CASE STUDY #10: CADMIUM POISONING

More Deaths May Be Tied To Cadmium - Tom Gibb, Pittsburgh Post-Gazette Staff (published Thursday, January 16, 2003)

The Indiana County coroner says he may seek permission to exhume three members of an Indiana County family -- a 19-year-old, his father and his grandmother -- who died within 18 months of each other. The exhumations would broaden an investigation into the mysterious cadmium poisoning of an Indiana County retiree last spring. One other body has already been exhumed in connection with that case, but results of the autopsy are not yet in.

County Coroner Thomas Streams said he was uncertain when or in what order the additional exhumation requests would come if his office decides to go ahead. His office reported yesterday it was considering whether to seek court permission to exhume:

George Holodnik, a mentally retarded 19-year-old, found dead in bed at his family's home in Lewisville, a crossroads hamlet 14 miles northeast of Saltsburg. Streams said last month that the December 1995 death initially was ruled the result of a seizure disorder.

Holodnik's father, 67-year-old Marine veteran Andrew Holodnik, who divided time between farming and construction. He died at home on April 8, 1997 of what Streams says was thought then to be a heart attack.

Ida Irene Kiner -- George Holodnik's grandmother and Andrew Holodnik's mother-in-law -- a widowed, retired social worker who lived with the family before going into the county nursing home shortly before her death on Nov. 10, 1995. There, at the nursing home, Kiner died at age 89 of what the death certificate showed as heart failure, malnutrition, and an abdominal mass.

Streams has labeled the matter a criminal investigation. But he, Deputy Coroner Michael Baker and District Attorney Robert Bell have said they have no clear suspects in the cases and won't say what could tie the deaths together. The investigation has not yielded enough information, Bell said last month, to provide probable cause to seek any search warrants.

In March 2002, Homer City-area retiree Russell Repine, 61, a seemingly healthy man, was found dead of what was thought to be a heart attack. His body was exhumed in June and toxicology tests showed that his body contained lethal levels of cadmium, a chemical commonly used in metal coatings and rechargeable batteries. The amount of cadmium was "much too much" to have come from gradual exposure, Baker said this week.

The second body exhumed was that of Anna Nagg, 58, a chronically ill Saltsburg woman. But when she died in November 2001, it followed what Streams termed "a sudden and unexpected illness." She died at at Latrobe Area Hospital where she was rushed from the tiny two-story home she shared with her husband and grown, mentally retarded son. Last month, a Northampton County pathologist performed an autopsy on Nagg's remains, but results of tests for poisons have not yet been returned, the coroner's office said yesterday.

"We may find nothing," Baker said after last month's autopsy. But given tips and other information that investigators won't discuss, "that doesn't mean that the investigation is over," he said. Exhumation would require a petition to the county court. "It's our practice to ask permission of family," Baker said this week. Save for George Holodnik's mentally retarded younger brother, now living in sheltered care, the last remaining family member is 59-year-old Indiana, Pa., resident Elaine Holodnik -- George Holodnik's mother, Andrew Holodnik's widow and Ida Kiner's only child. "I'd give permission," Elaine Holodnik said yesterday. "My goodness, why wouldn't I? They can look at anything they want to. I hope this is solved soon." To date, no investigators have approached to ask particulars about the deaths or about the possibility of exhumations, she said.

Holodnik said Repine and Nagg -- two people who lived 22 miles apart and didn't know each other-- were both "very good friends" of hers. Repine's daughter-in-law described Repine as an adviser who tried to help Holodnik straighten tangled personal finances. Holodnik described herself as a companion to Nagg, their friendship renewed during a chance meeting in church four years ago, after they had met years earlier while taking their sons to the same school. "She ... took 13 medications. She had diabetes in the worst way," Holodnik said last month. "We talked on the phone a day or two before she died. ... She told me she didn't feel that good that night, and I said, 'Anna, take care of yourself.' "
In an interview last month, Holodnik told of her husband collapsing at home and how, a year and a half earlier, "Momma got sick." But yesterday, Holodnik's most vivid recollection of the deaths in her own family was her recollection of finding son George not breathing as he lay alone in his father's bed. The discovery, on a Sunday morning, sent a friend hurrying to fetch a doctor who was worshipping at Lewisville's stately old Presbyterian Church, a few lots away. "My husband came in. I stood up to go to him and my legs just gave out," Holodnik said. "My husband grabbed hold of me, and I started shaking like crazy ... and he said, 'The Lord took him.'"

