

Human Health Impacts of Proposed Geoengineering Solutions

Patrick Roddie, July 2, 2015

ABSTRACT

Geoengineers propose spraying millions of tons of reflective particles into the atmosphere to reflect sunlight back into space in an attempt to reduce global warming. This is known as Solar Radiation Management ^[1] (SRM), Stratospheric Aerosol Engineering or Albedo Modification. This process, patented by defense contractor Raytheon^[2], is quite simple. Tiny particles sprayed from jets would act as condensation nuclei, attracting atmospheric water vapor to form persistent artificially nucleated contrails which would then spread out to form artificial cirrus. Since clouds act as insulators and water vapor represents 95% of the planet's greenhouse gas, it's questionable whether this program would reduce global warming.

When geoengineers discuss SRM in public, the only substances they discuss spraying are sulfates or sulfuric acid. However, their own literature concludes that sulfates have limited effectiveness and that nano particles of aluminum and barium should be used instead.

This paper studies the adverse human health effects of aluminum, barium and particulate pollution. It also documents the dramatic increase of Alzheimer's (now the sixth leading cause of death in the US) and respiratory failure (recently overtaking stroke to become the third leading cause of death^[3]) since the late 1990s when persistent contrails became commonplace around the world. I conclude that these persistent contrails are in fact artificially nucleated with the toxic particulate metals outlined in Raytheon's patent and a Solar Radiation Management program has been deployed since the late 1990s.

SOLAR RADIATION MANAGEMENT

Weather modification research is nothing new; the earliest patent dates back to 1920^[4]. Raytheon's 1991 patent^[2] proposes reducing global warming by injecting aluminum, thorium and other metallic oxides in the 10-100 micron range into the stratosphere using jet exhaust.

The US Navy patented another delivery method^[5], which forms artificially nucleated contrails from metal oxides with a 0.3 micron particle size. Other proposed delivery methods include airships, rockets, chimneys and slurry pipes^[6].

It has been estimated to cost between \$2bn and \$8bn to spray 5 million metric tons of albedo modification material into the stratosphere per year.

The best known proponent of SRM is Dr. David Keith^[7]. He told the AAAS annual meeting in 2010^[8] that aluminum oxide has four times the volumetric radiative forcing for small particles as does sulfur and 16 times less the coagulation rate. Sulfur particles stick together and quickly fall out of the stratosphere and are much less effective per unit mass. He also said a nano fabrication study proved it was very simple to spray high quality alumina particles from a plane by injecting alumina vapor into the exhaust.

His 2010 paper, "Photophoretic levitation of engineered aerosols for geoengineering^[9]," proposes spraying 50nm thick discs of aluminum, barium, titanium and ferrite instead of sulfates.

ALUMINUM

The Material Safety Data Sheet (MSDS) for nano particulate aluminum oxide^[10] says it's an irritant to the respiratory system, is implicated in Alzheimer's disease, can cause pulmonary disease, tumors and neoplasms and should also not be released into the environment without proper governmental permits.

Krewski *et al*^[11] found aluminum accumulates in the brain, kidneys and bone. Workers in the aluminum industry are prone to adverse respiratory effects, including potroom asthma and pulmonary fibrosis. Occupational exposure to aluminum is significantly correlated with a variety of neuropsychiatric symptoms including; loss of coordination, loss of memory, and problems with balance. Changes typical of foreign body reaction, alveolar proteinosis and wall thickening, diffuse pulmonary fibrosis and interstitial emphysema were also found. Lower aluminum exposures contribute to Shaver's disease, a pulmonary fibrosis seen in workers in bauxite refining or exposed to finely divided aluminum powders; and caused pneumoconiosis, fibrosis, and some cases of asthma. Animal studies show that high levels of aluminum in the central nervous system can lead to neurotoxicity. Aluminum could potentiate the aggregation of

molecules known to form pathologic lesions in Alzheimer's disease. There is evidence that aluminum can promote the aggregation of β -amyloid peptide *in vitro*. It is well *established* in the rabbit that exposure to aluminum induces the formation of filamentous structures containing cytoplasmic neurofilament protein.

Most studies have shown a correlation between aluminum in drinking water and Alzheimer's disease and aluminum is seven times more bioavailable when inhaled than when ingested orally. Aluminum also adversely affects people with impaired renal function, leading to anemia and bone disease.

