

Fifty Years after “How to Wreck the Environment”: Anthropogenic Extinction of Life on Earth

ABSTRACT

Aims: Fifty years ago geoscientist Gordon J. F. MacDonald penned a book-chapter entitled, “How to Wreck the Environment”, in which he described how a nation might alter the environment so as to covertly inflict harm on an enemy nation. Our objective is to review MacDonald’s suggestions of environmental warfare strategies in light of subsequent technological advances, and in the context of actual deployment of the war methods he described.

Methods: We review the interdisciplinary scientific and medical literature.

Results: MacDonald discussed overt and covert weather warfare based upon seeding clouds to cause rainfall. Subsequently, a method was developed for inhibiting rainfall by jet-emplacing pollution particulates where clouds form. For at least two decades citizens have observed such particulate trails occurring with increasing frequency. Forensic scientific investigations implicate toxic coal fly ash as their main constituent. Around 2010, the aerial particulate spraying ramped-up to a near-daily, near-global level. Presumably, a secret international agreement mandated the aerial spraying as a ‘sunshade’ for Earth. However, aerial spraying, rather than cooling, heats the atmosphere, retards Earth’s heat loss, and causes global warming. MacDonald also discussed destroying atmospheric ozone and triggering earthquakes and volcanic eruptions, activities now possible with high-frequency ionospheric heaters.

Conclusions: The U. S. military’s ongoing decision to weaponize the environment for national security purposes was accurately forecasted by MacDonald. But he failed to realize that national militaries could and would be co-opted by a secret international agreement the consequence of which, however unintentional, was to wage war on planet Earth, on all its biota, and on its natural, biogeochemical processes. Unless and until politicians, news media, scientists, and others in our society face the truth of what is happening before their very eyes and collectively demand a halt to these covert technological activities, we will march onward – to the first anthropogenic-caused mass extinction.

Keywords: trigger earthquakes, climate modification, ozone depletion, ionospheric heater, Gordon J. F. MacDonald, coal fly ash, geoengineering

1. INTRODUCTION

The politically powerful geoscientist Gordon J. F. MacDonald (1929-2002) wrote an influential essay titled, “How to Wreck the Environment,” that was published in 1968 in a book called *Unless Peace Comes* [1]. At a time when the military’s focus centered on nuclear warfare, MacDonald prophetically suggested: “Among future means of obtaining national objectives by force, one possibility hinges on man’s ability to control and manipulate the environment of his planet.” MacDonald, a top presidential science advisor and participant in national science-policy discussions, was well qualified to address the subject of future environmental warfare possibilities.

Much of what MacDonald predicted or speculated about has come to pass, not with the technology he described, but with potentially far more effective and devastating technology developed during the succeeding fifty years.

As MacDonald noted in 1968: “The key to geophysical warfare is the identification of the environmental instabilities to which the addition of a small amount of energy would release vastly greater amounts of energy.” MacDonald discussed purposefully triggering instabilities in such large-

29 scale natural systems as the weather, the climate, the oceans, and the human brain, including such
30 phenomena as hurricanes, earthquakes, and tsunamis for use in warfare. He was aware, considering
31 the limitations of geophysical understanding, that one should also anticipate unforeseen adverse
32 consequences that could arise from deliberately disturbing complex natural systems that have
33 unknown 'tipping points'.

34 During the fifty years since MacDonald's landmark publication [1], the technology necessary for the
35 weaponization of the environment has undergone major advances, well-known to those who have
36 funded the research. In tandem, the scientific understanding of Earth's behavior has likewise
37 undergone major advances over the last half-century.

38 However, major new concepts in geophysics – such as those being developed by the military
39 industrial complex – have been typically ignored in the geoscience community for decades. It is not
40 surprising, therefore, that deployment of radical environmental warfare technologies that alter
41 fundamental natural processes of our planet is proceeding, without scientific warning or a full
42 understanding of the underlying geodynamics and dangers such technologies pose to human and
43 other life. For example, to be habitable, Earth must maintain a delicate energy balance by radiating
44 into space essentially all of the energy it receives from the sun and from its own intrinsic geophysical
45 and anthropogenic energy sources. Since the late 1990s, there has been a well-organized effort,
46 orchestrated by the United Nations' Intergovernmental Panel on Climate Change (IPCC) and others,
47 to promote the idea that anthropogenic greenhouse gases, preeminently carbon dioxide, are
48 adversely affecting Earth's heat loss, causing global warming [2]. To compensate, the IPCC
49 repeatedly promotes the idea of engaging in future geoengineering, i.e., placing substances into the
50 atmosphere to block a portion of sunlight [3]. However, the IPCC has failed to acknowledge the
51 possibility of military geoengineering being conducted with ever increasing scope and range for
52 decades and that its primary consequence is not to cool Earth, but to cause global warming and
53 climate chaos.

54 Here, we review some of the ideas expressed by MacDonald in "How to Wreck the Environment" [1] in
55 the light of subsequent technological developments. We also review evidence that environmentally
56 destabilizing military technologies are being deployed on a global scale. Where applicable, we
57 discuss potential risks to our planet, and its biota, that likely are underappreciated by those
58 responsible.

59 2. METHOD

60 We reviewed interdisciplinary scientific and medical literature.

61 3. RESULTS AND DISCUSSION

62 The long-held dream of military planners to control the weather began to become reality with the
63 discovery in 1946 that clouds, when seeded with silver iodide or dry ice (solid carbon dioxide), under
64 appropriate circumstances, could result in rain or snow [4]. MacDonald [1] discussed that form of
65 cloud seeding and its military potential both for causing rainfall to impede enemy ground operations
66 and for covertly causing long-term drought, by forcing clouds to release their moisture before they
67 reached the targeted nation. These have been matters of serious concern to the U. S. military then
68 and now [5].

69 Weather became a weapon of war during the Vietnam War when cloud seeding operations were
70 conducted to extend the monsoon season over the Ho Chi Minh Trail to impede movement of
71 supplies and troops (Operation Popeye) [5]. The U. S. military seeded clouds approaching Cuba in an
72 attempt to cause drought to spoil the sugarcane harvest [6].