**Police, Medical Investigators Working To Learn Why 10 Bodies Have High Cadmium Levels** - Cindi Lash, Pittsburgh Post-Gazette (published Saturday, October 18, 2003)

First, there was Russell Repine, the seemingly healthy retiree from Homer City who appeared to have died of a heart attack. Now, more than a year after laboratory tests revealed a lethal dose of cadmium in Repine's body, Indiana County authorities have discovered the toxic metal in the bodies of 10 other former county residents. Like Repine, three of those people -- two men and a woman, who lived in different communities and died in recent weeks -- had startlingly high amounts of the metal in their blood.

Yet despite a vigorous investigation, state police have not been able to find any links between those people. Yesterday, frustrated investigators conceded that the source of the metal is still a mystery and that they aren't even sure if it caused or contributed to those deaths. The lack of shared factors among the dead is now prompting investigators, who initially suspected that Repine had been poisoned, to consider that the cadmium instead may be lurking in air, water or environmental sources.

A criminal act has not been ruled out, but investigators now "are leaning more toward an environmental cause," state police Sgt. Bernard Petrovsky said. Scientists have not set a firm standard for what constitutes a lethal dose of cadmium, but the amounts found in Repine and the three others generally would be considered toxic, county Chief Deputy Coroner Michael Baker said. "There's an urgency to find out what it is," said Indiana County Coroner Thomas Streams. "Now that we have more cases, we want to know what we're dealing with and to notify people of how to protect themselves."

The investigation began after laboratory tests showed that Repine, 61, who'd died in March 2002, had excessive levels of cadmium in his blood. The metal is used to make batteries, metal coatings, paint pigments and fertilizers. Investigators later exhumed the body of another Indiana County woman, Anna Nagg, 58, of Saltsburg, after receiving tips that Nagg, who died in November 2001, might also have been poisoned. Although Nagg and Repine once knew each other and had a mutual acquaintance, tests performed on her body turned up nothing suspicious. But because investigators still didn't know how cadmium got into Repine's body, Streams ordered cadmium-detection tests to be performed on every case brought into his office, including all unnatural, unexpected or unexplained deaths. Those tests turned up 10 more people, Baker said. Most had minimal levels, but three of them had alarming high amounts. They were:

- Burnell Dwyer, 72, of Conemaugh, who died Aug. 4 of a small bowel infarction. Tests last month showed he had a blood-cadmium level of 585 ìgrams per liter. By contrast, the federal Occupational Safety and Health Administration recommends that workers who are exposed to cadmium should be monitored by a physician and possibly removed from exposure if they are found to have levels higher than 10 ìgrams per liter.

- Violet Shuster, 75, of Buffington, who died Sept. 22 of a heart attack that followed other health problems. Her blood-cadmium level was 348 ìgrams per liter.

- Walter Pardee, 46, of Plumville, who died Sept. 14. He had several medical problems but an autopsy did not pinpoint a cause of death. His blood-cadmium level was more than 1,000 ìgrams per liter.

Officials have tested water supplies, soil and possessions at the homes and workplaces of the dead, but have found no cadmium. They are awaiting test results on herbal supplements that Shuster used regularly. Investigators also are trying to determine if Pardee was sickened by a bonfire set by his family to dispose of household items, toys and carpet on the day before he died, Baker said.

To assist with the investigation, Baker said, Indiana County officials have assembled "a formidable team" of experts from the FBI, the federal Centers for Disease Control and Prevention, the Armed Forces Laboratory in Dover, Del., and consultants who include Dr. Karl Williams, a forensic pathologist at Ellwood City Hospital. They have asked coroners in neighboring counties to consider routinely testing for cadmium. They also have shared information with
authorities in Ohio and Florida, where two other women they declined to identify were found dead with cadmium in their bodies.

Baker also warned residents to avoid possible poisoning by never disposing of batteries, scrap building materials or treated lumber in a fire or furnace and by steering clear of herbal remedies that were not commercially manufactured.