Suarez, Fernandez *et al*^[12] observed that chronic aluminum exposure in mixed cultures of astrocytes and neurons resulted in significant apoptosis and associated neuronal loss.

In vivo and *in vitro* studies^[13] provide indisputable evidence that aluminum can increase the levels of both pro-inflammatory cytokines and glutamate in the brain.

Bondy^[14] finds extended exposure to low levels of aluminum accelerates brain aging. Aluminum salts can increase levels of glial activation, inflammatory cytokines and amyloid precursor protein within the brain. Both normal brain aging and to a greater extent, Alzheimer's disease are associated with elevated basal levels of markers for inflammation.

Campbell^[15] et al found aluminum increases oxidative stress and inflammation in the brain, processes suggested to play a role in Alzheimer's disease. It exacerbates underlying events associated with brain aging and thus could contribute to progression of neurodegeneration.

Tomljenovic^[16] writes that 100 years of research has repeatedly demonstrated that chronic aluminum intoxication reproduces neuropathological hallmarks of Alzheimer's and the hypothesis that aluminum significantly contributes to Alzheimer's is built upon very solid experimental evidence and should not be dismissed.

Perl^[17] writes that it has been recognized in Alzheimer's disease that there is a dramatic tendency for the development of neurofibrillary tangles among neurons of cortical regions associated with the olfactory system and these contain dramatically elevated levels of aluminum. The olfactory system is particularly vulnerable to damage and is affected very early in the disease. This supports the concept that etiologic agents of importance to this epidemic may be airborne in nature and may enter the central nervous system via the olfactory pathways.

Shaw^[18] found aluminum-treated mice showed significantly increased apoptosis of motor neurons and increases in reactive astrocytes and microglial proliferation within the spinal cord and cortex. Morin stain detected aluminum in the cytoplasm of motor neurons with some neurons testing positive for hyperphosphorylated tau protein, a pathological hallmark of various neurological diseases, including Alzheimer's disease and frontotemporal dementia. Behavioral analyses revealed significant impairments in a number of motor functions as well as diminished spatial memory capacity.

Bradich *et al*^[19] demonstrated that inhaled aluminum nano particles impaired phagocytic function, repressed cytokine secretion and impaired the lung's natural ability to respond to respiratory pathogens.

BARIUM

According to the MSDS ^[20], exposure to barium salts can cause pulmonary arrest, vomiting, diarrhea, convulsive tremors, muscular paralysis, shock, convulsions and sudden cardiac failure. Barium targets the cardiovascular, nervous, gastrointestinal, hematology, respiratory, reproductive and renal systems as well as the adrenal glands and liver. It is also an irritant to the skin and eyes and should not be released into the environment.

"The threshold of a toxic dose in humans is reported to be about 0.2 to 0.5g of barium absorbed from the gut; the lethal dose is 3 to 4g."^[21]

"Barium is toxic to tissue, causing first stimulation then paralysis. The symptoms usually begin with the gastrointestinal muscles, and acute barium poisoning manifests itself rapidly after ingestion of a toxic dose, with nausea, vomiting, colic, and diarrhea. Skeletomuscular and cardiac symptoms follow with myocardial and general muscular stimulation and tingling of the extremities. Severe cases of poisoning progress to loss of tendon reflexes, heart fibrillation, and general muscular paralysis, including the respiratory muscles, leading to death."^[22]

"For most of acid soluble salts of barium the lethal dose for adults appears to lie between 1 & 15g. Death occurs within few hours or few days. ... Barium ion stimulates smooth, striated & cardiac muscle; result is violent peristalsis, arterial hypertension, muscle twitching & disturbances in cardiac action. Motor

disorders incl stiffness & immobility of limbs & sometimes of the trunk, leg cramps, twitching of facial muscles, & paralysis of tongue & pharynx with attendant loss or impairment of speech & deglutition. CNS may be first stimulated & then depressed. Ventricular tachyarrhythmias (incl ventricular fibrillation) & transient asystole have been observed. Kidney damage has been described as a late complication, probably as result of circulatory insufficiency.”^[23]