73 Seeding clouds to cause rain, as described by MacDonald [1], was only the first step in weather
74 manipulation. Subsequent research produced the technology to impede the fall of rain. For clouds to
75 yield rain, tiny droplets need to nucleate and then coalesce to form drops sufficiently massive to fall to
76 Earth. The technology for impeding rainfall is known from pollution investigations. A sufficiently large
77 number of pollution particles, dispersed into the region where clouds form, poses impediments to the
78 tiny droplets, blocking and keeping them from coalescing to become massive enough to fall as rain.
79 Eventually, the moisture burden becomes unbearable and clouds release their moisture in deluges.

80 In the late 1990s, alert citizens became concerned about the aerial particulate trails that extended
81 from horizon to horizon in the skies above them. With the passage of time, these aerial trails became
82 more frequent, while at the same time, the public was being misled that these were harmless
83 contrails, ice crystals formed from exhaust vapor [7]. By about 2010 the aerial spraying ramped up to
84 a near-daily activity over much of the globe [8]. (Figure 1)



85
86 **Figure 1.** Climate manipulation particulate trails. (Photographers with permission) Clockwise from
87 upper left: Paris, France (Patrick Roddie); Karnak, Eqtypt (author JMH); London, England (author IB);
88 Northern California, USA (Patrick Roddie); Geneva, Switzerland (Beatrice Wright); Yosemite,
89 California USA (Patrick Roddie); Jaipur, India (author JMH).

90

91 Weather modification is a phenomenon limited in duration and geographical extent, whereas climate
92 modification is necessarily global. The current, near-daily, near-global aerial spraying seems to

93 represent an attempt at climate modification, which MacDonald also discussed [1], and likely involves
94 weather modification activity as well. As MacDonald noted: "...climate is primarily determined by the
95 balance between the incoming short-wave radiation from the sun (principally light) and the loss of
96 outgoing long-wave radiation (principally heat)." He goes on to list the three factors that dominate this
97 balance: 1) sun's energy; 2) Earth's atmospheric transparency to different forms of radiated energy,
98 and; 3) Earth's surface characteristics. Alteration of any of the three can modify climate.

99 Altering the sun's energy output is not technologically feasible even today, but there are various ways
100 of effecting radiant energy transport through Earth's atmosphere. Among the possibilities mentioned
101 by MacDonald [1], albeit without specificity, is the idea of placing material into the upper atmosphere
102 that would "absorb either incoming light (thereby cooling the surface) or outgoing heat (thereby
103 warming the surface)." In speculating about such a possibility, MacDonald noted: "At present we know
104 too little about the paradoxical effects of warming and cooling, however, to tell what the outcomes
105 might be." That statement is as true today as when published 50 years ago.

106 The explanation of the behavior of material placed into the upper atmosphere, as stated by
107 MacDonald, is simplistic and incorrect. So too, is the oft-repeated proposition by members of the
108 geoscience community who now discuss the possibility of placing material in the upper atmosphere to
109 reflect a portion of sunlight back into space, 'sunshades for the Earth'. As we discuss below, particles
110 placed in the atmosphere exhibit behavior in response to incident radiation that is considerably more
111 complex than described by MacDonald, as are their physical and chemical reactions in the
112 atmosphere and at the Earth's surface.

113 As noted above, the U. S. military has been engaged for decades in aerial spraying of particulates
114 into the regions where clouds form to modify weather and for other reasons, such as the
115 enhancement of communication systems associated with electromagnetic radiation programs.

116 Aerial spraying appears to have become an international operation sometime around 2010, and is
117 presumably based on a secret international agreement, as observed climate modification activity must
118 involve, *ipso facto*, the collaboration of multiple states. As Figures 1 and 2 illustrate, diverse
119 independent countries are involved. MacDonald advised that *the key lesson* of the Vietnam war's
120 highly secret weather modification program, Project Popeye, was not its failure to alter the war's
121 outcome, but that "one can conduct covert operations using a new technology in a democracy without
122 the knowledge of the people" [1].

123 In the case of a possible secret international agreement to modify the climate, the presumption would
124 be it was made to benefit humanity. However, as we show, its implementation is exacerbating the
125 problem of global warming and causing climate chaos, and adversely affecting the health of
126 organisms, including humans. At face value it would seem that the actual geophysical and biological
127 consequences of such covert military operations would be inconsistent with an international program
128 for the benefit of humankind, *unless* that secret international agreement/understanding was based on
129 misrepresentations. If so, a strange dichotomy marks the subject of weather and climate modification,
130 characterized by a blatant contradiction between ends and means, intent and consequences.

131 Science should be based upon truth, but improper administration and funding of science has
132 corrupted science's integrity [9]. Since 1989, the United Nations' Intergovernmental Panel on Climate
133 Change (IPCC) has remained silent about the military aerial particulate spraying, and failed to take
134 into account its geophysical consequences in its climate models [10]. At present, aerial particulate
135 emplacement can only legally take place under the aegis of military entities, but there is a global effort
136 to encourage governance that permits non-military entities such as universities and for-profit
137 companies to also engage in climate intervention [11].

