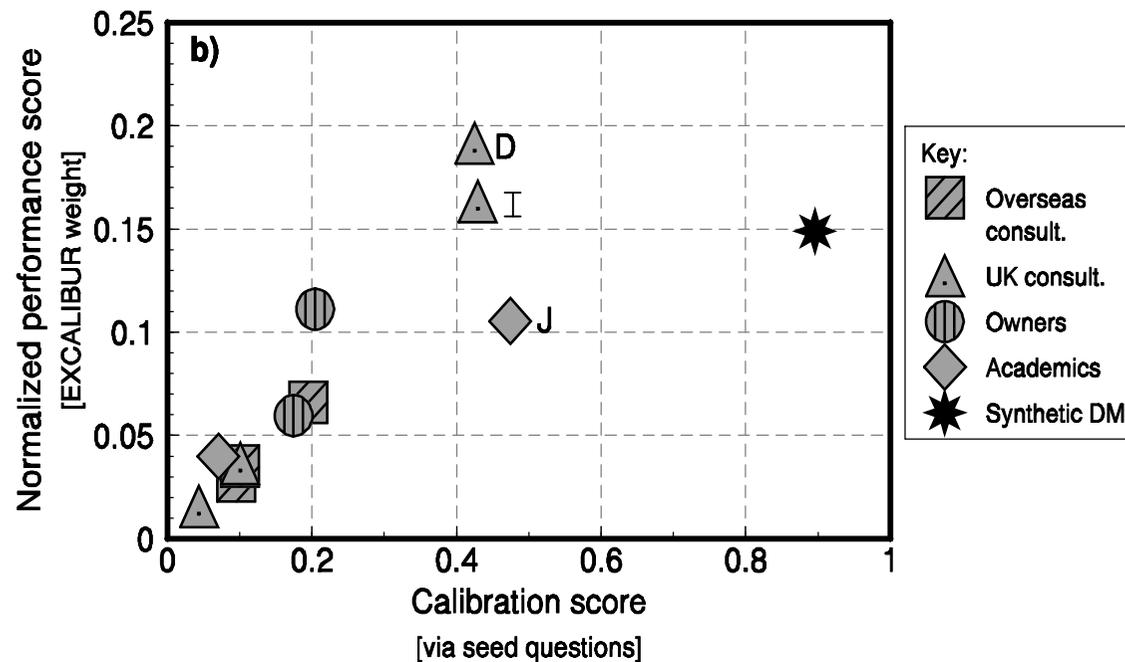


**Note the “two schools of thought” effect...**

**and the strong ‘opinionation’ of many experts**

# Reservoir engineers: performance-based scores, and peer assessment rankings

**Note: peer weighting is poor predictor of performance-based weights!**



## Matters arising .....

- Who wants to know their own calibration score?
- Voight effect .... proximity of expert's medians to realizations for experts with identical statistical accuracy scores?
- Paper, pencil, eraser –v– spreadsheet?

- How erratic are elicited scientists??

Despite built-in check formula and Warning Flags in spreadsheet, multiple non-increasing quantiles (NIQ) appeared in CDC elicitation files:

Study: 7188 expert-target responses over 15 panels;

no panel had zero NIQ errors;

73 NIQs in total on 444 targets;

20 of 48 experts had at least one NIQ;

