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# PERCHLORATE 101

- ◆ Occurrence: natural and manmade
- ◆ Uses
  - ◆ Solid fuel rocket motors
  - ◆ Pyrotechnics/explosives
  - ◆ Flares
- ◆ Environmental Impact
  - ◆ Mobile and persistent
    - ◆ Soluble
    - ◆ Stable
    - ◆ Can be biodegraded
- ◆ Health Impact
  - ◆ Competes with iodide
  - ◆ Can affect thyroid function



80 - 90% of use is in aerospace

Shuttle booster rockets: 1.5 M pounds/launch

CA DTSC: 30+ potential sources/activities

Clandestine meth labs - use flare striker caps as source for red

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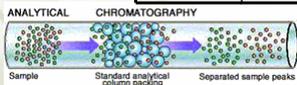
Stability is kinetic, not thermodynamic

Is relatively large, -1 ion

Similar to iodide

# *Evolving Analytical Capability*

	Method	Technology	Reporting Limit, $\mu\text{g/L}$ (ppb)
1995	Aerojet	IC/Cond Det	400 - 100
1997	CA DHS	IC/Cond Det	6
1999	EPA OW 314.0	IC/Cond Det	4.0
2004	FDA	IC/Mass Det	0.50 (water) 3.0 (milk)
2005	EPA OW 331.0	LC/Mass Det	(0.02), 0.10
	EPA OW 314.1	IC/Cond Det	0.14
	EPA OW 332.0	IC/Mass Det	0.02, 0.06



Concern over perchlorate has evolved with increasing analytical capability  
CA DHS survey

>7000 sources, 463 with detects, approx 80 DW systems

Primarily Los Angeles, San Bernardino, Riverside counties

EPA UCMR testing

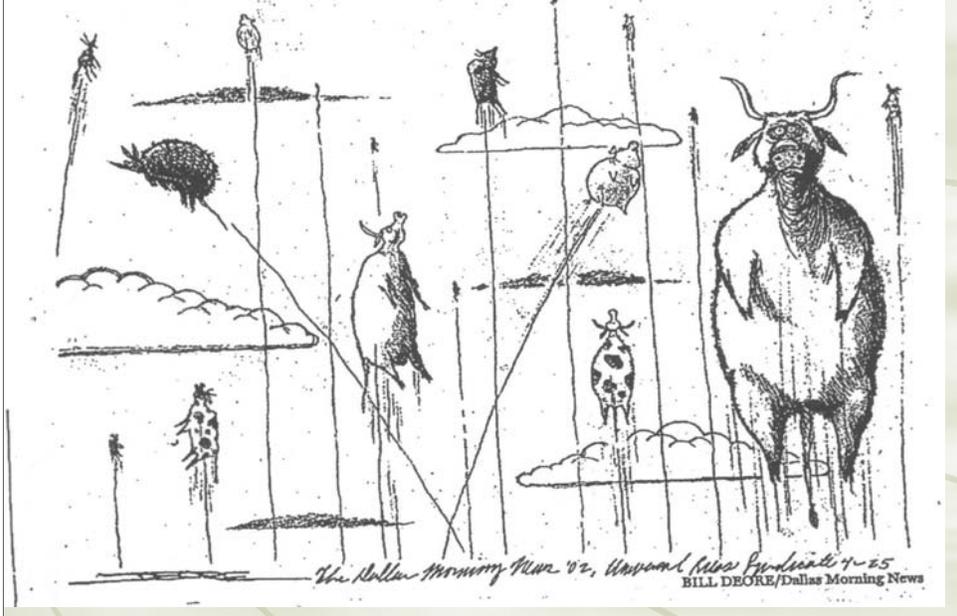
Nationwide: Approx 33,000 samples, 3800 DW systems, 600 detects (2%), 153 systems (4%)

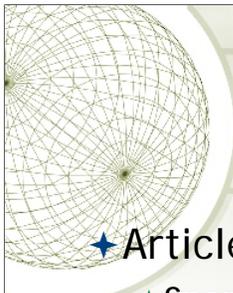
CA: Approx 8900 samples, 358 DW systems, 420 detects (5%), 58 systems (16%)

Conductivity detection: nonspecific, susceptible to false positives and interferences