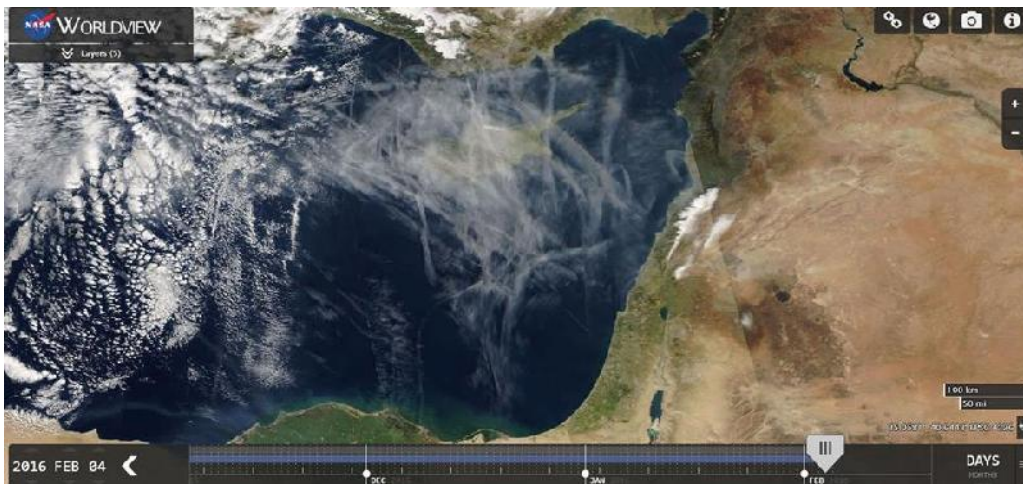
138 What reason was given to national governments to get them to agree to become willing parties to
139 near-daily, near-global, aerial particulate spraying into the atmosphere? Few government leaders,
140 politicians, and bureaucrats are trained in science. Have they been told that the aerial emplacements
141 of particulates will act like a sunshade to cool Earth to compensate for alleged anthropogenic
142 greenhouse-gas global warming?

143 If so, they have been conned into the greatest "science-based" scam ever perpetrated [12]: Cause
144 global warming and climate chaos by daily aerial spraying and then blame the warming result on

145 anthropogenic greenhouse gases to **undermine** the authority of nation states, and erect new world
146 governance structures to regulate anthropogenic, transnational greenhouse gas emissions.

147 **3.1 The Real Consequences of Aerial Particulate Spraying**

148 **One of the original military purposes** of aerial particulate dispersal into the regions where clouds form
149 was to impede precipitation and to cause drought in an unfriendly country. Indeed, **former** Iranian
150 President Mahmoud Ahmadinejad accused Western countries of doing just that [13]. Figure 2 shows
151 particulate trails blanketing the Republic of Cyprus, whose citizens sought, so far **unsuccessfully**, an
152 explanation from their government for the deliberate **obscuring** of their skies [14]. There is no
153 information available to the public about the extent of weather warfare. Interestingly, covert
154 environmental warfare was predicted by MacDonald [1]: "...removing moisture from the atmosphere
155 so that a nation dependent on water...could be subjected to years of drought. The operation could be
156 concealed by the statistical irregularity of the atmosphere. A nation possessing superior technology in
157 environmental manipulation could damage an adversary without revealing its intent." Not only the
158 adversary, but the aggressor nation's own citizens would be **unaware**. As noted, MacDonald observed
159 that, "one can conduct covert operations using a new technology in a democracy without the
160 knowledge of the people."



161

162

163 Figure 2. NASA Worldview satellite image from February 4, 2016 showing jet-laid **particulate** trails
164 blanketing the air above the Republic of Cyprus but nearly absent in surrounding regions. The Cyprus
165 Environment Services Department, part of the Cyprus government, promised to investigate the aerial
166 spraying following the February 2016 presentations made to the Parliamentary Environmental
167 Committee, but **to date there is no sign of an investigation.**

168

169 Presumably the use of readily available, inexpensive particulate matter was considered a practical
170 necessity **and was implemented** without regard for its possible adverse health effects. We know this
171 was done in Vietnam [4]. The undisclosed international agreement for near-daily, near-global aerial
172 spraying and its concomitant funding has allowed military entities to indiscriminately expose millions of
173 uninformed citizens to the dispersed particulate matter day after day, year after year, *inside their own*
174 *sovereign countries*. Moreover, the aerial spraying has been accompanied by a concerted
175 disinformation campaign to **mislead** the public, as well as the scientific community, about its adverse
176 health consequences [7,15-17]. In the following subsections, we review various consequences of
177 aerial spraying.

178 **3.1.1 Aerosolized Particulate Composition**

179 The composition(s) of the military aerial particulate sprayed into the atmosphere has long been a
180 closely held secret. At the beginning of the 21st century, concerned citizens took samples of post-
181 spraying rainwater and had them analyzed at commercial laboratories. Usually only aluminum
182 analysis was requested; occasionally both aluminum and barium; rarely aluminum, barium, and
183 strontium. The presence of those elements in rainwater indicated to one of us (JMH) that the
184 particulate matter sprayed into the atmosphere was capable of being rapidly leached by atmospheric
185 water, elements partially extracted from the particulates into the water (like tea is made from tea
186 leaves), just as the toxic waste product of industrial coal-burning, coal fly ash (CFA) is readily leached
187 by water.

188 By comparing laboratory CFA leachate [18,19] with samples of post-spraying rainwater [8,20,21], we
189 demonstrated that the aerosolized particulates are consistent with coal fly ash. We further showed
190 that element-ratios measured in post-spraying air-suspended dust collected outdoors and in matter
191 brought down by snow are consistent with similar ratios measured in CFA [18,19].

192 Coal fly ash forms in the hot gases above the coal-combustor. Typically CFA forms as spheres, 0.01 –
193 50 µm in diameter [22]. Readily available throughout the world at low cost, the fine grain-size of this
194 major industrial waste product means that little further processing is necessary before it is deployed in
195 aerosolized form in the atmosphere.

196 A large proportion the toxic heavy metal and radioactive elements originally present in coal end up
197 concentrated in CFA [23]. Because of its toxicity, regulations in Western nations require CFA to be
198 collected, usually trapped by electrostatic precipitators, rather than allowed to exit smokestacks. The
199 circumstances of CFA formation are unlike circumstances found in the natural environment (except
200 when coal deposits catch fire), condensing and accumulating in the hot gases above the combustor,
201 where burning takes place. Because the chemical reactions during formation of CFA are different from
202 reactions usually found in nature, many of the elements present in CFA are capable of being partially
203 extracted by exposure to moisture [18].

204 For the military this is advantageous, since CFA aerial spray makes atmospheric water more
205 electrically conductive, because of the many dissolved elements, and thus more responsive to
206 electromagnetic radiation. But for the humans, plants, and animals exposed to these toxins, the
207 consequences are, in the long run, devastating.

