

## **A guide to researching a family tree for evidence of previously unrecognized lead poisoning in family members**

This guide is intended as an aid for the reader trying to determine if they or a family member (perhaps now deceased) unknowingly experienced lead poisoning from lead supplied by the Bell System. Although the guide may help a reader make sense of seemingly disparate family events from long ago (and in the process perhaps arouse suspicion that poisoning occurred), the connect-the-dots approach espoused here should not be confused with proof of poisoning.

All the reader may have at his or her disposal are family stories and letters that vaguely allude to past problems but leave the reader without any real understanding of what the problems were.

Perhaps a search for the truth can begin by recalling stories, if any, that suggest strife and conflict in a family.<sup>1</sup> Memories and stories of domestic turmoil are more likely to have survived the years than events that evoked fewer emotions. Lead poisoning can lead to adverse behaviour in both adults and children. A parent's irritability and anger in the face of a child's failure to meet expectations at home or school can look like a normal reaction to a child misbehaving, and perhaps that's the accurate assessment. But an alternative explanation is that the behaviors of the child, parent, or both were actually symptoms of lead poisoning masquerading as domestic strife.

Having concluded that strife and conflict occurred a closer look may be informative. An effort should be made to determine if the child was hyperactive, easily distracted, or a slow learner. For school-age children official reports or family letters may have survived documenting the child's academic performance. If they indicate that the child struggled with poor grades and/or disruptive behavior in the classroom it can add support to the idea that lead poisoning occurred in the family. Even in the absence of any other information about a child's performance, knowledge that a child was held back in school and forced to repeat one or more grade levels is supportive information.

Attention is turned to the family's adults. Lead can result in irritability and anger in an adult resulting in emotional outbursts that may seem out of proportion to instigating events (it can affect children in the same way). In the case of occupational exposure to lead any such symptoms can be expected to have occurred in the family wage earner along perhaps with other adults in the family. However in the absence of a history of chronic irritability and anger in the wage earner, serious doubt is thrown on occupational lead exposure as the cause even if there is evidence of it in another adult in the family.

Since the irritability is pathologic and therefore largely not under voluntary control, evidence may have survived that the irritability worked to the detriment of the individual expressing it. In the workplace this may have surfaced as: being fired from a job, demoted, failing to be promoted, frequent changing of jobs, or friction with co-workers. Old family

---

<sup>1</sup> Family violence on the other hand has not been linked to lead poisoning.

photographs may be of help as well. Individuals will generally try to look their best for formal portraits even if they've had a bad day. In addition to dress this means showing a pleasant face. A formal photograph that shows evidence of irritability and anger in the facial features, particularly if that is a change from photographs taken earlier and/or later, adds support to the hypothesis that lead poisoning occurred. Finally, the irritability and anger may have engendered fear in others (particularly in young children), fear that the anger might be directed toward them. Memories of that fear may have survived in stories and letters.

Although unprotected exposure to lead is dangerous whenever and wherever it occurs, Bell System construction and maintenance personnel, and in particular Western Electric employees working in installation, were subjected to perhaps three peaks of intense lead exposure during the last century; once in the late '30s and early '40s when the first lead-sheathed transcontinental telephone cable was being laid (the pre-war years), once during the war years (approximately 1942-'45) when the lead content of all types of solder skyrocketed due to a shortage of tin, and once again in the early '50s when workers were exposed to lead-contaminated dust and debris associated with the widespread demolition and swapping out of manual for automated telephone switching equipment across the Bell System. If the reader is able to temporally place the events of interest into any or all of these time periods that is supportive information.

Having made it this far with suspicions intact, the reader may want to examine the table on the following page for further help. Although each of the findings and symptoms listed in the table could conceivably have had any one of a number of causes, as each finding or symptom is added to a list of events occurring in one family living under one roof, the odds increase that some or all were due to lead poisoning. <sup>i</sup> (see last page for endnote)