Mass detection: specific, fewer interferences, more sensitive

HOW THEY DISCOVERED ROCKET FUEL IN W. TEXAS WATER

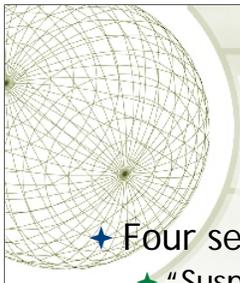




## *Perchlorate and Food*

- ★ Articles on Perchlorate and food
  - ✦ Snapshot of larger body of perchlorate articles
  - ✦ Over 2000 from 2000-2005
  - ✦ Between 2000 and 2003, 679 articles concerning perchlorate and water
    - ✦ Six articles concerning perchlorate and food

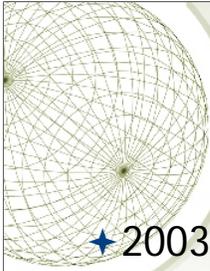
Articles on perchlorate levels in food provide snapshot of the larger body of perchlorate articles (between 2000 and 2003 when the first cluster of food-related articles appears, 679 articles had appeared concerning perchlorate and water, but only six articles had appeared concerning perchlorate and food, perhaps reflecting to some extent the analytical difficulties).



## *Perchlorate and Food*

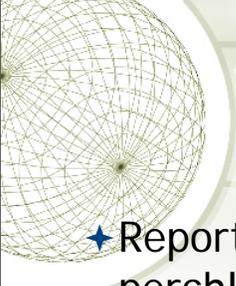
- ✦ Four separate “clusters”
  - ✦ “Suspect Salads”
  - ✦ “Rocket Fuel in Milk”
  - ✦ FDA Report
  - ✦ Breast milk study
- ✦ Written over two-year period, 2003-5
- ✦ Trends
  - ✦ Increasing familiarity with facts
  - ✦ Increasing confusion over significance of facts

These articles center around four separate reports, two from an environmental group, one from a government agency, and one study from university researchers. The articles, written over a two-year period, (2003-5) show increasing familiarity with the facts concerning perchlorate but also increasing confusion over the significance of those facts



## *Suspect Salads*

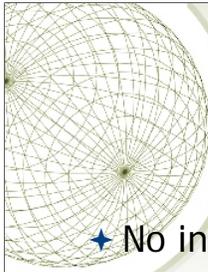
- ★ 2003: EWG report: "Suspect Salads: Toxic Rocket Fuel Found in Samples of Winter Lettuce."
  - ★ 22 samples of lettuce sent to chemists at Texas Tech University for analysis.
  - ★ Perchlorate found in 4 of 22



## *Suspect Salads*

- ★ Report apparently intended to put perchlorate into play as “stigmatized substance”
- ★ Result: 21 articles, majority (17) in California

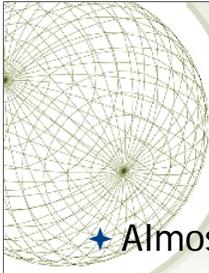
Report apparently intended to put perchlorate into play as the Greenpeace report had done with dioxin, and indeed 21 articles appeared in various newspapers throughout the country, as a result of this report, although the majority of these articles (17) appeared in California papers.



## *Suspect Salads: Problems*

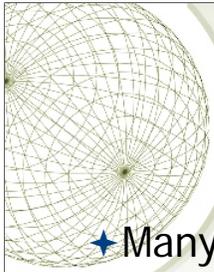
- ✦ No information about methodology used
- ✦ Results only published in EWG report
- ✦ Parts per billion numbers given as range
  - ✦ “Conventional Adult Butter Lettuce and Radicchio” had perchlorate concentration of “60 to 100 ppb.”
  - ✦ Footnote: “The level of detection varied by the type of lettuce analyzed, but is estimated to be 30 to 40 ppb concentration.”

Rather than trying to decipher these numbers, most articles relied on the echoing the EWG’s assertion that the perchlorate levels were “4 times more than the EPA says is safe in drinking water.”



## *Suspect Salads: Problems*

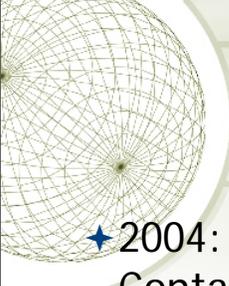
- ✦ Almost half of articles present no dissent
- ✦ Small sample size cited in only 6 articles
- ✦ Claims that "one in five" samples and "18 percent of samples" contain high levels of perchlorate repeated
  - ✦ No indication numbers referred to four of 22 samples.