208 **3.1.2 Public and Environmental Health Concerns**

209 Epidemiological investigations of particulate aerosol pollution in the same particle size range as CFA
210 provide some guidance as to the adverse health effects of the particulate matter sprayed into the
211 troposphere and lower stratosphere. Pollution particles in the size range (PM_{2.5}) [24] are associated
212 with morbidity and premature mortality [25-27], Alzheimer's disease [28,29], risk for cardiovascular
213 disease [30], risk for stroke [31], lung cancer [32], lung inflammation and diabetes [33], decreased
214 male fertility [34], reduced renal function in older males [35], onset of asthma [36], increased hospital
215 admissions [37], and low birth weight [38].

216 The adverse health consequences of aerosolized CFA are even more dire. Ambient air pollution
217 contributes to the growing global burden of respiratory disease and lung cancer [39,40]. Inhaled,
218 aerosolized CFA, with its complement of carcinogens, such as arsenic, chromium VI, and
219 radionuclides, settles deep in terminal airways and alveoli where it remains and can pose risks for
220 lung cancer [41].

221 Spherical exogenous magnetite (Fe₃O₄) nanoparticles, recently discovered in brain tissue of persons
222 with dementia [42], suggests an origin in the kind of air pollution produced by CFA, which is
223 characterized by spherical particles. Iron oxides and aluminosilicates, primary components of CFA,
224 are all found in the abnormal proteins that characterize Alzheimer's dementia, which leads to oxidative
225 stress and chronic inflammation of brain tissue [43].

226 Coal fly ash, when exposed to moisture or body fluids, releases numerous toxins, including aluminum
227 in a chemically mobile form, which is an environmentally and biologically unnatural state [18].
228 Chemically mobile aluminum is deadly to plants and trees as well as to amphibians [44]. Aluminum is
229 associated with neurological disorders [8], and has been found in high levels in bees [45].

230 **3.1.3 Thermal Consequences of Aerial Particulate Spraying**

231 In addition to inhibiting rainfall by interfering with moisture droplet coalescence, particles sprayed into
232 the troposphere and lower stratosphere reflect a portion of sunlight back into space. But a portion of
233 the incident sunlight is absorbed by the particles as heat. That heat can be transferred to the
234 atmosphere by molecular collisions or can be re-radiated in any direction, and not returned to space.
235 The aerosolized particulates also act to restrain infrared radiation loss from Earth's surface and thus
236 become a source of atmospheric heating – global warming [46].

237 Iron oxides, a significant component of CFA, absorb strongly in the ultraviolet range but reflect in the
238 infrared range [47]. Most of the airborne iron oxide particles observed in the continental outflows of
239 anthropogenic origin in China consist of magnetite nanoparticles or iron-bearing particles in CFA [48].
240 Strongly light-absorbing aerosols, such as CFA, directly heat the atmosphere and indirectly reduce
241 snow albedo by their warming effect [49]. As the aerosolized particulates fall to Earth, especially in far
242 northern and far southern regions, they change the albedo of the ice/snow, which allows more solar
243 energy to be absorbed by Earth [50]. This behavior, especially when considered in the context of
244 near-daily, near-global aerosol spraying clearly may contribute to global warming. Consequently, the
245 thermal state of Earth is biased toward warming, the exact opposite of official claims for
246 geoengineering.

247 There are other consequences of atmospheric CFA particulate matter in the troposphere and lower
248 stratosphere that further lead toward warming. For example, CFA particles can cause super-cooled
249 droplets of moisture high in the atmosphere to form ice crystals, which form cirrus clouds whose effect
250 is to retard Earth's infrared heat loss [51,52]. Current levels of CFA emissions are estimated to
251 contribute 0.1-06W/m² of extra warming through their role in cirrus cloud formation [53]. This estimate,
252 however, does not take into account the massive quantities of CFA used in aerial particulate spraying.

253 With all of the concern expressed in the press and elsewhere about global warming, it seems
254 inconceivable to us that political leaders would knowingly sign a secret international agreement that
255 promotes global warming. The presumptive alternative is that political leaders were deceived into
256 believing that they were agreeing to an activity that would cool the Earth, when in fact the net effect of
257 the activities warm the Earth and will destroy life if permitted to persist.

258 **3.1.4 Ozone Destruction**

259 In 1968 MacDonald [1] warned: "More sudden, perhaps much briefer but nevertheless disastrous,
260 effects are predictable if chemical and physical means were developed for attacking one of the natural
261 constituents of the atmosphere – ozone." In the intervening years, such means have been developed
262 and deployed. The chemical means are principally manifest in the form of aerosolized CFA; the
263 physical means, by radiofrequency ionospheric heaters.

264 Many assume that the protective ozone layer in the stratosphere is slowly recovering primarily due to
265 the international ban on chlorofluorocarbons (CFC's) by the Montreal Protocol [54], and that the
266 Antarctic ozone hole is slowly healing [55]. However, it is coming to light that these assumptions may
267 be wrong. There is new evidence for the continuous loss of ozone in the lower stratosphere [56]. It is
268 thought that a reduction in ozone in the tropical stratosphere, where most of the ozone is formed,
269 leads to transport of this ozone-rich air to the mid-latitudes via the Brewer-Dobson circulation [56].

270 Ozone column losses at high latitude are in the range of 6% [57]. Previously, depletion of lower
271 stratospheric ozone has been attributed to rapidly increasing anthropogenic (and some natural) short-
272 lived substances that contain chlorine or bromine [56]. However, the aerosolized CFA used for climate
273 modification, now conducted on a near-daily, near-global basis, places massive quantities of chlorine,
274 bromine, fluorine, and iodine into the atmosphere (Table 1), including highly reactive nano-
275 particulates. These are potential destroyers of ozone [58].

276 **Table 1.** Range of halogen element compositions of CFA [59].