Some physical finding and symptoms said to be associated with lead poisoning		Can occur in;		
Symptom/finding	Comment (if any)	Adults	Children	Animals
<b>Hydrocephalus</b>	Hydrocephalus occurs not only as a congenital abnormality in children but as an acquired condition in adults and children as well. Whether chronic lead poisoning can cause hydrocephalus in adults has never been studied although it has been documented in young children and in animals.	?	Yes	Yes
<b>Headache</b>	Little has been written about the headache of lead poisoning in detail, other than it is likely the result of cerebral edema and usually bitemporal in location. In general headaches due to cerebral edema are quite persistent, may be severe, and require more pain relief than can be provided by aspirin or Tylenol®. Because occupational lead exposure among Bell System workers was intermittent the headaches, if any, would have been intermittent as well. The headaches could conceivably have been confused with migraines. Unlike migraines, however, there would not have been sensitivity to light, or the prodrome (mainly visual effects) that is often seen in migraine sufferers just before onset of the headache.	Yes	?	?
<b>Emotional or behavioural problems manifesting as anger, hyperirritability, or nervousness</b>		Yes	Yes	?
<b>Cataracts</b>	Lead has been found to interfere with the movement of essential elements into and out of both animal and human lenses. Unimpeded exchange of elements such as zinc is needed in order to maintain lens clarity	Yes	?	?
<b>Hearing loss</b>	Often a high-frequency loss around 4000 Hz	Yes	Yes	?
<b>Attention deficit/hyperactivity/difficulty learning (ADHD)</b>	Researchers have concluded that the occurrence of the condition known as ADHD is largely genetic in origin although environmental contaminants also play a role. However there are cases of ADHD that have no known genetic component (that is, there is no history of ADHD among either first degree relatives or offspring). In those cases ADHD may be the result solely of environmental contaminants such as lead. Maternal cigarette smoking is thought by many to be a major risk factor as well although the evidence so far is inconclusive. In families where lead contamination and smoking are both present it	Yes	Yes	Yes

	<p>may be difficult to separate out the effect that each has on the occurrence of ADHD. However there may be a clue and that is that if there are additional indicators of lead poisoning in a family aside from the presence of ADHD these would be supportive of lead as the cause. Fergusson (see ref) found that even taking into account the effects of smoking lead poisoning remained an independent predictor of ADHD.</p>			
<b>Lower intellectual functioning</b>	<p>Strong evidence that lead poisoning can reduce IQ in children, and evidence that it can reduce occupational achievement in adults who had lead poisoning as children.</p>	Yes	Yes	Yes
<b>Sexual impotence/decreased libido/decreased fertility/difficulty attaining an erection</b>	<p>A brief anecdotal comment about this can be found at <a href="http://www.lead.org.au/bellsystemleadpoisoning/images/Lead_poisoning_news-Australia.pdf">www.lead.org.au/bellsystemleadpoisoning/images/Lead_poisoning_news-Australia.pdf</a>.</p>	Yes	-	Yes
<b>Stomach pain/constipation ("lead colic")</b>	<p>One author (see Janin) pointed out that the term "colic" is somewhat of a misnomer and that the pain is more of a dull ache. Furthermore it is not clear if constipation from lead poisoning is irrevocably linked to the occurrence of pain or whether constipation can occur with little or no pain.</p> <p>For Bell System workers exposed outside the factory the question arises as to whether cyclic exposure to lead for many years may have resulted in permanent damage to the normal function of the bowel due to recurrent constipation-related straining at the stool. One medical review found that the constipation and accompanying enlargement of the colon seen with lead poisoning both resolved with resolution of the poisoning. However this conclusion assumes two things, one is that the sufferer received competent medical attention for the problem, and second that once the problem occurred the victim's unprotected exposure to lead ended. However due to the nature of their exposure (that is, the lead exposure was intermittent, random, of variable intensity, and prolonged), none of these assumption may have been true for at-risk Bell System field workers. In that case conclusions based on these assumptions may need to be revisited.</p>	Yes	Yes	?
<b>High blood pressure</b>	<p>High blood pressure has been observed in individuals with active lead poisoning as well as in individuals whose poisoning resolved decades before. A cause and effect relationship between lead poisoning and high blood pressure has been shown by several researchers.</p>	Yes	?	Yes

<b>Juvenile delinquency</b>	-	-	Yes	-
<b>Speech impediment</b>	For more then 50 years it has been known that a child's ability to speak can be impaired by severe lead poisoning. Furthermore there are striking similarities between the damage that lead can do to the muscles of the voice box and damage observed to the same muscles in some individuals who chronically stutter. This has led researchers to suspect that lead poisoning may be a causative factor in a type of stuttering known as "neurogenic" <sup>2</sup> . Although the association has yet to be proven, it is remarkable that as the frequency of lead poisoning has declined over the years the frequency of stuttering has declined more or less in step. (see also, document footnote # 10 at " <a href="#">Uncovering a sixty year-old story of lead poisoning</a> ", as well as the web page " <a href="#">Lead poisoning and stuttering</a> ", on this website)	?	Yes	-
<b>Dental problems</b>	Individuals with lead poisoning are prone to dental cavities (caries). Researchers hypothesis that this may be the result of changes in the antimicrobial properties of saliva caused by lead substituting for calcium in the salivary glands. This in turn can lead to higher levels of plaque and cavities. In addition lead can substitute for calcium in the dental enamel of the developing teeth of children resulting in a weak, brittle, enamel.	Yes	Yes	Yes
<sup>2</sup> Although there are various subtypes of neurogenic, or acquired, stuttering, in general this type is said to have the following vocalizing characteristics: "involuntary repetition primarily of correct sounds and syllables anyplace in the word" (Rosenbeck, p 46); the absence of accessory features such as grimacing; periods of silence associated with a transient inability to initiate any kind of sound; a lack of openly expressed anxiety about the stuttering on the part of the stutterer.				