PA Families To Be Screened After Late Relatives Found With High Levels of Toxic Cadmium - Associated Press Online (October 20, 2003, 9:55 a.m. CDT)

INDIANA, Pa. - The families of three people who recently died and were found to have extremely high levels of cadmium in their bodies will be tested for the toxic metal, a deputy coroner said. A total of 10 people who recently died in Indiana County tested positive in autopsies for elevated levels of cadmium, a toxic metal often used in batteries, paints, and welding supplies, officials have said. It is unclear whether the deaths are related.

Preliminary testing on water and soil samples have given authorities no reason to link them to land or water contamination, and officials have said foul play remains a possibility because cadmium can be toxic in even small doses. "The very next step is to make sure the individuals' families are all tested," Indiana County Deputy Coroner Michael Baker said.

The coroner has tested for toxic levels of the metal in all autopsies in the rural western Pennsylvania county since the March 2002 cadmium poisoning death of 61-year-old Russell Repine. The highest level of cadmium was found in Burnell Dwyer, 72, who died of a bowel ailment but had a blood-cadmium level of nearly 600 ìgrams per liter. The U.S. Occupational Safety and Health Administration sets the cutoff of work exposure to cadmium at 5 ìgrams per cubic meter of air.

Pennsylvania Investigators Stymied By Cadmium Levels In Recent Deaths - Dan Nephin, Associated Press (published October 23, 2003)

PITTSBURGH (AP) - Authorities say they have been unable to determine the source of a toxic metal found in 11 people who died in a rural Pennsylvania county. While investigators do not believe foul play is to blame, preliminary tests have not indicated any link between the cadmium levels and land or water contamination.

"It's definitely been a mystery," Indiana County Chief Deputy Coroner Michael Baker said. The investigation began after Russell Repine died in March 2002. The death was first ruled a heart attack, but an autopsy found cadmium poisoning. Repine had 352 ìgrams of cadmium per liter of blood, Baker said. The U.S. Occupational Safety and Health Administration sets the cutoff of work exposure to cadmium at 5 ìgrams per cubic meter of air.

Elevated levels of cadmium were found in 10 other people after the coroner began regularly testing for cadmium during autopsies. Those people died of causes ranging from heart failure to a drug overdose, and Baker said he could not say whether cadmium contributed to their deaths. Overall, nearly three dozen bodies have been tested.

Cadmium is often used in batteries, paint and welding supplies. Chronic exposure can cause kidney damage, bone disease and lung and prostate cancer in humans. Dr. Barry Gustin, medical director of American Medical Forensics Specialists in Berkeley, Calif., which provides witnesses in legal cases, said most acute cadmium deaths are from breathing fumes. "We've seen a few welder deaths," Gustin said, but he said he's never encountered an intentional poisoning.

Cadmium cases may not be criminal - Joyce Shannon, Tribune Review (published January 6, 2004)

Dr. Graham R. Jones, chief of toxicology for the Alberta Medical Examiners Office and immediate past president of the American Academy of Forensic Science, said his office investigated a similar case of the potentially toxic heavy metal years ago. The office was asked to test the man's body for heavy metals because he had worked in an industrial job. They found extremely high levels of cadmium, which Jones said was unusual even for the man's profession. "It seemed to be an unusual finding," Jones said. Though they were puzzled, they selected coroner's cases at random and also tested their bodies. About six out of 10 also had high levels. Ultimately, the scientists determined it was caused by "postmortem redistribution," a process in which chemicals are released into the
bloodstream when organs "leak" after death. Jones could not recall the specifics of the case, such as the date and the man's name, and did not have the paperwork readily available.

Cadmium is a heavy metal found in nature that also is used in a number of industrial and commercial manufacturing processes. It also is found in batteries and cigarettes, and trace amounts are found in food. "Everything we eat contains trace amounts of cadmium," Jones said. However, those trace amounts are not enough to be toxic.

Jones said he believes the phenomenon could be more commonplace than portrayed. He said there just aren't enough studies done for the process to be common knowledge among forensic scientists, toxicologists, medical examiners and coroners. "The information was not there (in Indiana County) that should have been there," Jones said. There haven't been that many studies, Jones said, because grants for postmortem forensic work are very rare.