Chlorine (µg/g)	Bromine (µg/g)	Fluorine (µg/g)	Iodine (µg/g)
13 – 25,000	0.3 – 670	0.4 – 624	0.1 – 200

277

278 There is a disquieting parallel for this ecosystem degradation: Despite strengthened mercury emission
279 regulations, mercury measured in rainwater is increasing [60]. As the upper troposphere has now
280 been found to contain oxidized, particle-bound mercury [61], it is not unlikely that covert aerosolized
281 CFA, which contains up to 2 µg/g mercury, is a major source of mercury pollution when sprayed into
282 the atmosphere [21].

283 In addition to the chemical destruction of stratospheric ozone, there are indications that high-
284 frequency ionospheric heaters, now dispersed globally [62,63], may adversely affect stratospheric
285 ozone. Russian scientists have discovered a new physical phenomenon of the decrease of the
286 intensity of microwave emission from the mesosphere in the ozone line upon the modification of the
287 ionosphere with high-power high-frequency (HF) radio waves [64,65]. The Sura facility for generation
288 of high power radio waves is located near the village of Vasil'sursk in Russia. It has 190MW effective
289 radiated power transmitter and operated in the 30 min on/30 min off mode. Thermal radiation of the
290 atmosphere in the ozone spectral line, at a frequency of 110836.04 MHz, decreased in intensity
291 during the heating-on portion of the cycle by an average of 10±2% over all sessions of measurements
292 in March, 2009, as shown in Table 2.

293 **Table 2.** Comparison of O₃ number density x10⁹ reduction during the thirty minute heating facility
294 emitted high-power X-polarization radio waves at 4.3 MHz. Data from [64].

DATE>>>	3/ 14/ 2009	3/ 15/ 2009	3/ 16/ 2009	3/ 17/ 2009
Night		12.1±0.7	13.6±0.7	13.6±0.5
Day	9.37±0.48	9.60±0.50	9.55±0.40	9.82±0.35
HF Pumping	8.03±0.38	8.31±0.29	7.32±0.47	8.97±0.49
Day	9.09±0.42	9.23±0.21	9.01±0.24	9.67±0.30
Night	12.8±0.6	14.4±0.7	11.9±0.6	12.2±0.5

295

296 **3.1.5 Turning the Environment against Humanity**

297 The Russian discovery may be a bellwether of severe problems to come. For 60 years the U. S. and
298 other major powers' militaries have conducted ionospheric modification 'experiments' without regard
299 for the integrity of the ozone layer or life in general, exploiting the ionosphere to serve multiple military
300 ends, including communications with submarines, resource mapping and exploitation, and
301 weaponization of weather and climate [5,66]. In 1968, MacDonald [1] foresaw the possibility that in
302 the future the military might develop the means to trigger on-demand covert environmental
303 modifications to cause storms, floods, droughts, earthquakes, and tidal waves. Although one would
304 not expect an admission from the steeped-in-secrecy military, an email to then Secretary of State
305 Hillary Clinton [67], sent February 21, 2011 at 7:35 PM states "6.3 magnitude earthquake in
306 Christchurch, New Zealand **And on cue...**"[emphasis added]. The phrase, "And on cue", seems to
307 indicate that the time of a 6.3 magnitude earthquake in New Zealand was known in advance,
308 presumably an indication that the earthquake was deliberately triggered.

309

310 In 1997 Secretary of Defense William Cohen directly stated [68]: "Others are engaging...in an eco-
311 type terrorism whereby they can alter the climate, set off earthquakes, [and] volcanoes remotely
312 through the use of electromagnetic waves....It's real, and that's the reason why we have to intensify
313 our efforts."

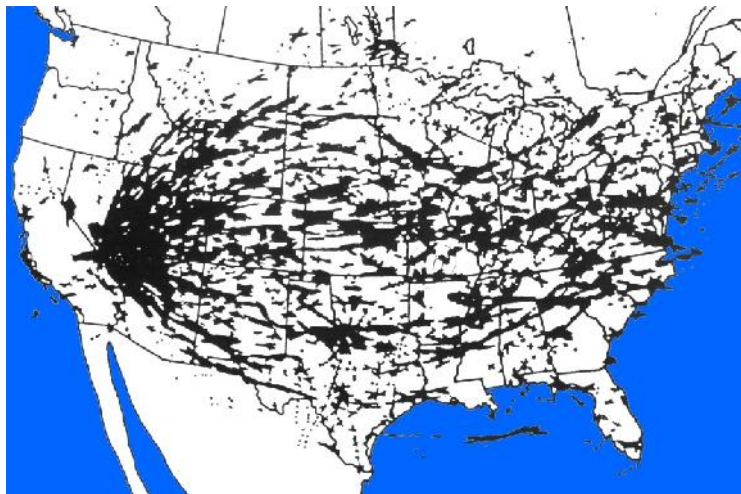
314

315 Fifty years ago MacDonald [1] noted: "The enhanced low-frequency electrical oscillations in the earth-
316 ionosphere cavity relate to possible weapons systems through the little-understood aspect of brain-
317 physiology....No matter how deeply disturbing the thought of using the environment to manipulate
318 behavior for national advantage is to some, the technology permitting such use will very probably
319 develop within the next few decades." With ionospheric heater transmitters scattered throughout the
320 world, that time might be close at hand – half a century after MacDonald's forecast.

321

322 **3.1.6 Extinction of Life on Earth**

323 Historically, the militaries of the world's major powers have exhibited little or no concern for the health
324 of their own citizens when what they perceive as 'national security' goals are at stake [69, 70]. During
325 the 1950s and 1960s, more than one hundred nuclear devices were detonated above ground in
326 Nevada (USA) [71]. Without being told of the potential health risks, thousands of military personnel
327 were deliberately exposed to nuclear blasts, including "war game" maneuvers that took place directly
328 beneath the atomic clouds [71,72]. Nor were local residents clearly informed of the risks or provided
329 with ways to minimize those risks [71]. Radioactive fallout occurred not only in the area near the
330 nuclear blasts, but as winds propelled the radioactive cloud across the United States, fallout occurred
331 along the paths, shown in Figure 3, that depended on local weather conditions.



