Before the

ENVIRONMENTAL PROTECTION AGENCY

In Re Final Rules on Sulfuryl Fluoride
Pesticide Residue Tolerances

Docket Nos. OPP-2005-0174;
OPP-2003-0373

To:

Public Information and Records Integrity Branch
Information Resources and Services Division
Room 7502C
Office of Pesticide Programs
U.S. EPA
1200 Pennsylvania Ave. N.W.
0001 Washington, D.C. 20460-0001

Jonathan Fleuchaus
Office of General Counsel
Room 2333A
U.S. EPA
1200 Pennsylvania Ave. NW
Washington, D.C. 20460-

Objectors' Submission to Docket

18 IQ Studies

Objectors Fluoride Action Network, Beyond Pesticides and Environmental Working Group, through counsel, hereby submit to the Docket 18 IQ studies. These materials are presented as follows:

- **Part I:** Listing of Studies
  (with descriptions of publication and translation)

- **Part II:** Studies

- **Part III:** Two Overview Papers on the Studies

Respectfully submitted,

Perry E. Wallace
Zelle, Hofmann, Voelbel, Mason & Gette, LLP
2300 Wisconsin Ave. N.W.
Suite 100A
Washington, D.C. 20007
301-675-5969
Part I

Listing of Studies
Papers attached:

• 18 IQ studies
• 2 overview papers of the IQ studies

Research on the intellectual development of children in high fluoride areas.
Translated by Julian Brooke and published with the concurrence of the Chinese Journal of
Control of Endemic Diseases.

A preliminary investigation of the IQs of 7-13 year old children from an area
with coal burning-related fluoride poisoning.
Translated by Julian Brooke and published with the concurrence of the Chinese Journal of
Endemiology.

Research on the effects of fluoride on child intellectual development under
different environments.
Translated by Julian Brooke and published with the concurrence of Chinese Primary Health Care.

The effects of high fluoride intake on child mental work capacity and
preliminary investigation into mechanisms involved.
• Translation into English by Julian Brooke. (English translation not yet published)

The effects of endemic fluoride poisoning on the intellectual development
of children in Baotou.
Translated by Julian Brooke and published with the concurrence of the Chinese Journal of Public
Health Management.

Using the Raven’s standard progressive matrices to determine the effects
of the level of fluoride in drinking water on the intellectual ability of school-age children.
Chinese Journal of the Control of Endemic Diseases 5:203-204.
Translated by Julian Brooke and published with the concurrence of the Chinese Journal of
Control of Endemic Diseases.
A study of the intellectual ability of 8-14 year-old children in high fluoride, low iodine areas. 
• Translation into English by Julian Brooke. (English translation not yet published)

A study of the IQ levels of four- to seven-year-old children in high fluoride areas. 
• Translation into English by Julian Brooke. (English translation not yet published)

The effects of endemic fluoride poisoning caused by coal burning on the physical development and intelligence of children. 
• Translation into English by Julian Brooke. (English translation not yet published)

Effect of fluoride exposure on intelligence in children. 

The relationship of a low-iodine and high-fluoride environment to subclinical cretinism in Xinjiang. 
Xinjiang Institute for Endemic Disease Control and Research; Office of Leading Group for Endemic Disease Control of Hetian Prefectural Committee of the Communist Party of China; and County Health and Epidemic Prevention Station, Yutian, Xinjiang.

Effect of high-fluoride water on intelligence in children. 

Decreased intelligence in children and exposure to fluoride and arsenic in drinking water. 

Effect of high fluoride water on intelligence of school children in India. 

Arsenic and fluoride exposure in drinking water: children's IQ and growth in Shanyin County, Shanxi Province, China. 

Effect of fluoride in drinking water on children's intelligence. 
*Effect of high-fluoride water supply on children’s intelligence.*

*Effect of high fluoride concentration in drinking water on children’s intelligence.*
• English translation forwarded by lead author: (B. Seraj, Department of Pediatric Dentistry, Faculty of Dentistry, Tehran University of Medical Sciences)

2 Overview Papers:

Connett M, Limeback H.
*Fluoride and its effect on human intelligence. A systematic review.*
International Association for Dental Research 83rd General Session and Exhibition. Toronto, Canada.

*Fluoride and Children’s Intelligence: A Meta-analysis.*
Part II

Studies
Copyright Material (Copyright material may not be reproduced without the consent of the copyright holder.)
Part III

Two Overview Papers on the Studies
Over view Paper I

Fluoride and its Effect on Human Intelligence. A Systematic Review
Title: **Fluoride and its effect on human intelligence. A systematic review.**

Authors: Michael Connett and Hardy Limeback

Objectives: A systematic review was undertaken to examine if fluoride (F⁻) exposure is associated with a decline in human intelligence (IQ).