## *Suspect Salads: Dissent*

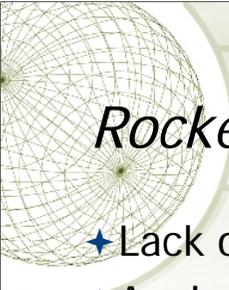
- ★ Many articles did present information from other sources.
  - ◆ News reports more balanced than six opinion pieces and editorials
- ★ Conclusion: in 2003, EWG successful in framing perchlorate as serious health risk

One newspaper, The Riverside Press-Enterprise, went so far as to commission its own study at Georgia Tech of 18 samples of lettuce and one sample of mustard greens. The same newspaper also devoted an article to interviews with other scientists who evaluated the state of knowledge concerning perchlorate risk. And news reports tended to be more balanced in their coverage than six opinion pieces and editorials, which were unanimous in their expressions of doubt and concern regarding the health threat represented by perchlorate.



## *Rocket Fuel in Milk*

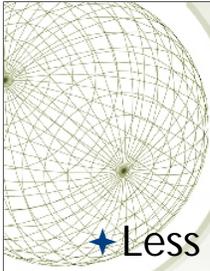
- ★ 2004: EWG issues “Rocket Fuel Contamination in California Milk.”
- ★ 32 samples of milk from Los Angeles and Orange Counties sent to Texas Tech
  - ★ Perchlorate found in 31 samples at average levels of 1.3 ppb.



## *Rocket Fuel in Milk: Problems*

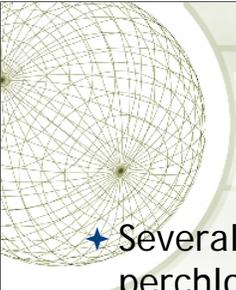
- ✦ Lack of methodology used in analyses
- ✦ Analyses published only in EWG report
- ✦ No articles point these problems out

Earlier analysis of milk from Lubbock, Texas, by the same researchers had been published in *Environmental Science and Technology* in 200). Although articles showed balance in consideration of various points of view, single editorial reprinted in four newspapers (Alameda, Hayward, San Mateo, and Tri-Valley) was much more inclined to accept the EWG conclusions without question, even using the EWG language to describe milk as “once the very symbol of a healthy childhood.”



## *Rocket Fuel in Milk*

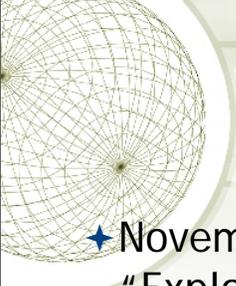
- ★ Less interest in second EWG report
  - ◆ Twelve articles, all in California,
  - ◆ Four of twelve reprints
  - ◆ Four more reprints of single editorial.
  - ◆ In all, six original pieces



## *Rocket Fuel in Milk: Conclusions*

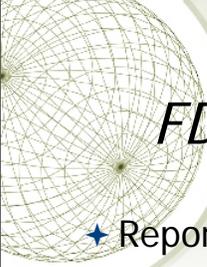
- ★ Several articles stress minute amounts of perchlorate
  - ★ Two provide metaphors to explain parts per billion
- ★ All articles interview diverse sources, including scientists who both support and dispute EWG claims.
- ★ EWG framing of issue less successful in 2004, but no other framing emerges

("equal to a half a teaspoon in an Olympic-size swimming pool,"  
"They are on the same order of magnitude as a sugar cube in an oil  
tanker")



## *FDA Report*

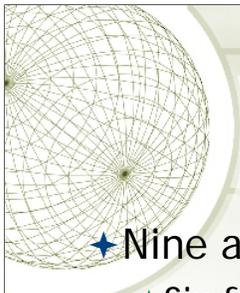
- ★ November 2004 FDA issues  
“Exploratory Data on Perchlorate in Food”
- ★ Analyses of 128 samples of lettuce, 51 samples of bottled water, and 28 samples of milk collected throughout US



## *FDA Report vs. EWG Report*

- ★ Report presents data without interpretation
  - ★ "...these data are exploratory and should not be understood to be a reflection of the distribution of perchlorate in the U.S. food supply."
  - ★ Cautions consumers not to regard perchlorate levels as "an indicator of perchlorate exposure" nor to alter diets to avoid perchlorate.
- ★ Reporters given data without being told what it meant

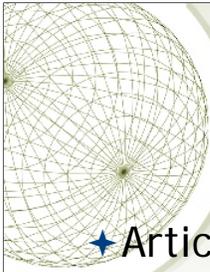
Reporters were required to study a great deal of data (three extensive tables, giving only the type of food, its point of origin, and the level of perchlorate given in parts per billion) without being told the significance of that data.