332

333 **Figure 3.** U. S. Department of Energy image showing areas of the continental United States crossed
334 by more than one nuclear cloud from aboveground detonations as indicated in black during the
335 1950s-1960s (courtesy of U. S. Department of Energy).

336

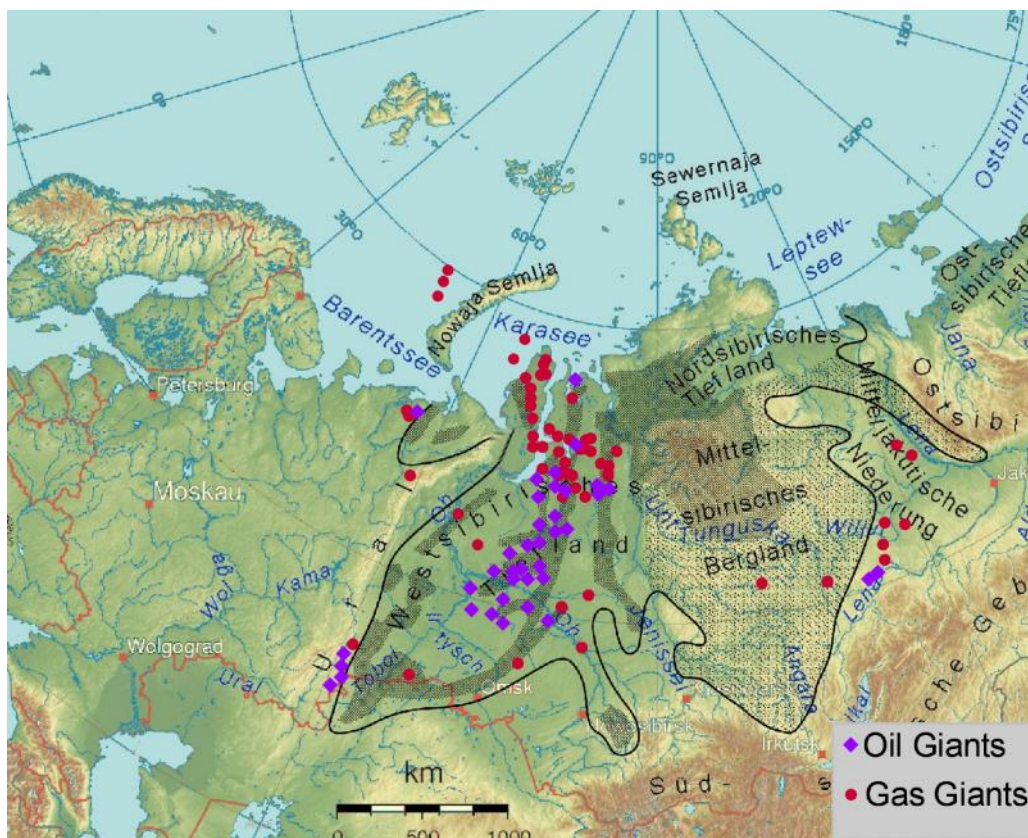
337 Atmospheric nuclear aboveground testing came to an end only as the result of public outcry over
338 news reports that bomb-produced radioactive strontium-90, found in cows' milk, posed dangers of
339 being incorporated into the teeth and bones of infants and children especially [73]. Now, more than a
340 half-century later, the scientific community is mute about vast military experiments on such Earth
341 systems as the climate, and the world's media are similarly mute. Yet the dangers of aerial particulate
342 spraying and ionospheric heating activities, taken as a whole, may prove as serious as those once
343 posed by atmospheric nuclear testing [41,43,74]. Continued without abatement, these military
344 experiments in our atmosphere pose a risk of extinction of life on Earth.

345 Mass extinction as defined when the Earth loses more than three-quarters of its species in a
346 geologically short period of time has happened only five times in the last 540 million years [75].
347 Common features of the "Big Five" suggest that key synergies may involve unusual climate dynamics,
348 atmospheric composition, and global ecological stressors that affect multiple lineages [76]. Drizo et al.
349 [77] have asserted that in just the past 500 years, humans have triggered a wave of extinction, threat,
350 and population declines already comparable in rate and magnitude with previous extinctions. Earth is
351 now experiencing a huge wave of population declines and extirpations with cascading consequences
352 on both ecosystem functioning and resources vital to modern civilization. A recent study, for example,
353 documents an alarming decline, a 75% reduction, in insect populations (biomass) over the past three
354 decades in protected areas of Germany [78]. The term "biological annihilation" has been used to
355 highlight the current state of Earth's ongoing Sixth Great Extinction [79].

356 **3.1.7 Geophysical Ignorance, Arrogance, and Secrecy**

357 Earth's great extinctions correlate with epic volcanic phenomena called Large Igneous Province (LIP)
358 [80]. Earth's most extreme mass extinction, at the end of the Permian (or "Great Dying"), 250 million
359 years ago, coincided with the Siberian Traps LIP, a massive outpouring of lava and intrusion of
360 underground magma. The underground magma mixed with thick coal seams and this hot coal-basalt
361 mixture extruded at numerous surface locations, producing plumes of pyroclastic fly ash, soot, sulfate,
362 and basaltic dust which ascended to the upper atmosphere [81]. This material was dispersed globally,
363 and the resulting char deposits in Permian-aged rock have been found to be remarkably similar to
364 modern coal fly ash [82]. The Permian was characterized by high levels of carbon dioxide, methane
365 gas and rapid global warming to levels lethal to most living organisms [83]. A period of deadly
366 ultraviolet radiation stress during the Permian period may have resulted from depletion of
367 stratospheric ozone by massive output of hydrothermal organo-halogens from the vast Siberian Traps
368 volcanism [84].

369 The rifting that occurred east of the Urals 250 million years ago resulted in one of the world's largest
370 petroleum and gas deposits, as shown in Figure 4 [85]. There is considerable frozen methane trapped
371 in the permafrost in that extensive northern area [86]. Anthropogenic global warming, caused by the
372 near-daily, near-global aerial particulate spraying, poses a serious risk of massively thawing and
373 releasing that entrapped methane to the atmosphere. The potential for another mass-extinction event,
374 should this happen, cannot be dismissed.