The Indiana County case originated with Russell Repine, 61, of Brush Valley, who died in March 2002. Repine's family and authorities first believed he died of a heart attack, but then questions were raised by Repine's family and Indiana County Coroner Thomas Streams obtained a court order to exhume his body. Toxicology tests later revealed Repine had a massive, lethal dose of cadmium, and Streams ruled the death a "criminal act" rather than from environmental or work-related causes. But a second exhumation yielded no answers after the deceased woman, Anna Nagg, 57, of Saltsburg, was found to have natural levels of cadmium. The Indiana County Coroner's Office began testing every case that came into the office.

Officials found three others with elevated cadmium levels: Walter Pardee, 46, of Plumville, who died Sept. 14, a day after he became ill after burning old furniture, mattresses, plastic toys and carpets; Violet Shuster, 75, of Buffington, who died of a heart attack on Sept. 22; and Burnell Dwyer, 72, of Conemaugh Township, who died Aug. 4 of a bowel condition.

But then Baker and the other experts called in to investigate the case stumbled upon a 1994 Japanese study that asserted the postmortem redistribution phenomenon. Baker said yesterday that Dr. Karl Williams, the laboratories' director at Ellwood City Hospital, would begin a study to determine how common the phenomenon is. Williams wants to attack the study from two angles. First, he'll test cadmium levels in normal, healthy Indiana County residents and take samples from another random place. He also wants to test cadmium levels of those near death and those after death. He said he hopes to begin to have results in about two weeks.

Williams also doubts that there is a killer on the loose or that it is caused by an environmental factor, since none of the positive test subjects showed signs that they had been poisoned. Symptoms include a yellowing of the teeth and nausea. One of the victims also had died after an accident, Williams noted. "Some of them clearly had nothing to do with cadmium," he said. The state police, who have been involved in the case from the beginning, are now letting the coroner's office take the lead. "At this point it appears that it's leading to something that really isn't police-related," said Sgt. Bernard Petrovsky. "That could change in a heartbeat, (but) I don't expect that to happen."

Dr. Joshua Hamilton, director of the Dartmouth Toxic Metals Research Program at Dartmouth University in New Hampshire, said the redistribution theory sounds probable. He said (that) a protein "binds up" cadmium in the body, mostly in the kidneys and liver, to keep it from harming people. The protein also binds up essential metals like zinc and copper, and also can protect the body from harmful metals like silver. The protein would break down after death, releasing those metals into the rest of the body.

Two questions need to be answered, Hamilton said: what the source of the cadmium is and why it hasn't been seen by others in the past. "Certainly (the redistribution theory is) one possibility," Hamilton said. "The question is why this hasn't been seen elsewhere. "It may be that people simply haven't looked before."

Listed above in chronological order are a number of news accounts dealing with a series of deaths in Indiana County, PA. Although all of the deaths were originally attributed to natural causes, a chemical analysis done as part of an autopsy revealed high levels of cadmium in the blood of Mr. Russell Repine. Since that discovery, several other deceased individuals have been found to have elevated levels of cadmium in their body. Pennsylvania officials now have a full-fledged mystery on their hands. You will use your knowledge of Environmental Geology in an attempt to shed some light on the situation.
1. Complete the table below based on information from the new articles on the previous pages. You may not have information for all persons.

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2. Visit the OSHA (http://www.osha.gov/SLTC/cadmium/index.html) and Wisconsin Department of Health and Family (http://www.dhfs.state.wi.us/eh/ChemFS/fs/cadmium.htm) websites to get additional information about cadmium. Also the EPA Drinking Water Standards. What is the maximum acceptable level of cadmium in drinking water? __________ In air? __________

3. Based on the information you've read, does cadmium accumulate in the body over time or is it readily eliminated?

4. In the news accounts on the previous pages, there are several references to analyses performed on blood. However, for the individuals that were disinterred, no blood was available. How was the analysis for cadmium done?

5. What is the name of the youngest rock unit on the map? What is the name of the oldest rock unit on the map?

6. Although not shown on the map, there has been and continues to be mining in this area. What kind of mining do you think this is? HINT: look at the description of rock units.

7. The hometowns for all poisoning victims are shown with a red star on the map. Do these towns all sit on top of the same rock unit? If so, which one?

8. Do you think that geology is a common factor in the high concentrations of cadmium observed?

9. Are there any other sources of cadmium that the poisoning victims may have had in common?

10. What do you think of the “element redistribution by the bloodstream after death” theory?

11. What is your theory as to what happened to these folks? Crime? Environmental contamination? Something else?