## **References:**

### ***Headache:***

Goetz C., Washburn K., Kompolito K "Metal Intoxication: Lead" in Clinical Neurology, Lippincott, Williams and Wilkins, 1998.

Cullen M.R., Robins J, Eskenazi B "Adult inorganic lead intoxication: presentation of 31 new cases and a review of recent advances in the literature", Medicine 62(4); pp 221-247, 1983.

Stewart W, Schwartz B, "Effects of lead on the adult brain: a 15year exploration". American Journal of Industrial Medicine 50: p 729-739, 2007.

### ***Lead colic:***

Janin Y, Couinaud C, Stone A, Wise L. "The 'lead-induced colic' syndrome in lead intoxication" Surgery Annual 17; pp 287-307, 1985

### ***Hydrocephalus:***

Hirano A, Iwata M, "Neuropathology of lead intoxication" in Handbook of Clinical Neurology 36, pp 35-64, 1979.

Goetz C., Washburn K., Kompolito K "Metal Intoxication: Lead" in Clinical Neurology , Lippincott, Williams and Wilkins, 1998.

### ***Irritability/Anger***

Lucchini R, Elisa A, Cortesi I, Placid D, et.al "Assessment of neurobehavioral performance as a function of current and cumulative occupational lead exposure", Neurotoxicology 21(5), pp 805-812, 2000.

Byers R, Lord E, "Late effects of lead poisoning on mental development", American Journal of Diseases of Children 66(5), p 471, 1943.

Sciarillo W, Alexander G, et. al. "Lead exposure and child behavior", American Journal of Public Health 82(10), p 1356, 1992.

Cullen M.R., Robins J, Eskenazi B "Adult inorganic lead intoxication: presentation of 31 new cases and a review of recent advances in the literature", Medicine 62(4); pp 221-247, 1983.

### ***High Blood Pressure***

Lead Poisoning : the Report of the Committee on Lead Poisoning; p 23, The American Public Health Association, NY,NY, 1930.

A Guide to Researching Lead Poisoning in a Family Tree 2/20/08 Schwartz J, "The relationship between blood lead and blood pressure in the NHANES II survey", Environmental Health Perspectives 78, pp 15-22, 1988.

Hu H, "A 50-year follow-up of childhood plumbism: hypertension, renal function, and hemoglobin levels among survivors", American Journal of Diseases of Children 145, pp 681-687, 1991.

### ***Juvenile delinquency***

Needleman H, Riess J., et.al, "Bone lead levels and delinquent behavior", JAMA 275(5), p 363-369, Feb 1996.

Dietrich K, Ris M, et.al. "Early exposure to lead and juvenile delinquency" *Neurotoxicology and Teratology* 23(5), p 511-518, 2001

### ***Sexual impotence/decreased libido/decreased fertility/difficulty attaining an erection***

Cullen M.R., Robins J, Eskenazi B "Adult inorganic lead intoxication: presentation of 31 new cases and a review of recent advances in the literature", *Medicine* 62(4); pp 221-247, 1983.

Lancranjan I, Popescu H, et.al. "Reproductive ability of workmen occupationally exposed to lead", *Archives of Environmental Health* 30, pp 396-401, 1975.

Varma MM, Joshi SR, Adeyemi AO "Mutagenicity and infertility following administration of lead sub-acetate to Swiss male mice", *Experientia* 30 (5), pp486-487, 1974.

### ***Speech impediment***

Mayfield S., "Language and speech behaviors of children with undue lead absorption: a review of the literature", *Journal of Speech and Hearing Research* 26, pp 362-368, 1983.

Byers R, Lord E, "Late effects of lead poisoning on mental development", *American Journal of Diseases of Children* 66(5), p 471-494, 1943.

Schwartz J, Otto D, "Blood lead, hearing thresholds, and neurobehavioral development in children and youth", *Archives of Environmental Health* 42(2), p 153-160, 1987.