375

376 **Figure 4.** The relationship between major petroleum and natural gas production wells and the
377 boundary of the Siberian Traps, indicated by the black line. Methane hydrate deposits currently locked
378 in the permafrost within this extensive area upon melting pose a major catastrophe. From [85].

379

380 Military activities aimed at manipulating Earth's environment by polluting the atmosphere with CFA
381 and utilizing ionospheric heaters to cause earthquakes, volcanic eruptions, and other undisclosed
382 purposes are, we submit, causing great harm to life on Earth. One of the many tipping points the
383 world's leading militaries are toying with involves Earth's global monsoon system, which directly

384 impacts two-thirds of humanity, most of them in the global South. In scholarly discussions of the
385 possible impacts of deliberate atmospheric aerosol climate management, it is widely recognized that
386 the global monsoon system is imperfectly understood at present; that engaging in the deliberate
387 alteration of the global climate regime could distort or upset the persistent overturning of the
388 atmosphere over the tropics, with potentially grave implications for floods, droughts, and agriculture in
389 Africa, China, India, and Southeast Asia [87,88].

390 It is doubtful that assent to a secret climate-engineering scheme by elites in developing nations highly
391 dependent on the natural functioning of the global monsoon system is *fully informed* assent. The
392 military classifies information it considers important to the carrying out of its security and war
393 objectives, one of which is combating climate change [89]. The civilian world has no access to these
394 secrets, except at the highest and most specialized levels of government [90]. The military regimes
395 involved in executing the massive climate-change program discussed in this paper are like the
396 Sorcerer's Apprentice: presumptuous, acting in secret, and unwittingly arrogant.

397 4.0 CONCLUSIONS

398 The **decision** to alter the natural workings of our planet, to pollute the air we breathe, to disrupt natural
399 climate, to weaponize natural geophysical processes, to disrupt the ionosphere that protects us from
400 the sun's deadly electromagnetic radiation, and to **mislead** the public about the health risks involved
401 was accurately forecasted in 1968 by Gordon J. F. MacDonald in his essay aptly entitled "How to
402 Wreck the Environment." But MacDonald's vision was not 20/20. He imagined that a nation would be
403 able to develop military technology for the benefit of its own national interests, but failed to see
404 the evolution of a planetary "enemy" and the resultant pressures on nation states' militaries to act in
405 planetary concert against this so-called enemy – climate change.

406
407 MacDonald also failed to fully appreciate the negative impacts of the future environmental warfare
408 technologies, including their impact on human and environmental health [20,21,58,41,43,74]. Ninety
409 percent (90%) of the world's population now lives in areas with unhealthy air. Coal-combustion
410 products are the most important single contributor to this global air pollution, with exposure to the
411 PM_{2.5} particles that characterize coal fly ash the leading environmental risk factor for all such deaths
412 (4.5 million in 2015) [91]. Air pollution disproportionately affects the young and the old and those with
413 chronic illness.

414
415 War trumps all humanity's other organized activities. It involves not only life-and-death secrecy
416 protocols but distorts the openness of scientific discovery [92,93]. The secret war on climate change is
417 no exception to this rule. MacDonald did not realize half a century ago that the world's militaries could
418 be co-opted by a secret international agreement to wage a first-ever war on the planetary Earth
419 system, on all Earth's biota and fundamental biogeochemical processes.

420
421 Unless and until politicians, news media, scientists, and others in our society face the truth of what is
422 happening before their very eyes and collectively demand a halt to these covert technological
423 activities, we will march onward – to the first anthropogenic-caused mass extinction of life on Earth.

424 **AUTHORS' ETHICAL STATEMENT**

425
426 The authors hold that technical, scientific, medical, and public health representations made in the
427 scientific literature in general, including this particular journal, should be and are truthful and accurate
428 to the greatest extent possible, and should serve to the highest degree possible to protect the health
429 and well-being of humanity and Earth's natural environment.

430

431 REFERENCES

432 1. MacDonald GJ. How to wreck the environment. In Unless Peace Comes: A Scientific
433 Forecast of New Weapons, ed. Nigel Calder. 1968:181-205.

434

- 435 2. Frumhoff PC, Stephens JC. Towards legitimacy of the solar geoengineering research
436 enterprise. Phil Trans R Soc A. 2018;376(2119):20160459.
- 437
- 438 3. [https://www.scientificamerican.com/article/latest-ipcc-climate-report-puts-geoengineering-in-](https://www.scientificamerican.com/article/latest-ipcc-climate-report-puts-geoengineering-in-the-spotlight/)
439 [the-spotlight/](https://www.scientificamerican.com/article/latest-ipcc-climate-report-puts-geoengineering-in-the-spotlight/) Accessed July 2, 2018
- 440
- 441 4. Schaefer VJ. The production of ice crystals in a cloud of supercooled water droplets. Science.
442 1946;104:457-9.
- 443
- 444 5. Fleming JR. Fixing the Sky: The Checkered History of Weather and Climate Control. New
445 York: Columbia University Press; 2010.
- 446
- 447 6. Palm Beach Post-Times. Ex-Researcher Says U. S. Seeded Clouds Over Cuba. June 27,
448 1976.
- 449
- 450 7. <http://www.nuclearplanet.com/USAF.pdf>: Accessed June 8, 2018
- 451
- 452 8. Herndon JM. Aluminum poisoning of humanity and Earth's biota by clandestine
453 geoengineering activity: implications for India. Curr Sci. 2015;108(12):2173-7.
- 454
- 455 9. Herndon JM. Corruption of Science in America. The Dot Connector. 2011.
- 456
- 457 10. <http://www.ipcc.ch/report/ar5/>: Accessed June 8, 2018
- 458
- 459 11. Virgoe J. International governance of a possible geoengineering intervention to combat
460 climate change. Climatic Change. 2009;95(1-2):103-19.
- 461
- 462 12. Herndon JM. An open letter to members of AGU, EGU, and IPCC alleging promotion of fake
463 science at the expense of human and environmental health and comments on AGU draft
464 geoengineering position statement. New Concepts in Global Tectonics Journal. 2017;5(3):413-6.
- 465
- 466 13. Staff R. Ahmadinejad says enemies destroy Iran's rain clouds -reports. Commodity News
467 [Internet]. 2011.
- 468