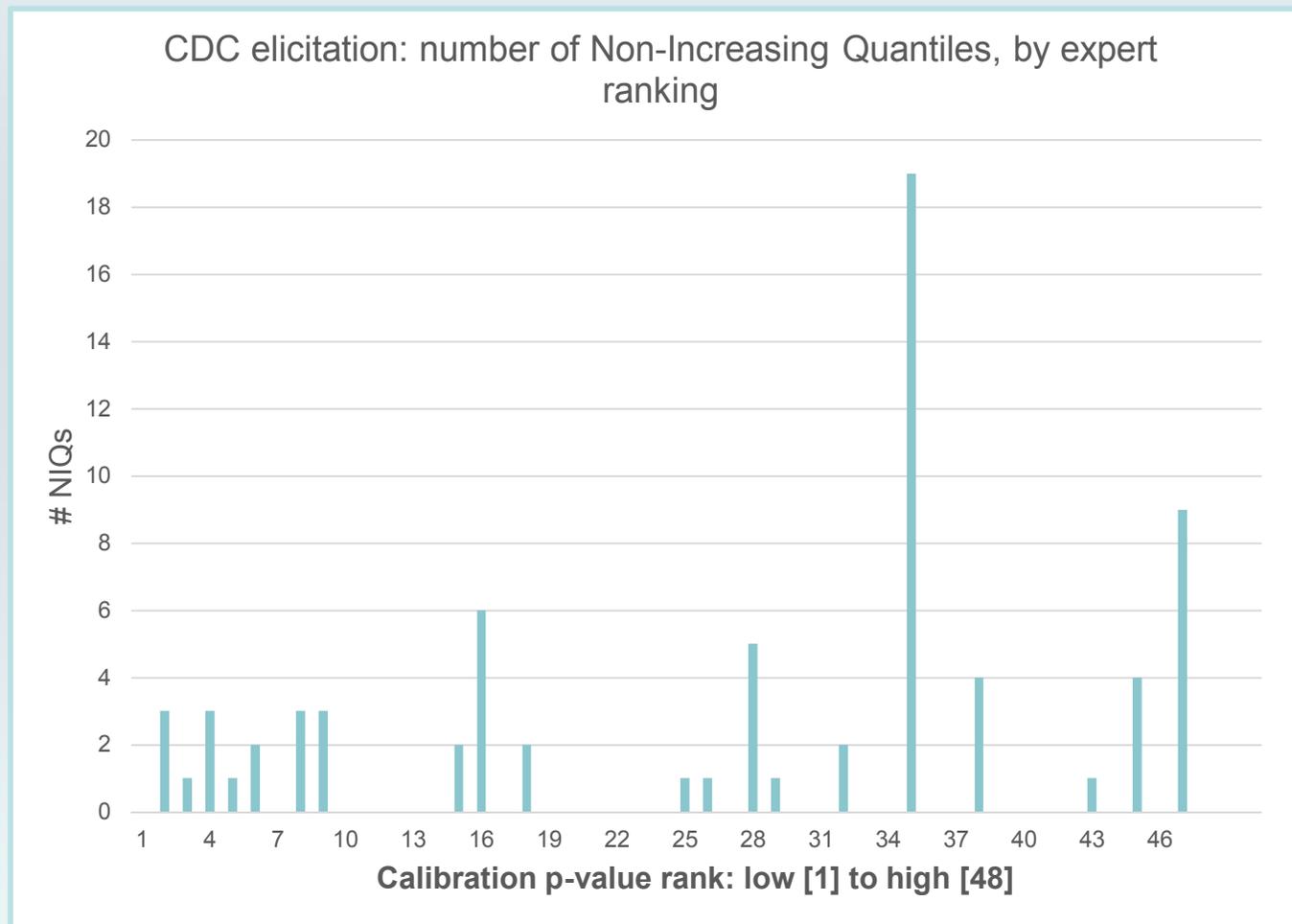
highest rate of NIQs was 4.9% on Panel1 (from 225 expert•targets);

average 1.4% NIQs over all panels;

biggest recidivist had 19 NIQs on 143 targets

- Revising responses – one expert changed calibration item quantiles; their P-value went from  $10^{-7}$  to 1.0!

# NIQs not correlated with Classical Model calibration p-value



## CDC study

- Another error encountered was the "impossible event" or the "certain event". For some items, some experts assigned 0% to all quantiles, and others 100% to at least the 50% and 95% quantiles.
- A frequency-based approach can help, by guiding experts to think in terms of "1 in 1,000,000" or "9999 in 10000", etc.
- The message: probabilistic thinking is not easy for everyone, and *improbable* is often mistaken for *impossible*. Cromwell's advice, writing to the General Assembly of the Church of Scotland on 5 August 1650: "*I beseech you, in the bowels of Christ, think it possible that you may be mistaken.*"