Materials and Methods: Ovid MEDLINE and its allied versions, CINAHL, AMED, EMBASE, Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED, Health and Psychosocial Instruments, HealthSTAR, International Pharmaceutical Abstracts were searched from the earliest record until January 2008. Only original human studies examining the effect of F⁻ on IQ were selected. Elevated F⁻ in drinking water was the primary variable but studies where F⁻ was elevated in the urine as a result of pollution were also included. Hand-searching of the bibliographies of the selected studies, as well as a separate search strategy in Cab Direct and online Chinese databases (Chinese version of Google Scholar and several others) were performed and the relevant Chinese studies were translated into English.

Results: Of a total of 224 papers searched for relevancy from their titles, abstracts, and full copy, 20 original studies met our inclusion criteria, were read in full and critiqued by the authors. Only 6 of the studies were reviewed by the 2006 US NRC Subcommittee on Fluoride in Drinking Water and 4 studies were published after 2006. The extent of F⁻ exposure was reported in all but one study and 9 studies reported urinary F⁻. Most papers omitted important details (e.g. blinding, managing confounders). All but 2 reported statistically significant (t-tests) declines in IQ in children exposed to elevated levels of F⁻. One study reported a bivariate analysis and another did multiregression analysis. Three studies were conducted outside of China, suggesting that this is not just a relationship that is limited to one country.

Conclusions: While the evidence is not conclusive, we identified 18 ecological studies that purport an association between high fluoride exposure and decreased human intelligence.
<table>
<thead>
<tr>
<th>Condition</th>
<th>No Dose</th>
<th>Dose 1</th>
<th>Dose 2</th>
<th>Dose 3</th>
<th>Dose 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low F</td>
<td>0.2 ml</td>
<td>0.5 ml</td>
<td>1.0 ml</td>
<td>1.5 ml</td>
<td></td>
</tr>
<tr>
<td>Medium F</td>
<td>0.2 ml</td>
<td>0.5 ml</td>
<td>1.0 ml</td>
<td>1.5 ml</td>
<td></td>
</tr>
<tr>
<td>High F</td>
<td>0.2 ml</td>
<td>0.5 ml</td>
<td>1.0 ml</td>
<td>1.5 ml</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Condition 1: Dose 1 < Dose 2 < Dose 3 < Dose 4
- Condition 2: Dose 1 < Dose 2 < Dose 3 < Dose 4
- Condition 3: Dose 1 < Dose 2 < Dose 3 < Dose 4

Legend:
- Low F: 0.2 ml
- Medium F: 0.5 ml
- High F: 1.0 ml

Units: ml
<table>
<thead>
<tr>
<th>Study</th>
<th>Type</th>
<th>Fluorosis Level</th>
<th>Fluoride (ppm)</th>
<th>Sample Size (Mean ± SD)</th>
<th>Mental Capacity Decreased</th>
<th>Significance</th>
<th>Summary</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li (95)</td>
<td>Low F, High F</td>
<td>Fluorosis</td>
<td>0.91 ± 0.12</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride environment can adversely affect the development of intelligence in children</td>
<td>Universiti of Taran</td>
</tr>
<tr>
<td>Wang (96)</td>
<td>Low F, High F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Zhao (96)</td>
<td>Low F, High F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Li (00)</td>
<td>Low F, High F, Low F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Hong (01)</td>
<td>Low F, High F, Low F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Li (03)</td>
<td>Non-fluorosis</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Yang (03)</td>
<td>Low F, High F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
<tr>
<td>Wang (05)</td>
<td>Low F, High F</td>
<td>Fluorosis</td>
<td>3.37 ± 0.15</td>
<td>Raven</td>
<td>138.5 ± 0.27</td>
<td>&lt;0.01</td>
<td>High fluoride intake has a clear influence on the IQ of preschool children</td>
<td>Manual (translate)</td>
</tr>
</tbody>
</table>

- **Control**: 49
- **Dental Fluorosis**: 97
- **Skeletal Fluorosis**: 57
<table>
<thead>
<tr>
<th>Study</th>
<th>Low F</th>
<th>Mod F</th>
<th>High F</th>
<th>Wechsler</th>
<th>( \beta ) values</th>
<th>( p ) values</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocha-Amador ('07)</td>
<td>0.8</td>
<td>5.3</td>
<td>9.4</td>
<td></td>
<td>-6.7</td>
<td>&lt;0.001</td>
<td>&quot;Children exposed to either F or As have increased risks of reduced IQ scores&quot;</td>
</tr>
<tr>
<td>Trivedi ('07)</td>
<td>2.01</td>
<td>5.55</td>
<td></td>
<td></td>
<td>-11.2</td>
<td>&lt;0.001</td>
<td>&quot;.The mean IQ level of students exposed to high F drinking water was significantly lower than that of the students to a lower F level drinking water&quot;</td>
</tr>
<tr>
<td>Wang ('07)</td>
<td>0.5</td>
<td>8.3</td>
<td></td>
<td></td>
<td>-10.2</td>
<td>&lt;0.001</td>
<td>&quot;Children's intelligence and growth can be affected by high concentrations of As or fluoride.&quot;</td>
</tr>
</tbody>
</table>

Grey = reviewed by the NRC
Yellow = not found in the U of T search