“When ingested or given orally, the soluble, ionized barium compounds exert a profound effect on all muscles and especially smooth muscles, markedly increasing their contractility. The heart rate is slowed and may stop in systole. Other effects are increased intestinal peristalsis, vascular constriction, bladder contraction, and increased voluntary muscle tension. The inhalation of the dust of barium sulfate may lead to deposition in the lungs in sufficient quantities to produce “baritosis” (benign pneumoconiosis).”^[24]

“Barium poisoning can cause “profound hypokalemia, tremors, seizures, vertigo, severe muscle weakness, mydriasis, hypertension, chest pain, bradycardia, ventricular dysrhythmias, respiratory failure, shock, and cardiac arrest.”^[25]

PARTICULATE POLLUTION

According to the United States Environmental Protection Agency^[26], particulate pollution can cause early death from heart attack, stroke, congestive heart failure and COPD. It also causes asthma and inflammation of lung tissue and may cause cancer, reproductive and developmental harm. Particulate pollution can lower life expectancy by one to three years.

MORTALITY

Deaths from respiratory failure and Alzheimer’s disease have dramatically risen since the SRM program was deployed worldwide in the late 1990s, when artificially-nucleated persistent contrails became an increasingly common sight, regardless of altitude or humidity. These trails persist for hours, spreading out into artificial cirrus. In 2011, respiratory failure overtook stroke to become the third leading cause of death^[27] in the United States, at a time when smoking was at an all-time low, emissions standards on vehicles and power plants were at their strictest and heavy industry had relocated to China.

Alzheimer’s disease rose to the 6th leading cause of death^[28] in the US from the 8th between 1999 and 2013. In 1994, it didn’t even make the top ten. Now people in their 20s are showing signs of Alzheimer’s.^[29]

EVIDENCE OF SOLAR RADIATION MANAGEMENT

Persistent contrails are formed when atmospheric water vapor condenses to condensation nuclei in aerosol or particle form. Water vapor can not condense to itself in the absence of condensation nuclei. The combustion products of hydrocarbons such as jet fuel are water vapor and CO₂, neither of which can act as condensation nuclei. Persistent contrails used to be rare, but since the late 1990s, they’ve become an almost daily phenomenon all over the world. It is extremely common to see planes leaving long trails which persist for hours, spread out and change the sky from deep blue to milky white. The appearance of these trails happens regardless of altitude, temperature, humidity or other atmospheric conditions.

Here in San Francisco, I have recorded hundreds of time-lapse videos^[30] showing the progression of these persistent contrails since 2011.

Water and ice have refractive indices of 1.333 and 1.309^[31] respectively and produce rainbows with angular radius 42°, ^[32] centered on the antisolar point.

But in recent years a formerly rare phenomenon has become commonplace, a 21° halo completely encircling the sun. Some argue that these halos or “incredibly rare sun dogs” are formed by ice crystals, but nothing can change the refractive index of ice – which forms 42° halos. Metal salts have a higher refractive index and therefore form much tighter halos. Crystalline aluminum oxide (Al₂O₃, sapphire), for example, has a refractive index of 1.762–1.778^[31] while barium sulfate has a refractive index of 1.636^[33].

My contention that these halos or “incredibly rare sun dogs” are formed by metal salts with a higher refractive index than water is reinforced by rainwater analysis taken during a 30 day period when I recorded 21 of these halos ^[34] in March-April 2015. I collected rainwater in clean glass bowls on the roof of my San Francisco apartment building on April 5th, 2015, six thousand miles downwind from the nearest

factory, power plant, refinery, freeway, quarry or mine. I sent it to a NELAP certified lab and they recorded barium at a staggering 160µg/L^[35].

An earlier test of rainwater collected in January 2014 recorded aluminum at 190µg/L and barium at 15µg/L^[36].

Unfortunately, historical data is hard to find, since the EPA stopped publishing data on airborne aluminum in 2002 – as the SRM program ramped up into high gear.

FUTURE RESEARCH

Epidemiological studies need to be conducted to see if hospital admissions for breathing problems, respiratory failure, heart attack and stroke correlate with days where pronounced 21° halos are visible.

Freedom of Information Act requests should be made to the EPA, NOAA, FAA and NASA to publish historical data on atmospheric levels of aluminum, barium, strontium, titanium and thorium.

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