## *FDA Report*

- ★ Nine articles published in all.
  - ✦ Six for California newspapers
- ★ Riverside Press-Enterprise: four of nine
  - ✦ Only one deals directly with FDA report.

Although six were for California newspapers, there were also reports in the Salt Lake City and Santa Fe newspapers, as well as a national AP report. However, since the reporters were given no clear indication of the data's significance, several of the articles published in the wake of the FDA report focused on topics other than the report itself.



## *FDA Report: Scientific Sources*

- ★ Articles struggle to find other sources to explain data.
  - ✦ EPA spokesmen suggest data “important” but not cause for alarm
    - ✦ Also point out questions raised by widespread presence of perchlorate in areas “not known for perchlorate contamination.” (PE 11/30).
  - ✦ Regional agencies echo FDA statements

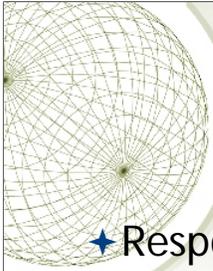
FDA spokesmen were not available to explain the report in the early days following the report's release. Regional agencies include California Office of Environmental Health Hazard Assessment and the New Mexico Environment Department. Uniformly echo FDA statement that data did not warrant changes in diet for either adults or children and that the issue itself deserved more study.



## *FDA Report: Activist Sources*

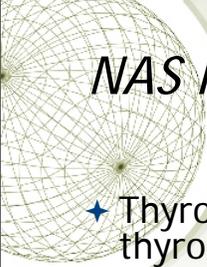
- ★ EWG spokesman: Food products are “contaminated with rocket fuels.”
- ★ Senator Feinstein: “It is imperative that we reduce the perchlorate in our drinking water and protect Californians...from this threat to their health”

Seems to contradict the FDA position that no new actions were justified by their data.



## *FDA Report: Conclusion*

- ★ Response to FDA report confused.
  - ✦ Without interpretation of data, reporters produce articles that quote contradictory sources
  - ✦ Discussion falls into “on one hand...on the other hand”



## *NAS Report - Health Implications of Perchlorate Ingestion*

- ★ Thyroid gland produces two hormones, thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ )
  - ✦ Concentrations are maintained by regulatory mechanisms
  - ✦ Iodide is required for normal function
  - ✦ Perchlorate can competitively inhibit iodide transport by the NIS
- ★  $T_3$  is required for CNS development and growth in fetuses and infants
- ★  $T_3$  and  $T_4$  are required for metabolic activity and normal function in infants, children and adults

2002 - EPA draft risk assessment for perchlorate would have lead to a maximum concentration for perchlorate in DW (MCL) of 1 ppb

DoD, NASA, industry disagreed

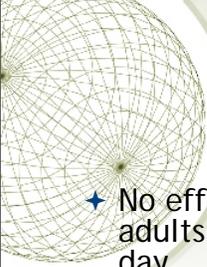
2003 - EPA, DoD, DOE, NASA agreed to fund NAS study

Committee met 5 times between Oct 03 and Jul 04

reviewed EPA draft risk assessment, material submitted by interested parties, scientific literature

issued report Jan 05

NIS: sodium iodide symporter - transport mechanism to get iodide into the thyroid



## *NAS Report - cont*

- ✦ No effect on iodide uptake was observed in healthy adults for a perchlorate dose of 0.007 mg/kg per day
  - ✦ No evidence that thyroid hormone production was adversely affected at that level
  - ✦ Effect of higher doses was short-term, not sustained
- ✦ Thyroid cancer was not a likely outcome of perchlorate exposure
- ✦ An uncertainty factor of 10 should be protective of the most sensitive population
  - ✦ Fetuses of pregnant women with iodide deficiency or thyroid disease
- ✦ Established an R<sub>r</sub>D of 0.0007 mg/kg per day
- ✦ Drinking water equivalent level (DWEL): 24.5 µg/L