Rosenbek J "Stuttering secondary to nervous system damage" in *Nature and Treatment of Stuttering: New Directions*; R. Curlee and W. Perkins (Ed.): Chap 3; College Hill Press, San Diego, 1984.

Wendell Johnson and Associates, *The Onset of Stuttering: research findings and implications*, University of Minnesota Press, Minneapolis, 1959.

### ***Cataracts***

Schaumberg D, Mendes F, "Accumulated lead exposure and risk of age-related cataract in men", *JAMA* 292(22), pp.2750-2754, 2004.

Shukla N, Moitra JK, Trivddi RC, "Determination of lead, zinc, potassium, calcium, copper, and sodium in human cataract lenses", *The Science of the Total Environment* 181; 161-165, 1996.

Neal R, Cooper K, et.al. "Effects of some sulfur-containing antioxidants on lead-exposed lenses", *Free Radical Biology and Medicine* 26; 239-243, 1999.

Neal R, Cooper K, et.al. "Effects of N-acetylcysteine and 2,3-dimercaptosuccinic acid on lead induced oxidative stress in rat lenses", *Toxicology* 130; 167-174, 1998.

### ***Hearing loss***

Repko J, Corum C, et.al. *The Effects of Inorganic Lead on Behavioral and Neurologic Function: Final Report*, pp 39-48, DHEW, Contract No. 210-75-0054, U. Government Printing Office, Washington DC, 1978.

Schwartz J, Otto D, "Blood lead, hearing thresholds, and neurobehavioral development in children and youth", *Archives of Environmental Health* 42(2), p 153-160, 1987.

Forst L, Freels, Persky V, "Occupational lead exposure and hearing loss", *Journal of Occupational and Environmental Medicine* 39(7), pp 658-660, 1997.

### ***Dental Cavities (Caries)***

Moss M, Lanphear B, Auinger P, "Association of dental caries and blood lead levels", JAMA 281(24), pp 2294-2298, 1999.

Gemmel A, Tavares M, et.al., "Blood lead levels and dental caries in school-age children", Environmental Health Perspectives 110(10), pp. A625-A630, 2002.

Shapiro I, Needleman H, Tuncay O, "The lead content of human deciduous and permanent teeth" Environmental Research 5, pp. 467-470, 1972.

### ***Lower Intellectual Functioning***

Bellinger D, Stiles K, Needleman H, "Low-level lead exposure, intelligence and academic achievement: a long-term follow-up study" Pediatrics 90, pp 855-861, 1992.

Baghurst P, McMichael A, et.al. "Environmental exposure to lead and children's intelligence at the age of seven years: the Port Pirie Cohort Study" New England Journal of Medicine 327(18), pp 1279-84, 1992.

Pocock S, Smith M, Baghurst P, "Environmental lead and children's intelligence: a systematic review of the epidemiological evidence", British Medical Journal 309, pp 1189-97, 1994.

White R, Diamond R, et.al. "Residual cognitive deficits 50 years after lead poisoning in childhood", British Journal of Industrial Medicine 50: pp 613-622, 1993.

### ***ADHD***

Biederman J, "Attention-deficit/hyperactivity disorder : a selective overview" Biological Psychiatry 57: pp 1215-1220, 2005.

Goldman L, Genel M, et.al. "Diagnosis and treatment of attention-deficit/hyperactivity disorder in children and adolescents" JAMA 279 (14): pp 1100-1107, 1998.

Fergusson D, Fergusson J, et.al., "A longitudinal study of dentine lead levels, intelligence, school performance and behaviour", Journal of Child Psychology and Psychiatry 29 (6): pp811-824, 1988.



i Because chronic lead poisoning has been poorly characterized there is not a standard definition. As a result groups said to have chronic poisoning (that is, long-term low level poisoning) cannot be assumed to have levels of disease and disability that are equivalent. For example blood lead levels drawn over time in two hypothetical individuals, both of whom are said to have chronic lead poisoning, are seen in the graphs below. The top example could represent hypothetical blood lead levels in an exposed Bell System employee working in the field (that is, working outside the factory), while the bottom example might represent an auto industry worker in a battery plant. Based on differences in the variability of their blood lead levels the two individuals could have very different medical experiences. For the Bell System worker symptoms could come and go in such random fashion that he might seldom if ever come to the attention of a physician. The battery plant worker on the other hand would stand a better chance of receiving medical care because his symptoms are more likely to become sustained. Once the battery plant worker is identified as having lead poisoning he is removed from exposure. But because the Bell System employee is never identified as having poisoning his exposure continues unabated, probably for years. Nobody knows what that might mean for the health of the affected worker because research that might have provided an answer was never done. But for some affected individuals the news couldn't have been good.