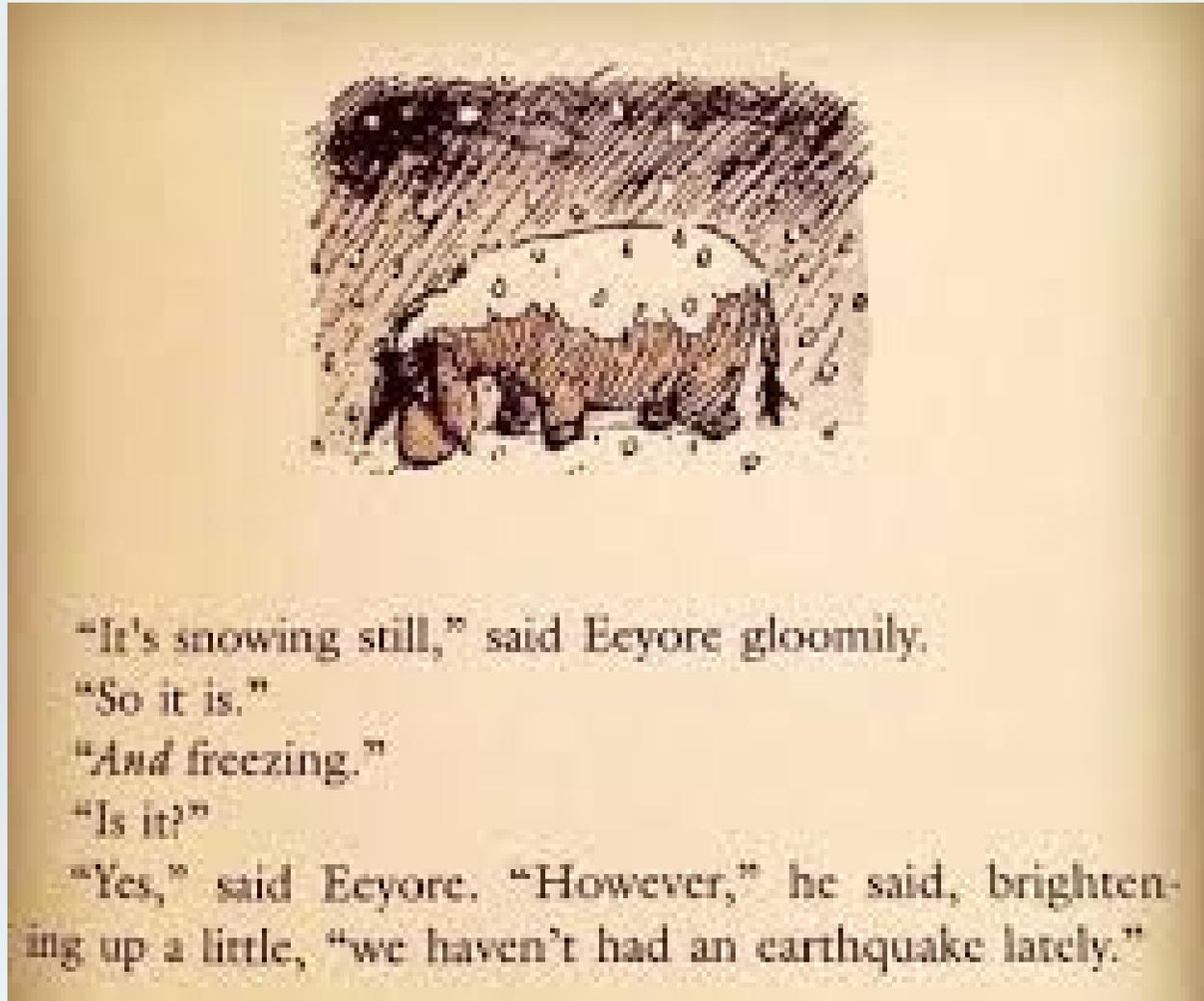
A reflection on the Classical Model in the Montserrat volcano case:

*“ Those are not the exact numbers I would use, but I can’t argue with them “*

*Senior USGS volcanologist, Montserrat Volcano Observatory: 1995.*

- Despite my remarks, not all things are negative

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A.A. Milne: *“The House at Pooh Corner”* 1928

**Thank you!**