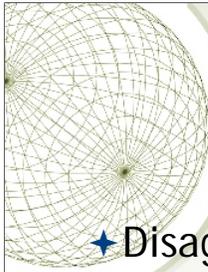
6 month study of healthy men and women

Set level at point where there was no effect on iodide uptake

Is the trigger for any subsequent health effect

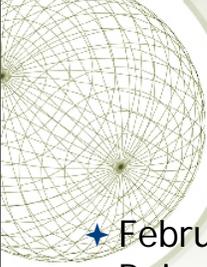
Use uncertainty factors to protect sensitive populations, since cannot test on everyone/everything

Reference dose for chronic exposure (R<sub>r</sub>D): how much can be tolerated on a daily basis without any adverse health effect



## *NAS Report - Controversy*

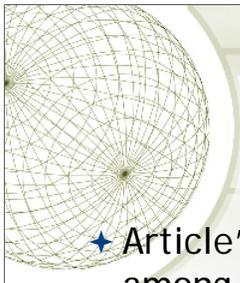
- ★ Disagreement over the appropriate value for the uncertainty factor
  - ◆ Protective of most sensitive populations?
- ★ Unhappiness that the report did not recommend a drinking water MCL
  - ◆ Beyond the scope of the committee
  - ◆ Done by EPA after considering other sources of exposure



## *Breast Milk Report*

- ✦ February 2005 “Perchlorate and Iodide in Dairy and Breast Milk,” published in *Environmental Science & Technology*
- ✦ Analyses of 47 dairy milk samples from 11 states and 36 breast milk samples from 18 states.
  - ✦ Perchlorate found in all breast milk samples and all but one dairy milk sample.

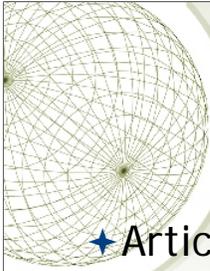
However, between the November 2004 FDA report and the February 2005 Texas Tech study another development had placed perchlorate very much in the spotlight.



## *Breast Milk Report*

- ★ Article's conclusion: "Perchlorate is unique among many environmental threats. Its sole effect is in inhibiting iodide transport.... For iodine, the range between the RDA and the maximum safe dose (2 mg/d) is an order of magnitude. **An increase in the RDA for the susceptible population could be the most prudent course.**" (emphasis added)

Atmosphere of confusion and uncertainty when the research results from the breast milk study were released.



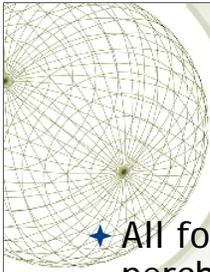
## *Breast Milk Report*

- ★ Article also notes perchlorate more widespread than previously suspected
  - ◆ “Water may not be the principal direct vector for perchlorate exposure and a comparable control population with no perchlorate exposure may be mythical”



## *Breast Milk Report*

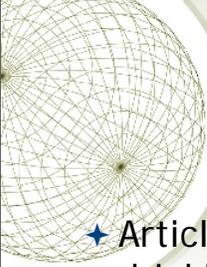
- ★ Seven articles published nationally.
  - ★ One reprint, six original pieces
  - ★ Four news stories, one editorial and one opinion piece.
  - ★ Three news reports interview Tech researchers
  - ★ All provide summary of data included in article.
  - ★ Only one news report makes reference to recommendation, without mentioning increased RDA



## *Breast Milk Report*

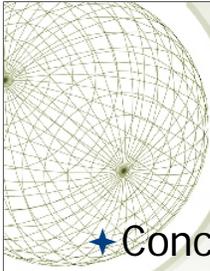
- ✦ All four articles concerned with levels of perchlorate found in breast milk rather than dairy milk
- ✦ News articles interview scientists, activists, and regulators, with mixed results.
  - ✦ EPA officials refuse to comment on study until they had been able to examine it.
  - ✦ Activists assert that study indicates widespread contamination of the food supply
  - ✦ Authors of study caution against over-reacting

One author states "It's something that may have been around for 50 years, and we just now found it"



## *Breast Milk Report*

- ★ Articles link study to NAS report and EPA's drinking water safe exposure level
  - ★ Press-Enterprise: dispute between EPA officials over safe exposure level
  - ★ Rocky Mountain News: interview with chair of NAS panel, arguing that breast milk samples were within NAS recommended level.
  - ★ Opinion piece and editorial: study is evidence that EPA levels are too high



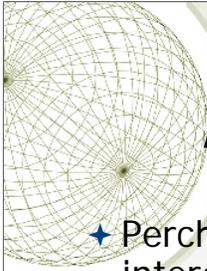
## *Breast Milk Report*

- ★ Conclusion and recommendation ignored in almost all news coverage.
- ★ Authors' observations that perchlorate seemed more widespread and that water might not be main vector for exposure also overlooked.



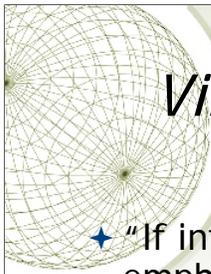
## *Breast Milk Report*

- ★ Unlike FDA report, data in study were placed in context
- ★ Unlike EWG reports, results were published in refereed journal with complete description of methodology.
- ★ Researchers were available for questions (FDA researchers were not).



## *Perchlorate and the Press*

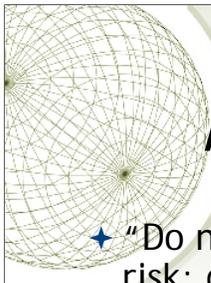
- ✦ Perchlorate reporting involves several interested “stake-holders,”
  - ✦ No group has succeeded in entirely framing issue.
  - ✦ Confusion still exists over nature of risk involved and derivation of “safe levels” in food.
  - ✦ Scientific interest in origin of perchlorate hasn’t entered press reports
    - ✦ In 2005, polluted water (particularly Colorado River) still cited as principle source of perchlorate.



## *Vincent Covello, Center for Risk Communication*

- ✦ “If information is evolving or incomplete, emphasize appropriate reservations about its reliability”
  - ✦ Highlights difficulties scientists encounter when data are unclear or ambiguous.
- ✦ Scientists consulted by reporters tried to adhere to these recommendation
  - ✦ Tech researchers: research “raises more questions than answers.”

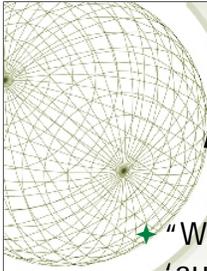
Vincent Covello, Director of the Center for Risk Communication, has suggested several guidelines (2003) for communicating risk to the public, some of which are relevant to the perchlorate. However, these guidelines also highlight the difficulties that scientists encounter in a situation in which data are unclear or ambiguous. In general, the scientists consulted by reporters in these articles tried to adhere to these recommendation, asserting, as one of the Tech researchers pointed out, that the research “raises more questions than answers.”



## *Perchlorate and the Press*

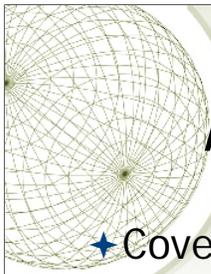
- ✦ “Do not minimize or exaggerate the level of risk; do not over-reassure.”
  - ✦ Scientists point out low risk involved in small samples used for food analysis
  - ✦ But don’t claim no risk exists
- ✦ Other sources argue that risk is greater
  - ✦ New Mexico activist: perchlorate is “a biochemical assault,” which is contributing to “a significant decline in raw potential intelligence in our civilization.”

Need for answers in this context was acute, and since they were not forthcoming from the scientists and regulators (who also followed another Covello recommendation--“Do not speculate”), reporters sometimes tended to rely on activists who were willing to draw conclusions and make recommendations based on limited information.



## *Perchlorate and the Press*

★ "We [reporters] tend to rely most on 'authorities' who are either most quotable or quickly available or both. They often tend to be those who get most carried away with their sketchy and unconfirmed but 'exciting' data--or have big axes to grind, however lofty their motives. The cautious, unbiased scientist who says 'Our results are inconclusive' or 'We don't have enough data yet to make any strong statement' or 'I don't know' tends to be omitted or buried deep down in the story." -- Victor Cohn and Lewis Cope



## *Perchlorate and the Press*

- ★ Covello: “Recognize that competing agendas, symbolic meanings, and broader social, cultural, economic, or political considerations may complicate risk communication”
- ★ Even when risk communication is done correctly, it may not be enough.

Ironically, however, the research study from Texas Tech--which included both clear conclusions and recommendations--was buried by timing, coming out, as it did, shortly after the NAS report was issued.