- 469 14. <http://cyprus-mail.com/2016/02/17/minister-pledges-probe-into-chemtrails/>: Accessed June 8,
470 2018
- 471
- 472 15. Weart S. A National Security Issue? How People Tried to Frame Global Warming. In:
473 Pumphrey C, editor. Global Climate Change: National Security Implications. Carlisle, PA (USA):
474 Strategic Studies Institute, US Army War College; 2008.
- 475
- 476 16. [http://www.nuclearplanet.com/Public Deception by Scientists.html](http://www.nuclearplanet.com/Public_Deception_by_Scientists.html): Accessed June 8, 2018
- 477
- 478 17. <http://www.nuclearplanet.com/explainretractions.pdf>: Accessed June 8, 2018
- 479
- 480 18. Moreno N, Querol X, Andrés JM, Stanton K, Towler M, Nugteren H, et al. Physico-chemical
481 characteristics of European pulverized coal combustion fly ashes. Fuel. 2005;84:1351-63.
- 482
- 483 19. Suloway JJ, Roy WR, Skelly TR, Dickerson DR, Schuller RM, Griffin RA. Chemical and
484 toxicological properties of coal fly ash. Illinois: Illinois Department of Energy and Natural Resources,
485 1983.
- 486
- 487 20. Herndon JM, Whiteside M. Further evidence of coal fly ash utilization in tropospheric
488 geoengineering: Implications on human and environmental health. J Geog Environ Earth Sci Intn.
489 2017;9(1):1-8.
- 490
- 491 21. Herndon JM, Whiteside M. Contamination of the biosphere with mercury: Another potential
492 consequence of on-going climate manipulation using aerosolized coal fly ash J Geog Environ Earth
493 Sci Intn. 2017;13(1):1-11.
- 494
- 495 22. Chen Y, Shah N, Huggins F, Huffman G, Dozier A. Characterization of ultrafine coal fly ash
496 particles by energy filtered TEM. Journal of Microscopy. 2005;217(3):225-34.
- 497
- 498 23. Pandit GG, Sahu SK, Puranik VD. Natural radionuclides from coal fired thermal power plants
499 – estimation of atmospheric release and inhalation risk. Radioprotection. 2011;46(6):S173–S9.
- 500
- 501 24. Kampa M, Castanas E. Human health effects of air pollution Environmental Pollution.
502 2008;151:362-7.
- 503

- 504 25. Dai L, Zanobetti A, Koutrakis P, Schwartz JD. Associations of fine particulate matter species
505 with mortality in the United States: A multicity time-series analysis. *Environ Health Perspect.*
506 2014;122(8):837-42.
- 507
- 508 26. Dockery DW, Pope CAI, Xu XP, Spengler JD, Ware JH, et al. An association between air
509 pollution and mortality in six U. S. cities. *N Eng J Med.* 1993;329:1753-9.
- 510
- 511 27. Pope CAI, Ezzati M, Dockery DW. Fine-particulate air pollution and life expectancy in the
512 United States. *N Eng J Med.* 2009;360:376-86.
- 513
- 514 28. Calderon-Garciduenas L, Franko-Lira M, Mora-Tiscareno A, Medina-Cortina H, Torres-Jardon
515 R, et al. Early Alzheimer'd and Parkinson's diese pathology in urban children: Friend verses foe
516 response - it's time to face the evidence. *BioMed Research International.* 2013;32:650-8.
- 517
- 518 29. Moulton PV, Yang W. Air pollution, oxidative stress, and Alzheimer's disease. *Journal of*
519 *Environmental and Public Health.* 2012;109(8):1004-11.
- 520
- 521 30. Haberzetti P, Lee J, Duggineni D, McCracken J, Bolanowski D, O'Toole TE, et al. Exposure to
522 ambient air fine particulate matter prevents VEGF-induced mobilization of endothelial progenitor cells
523 from bone matter. *Environ Health Perspect.* 2012;120(6):848-56.
- 524
- 525 31. Hong YC, Lee JT, Kim H, Kwon HJ. Air pollution: A new risk factor in ischemic stroke
526 mortality. *Stroke.* 2002;33:2165-9.
- 527
- 528 32. Beeson WL, Abbey DE, Knutsen SF. Long-term concentrations of ambient air pollutants and
529 incident lung cancer in California adults: Results from the AHSMOG Study. *Environ Health Perspect.*
530 1998;106(12):813-22.
- 531
- 532 33. Potera C. Toxicity beyond the lung: Connecting PM2.5, inflammation, and diabetes. *Environ*
533 *Health Perspect.* 2014;122(1):A29.
- 534
- 535 34. Pires A, de Melo EN, Mauad T, Saldiva PHN, Bueno HMdS. Pre- and postnatal exposure to
536 ambient levels of urban particulate matter (PM2.5) affects mice spermatogenesis. *Inhalation*
537 *Toxicology: International Forum for Respiratory Research:* DOI: 103109/089583782011563508.
538 2011;23(4).
- 539
- 540 35. Mehta AJ, Zanobetti A, Bind M-A, C., Kloog I, Koutrakis P, Sparrow D, et al. Long-term
541 exposure to ambient fine particulate matter and renal function in older men: The VA Normative Aging
542 Study. *Environ Health Perspect.* 2016;124(9):1353-60.

543

544 36. Tetreault L-F, Doucet M, Gamache P, Fournier M, Brand A, Kosatsky T, et al. Childhood
545 exposure to ambient air pollutants and the onset of asthma: An administrative cohort study in Quebec.
546 Environ Health Perspect. 2016;124(8):1276.

547

548 37. Bell ML, Ebisu K, Leaderer BP, Gent JF, Lee HJ, Koutrakis P, et al. Associations of PM2.5
549 constituents and sources with hospital admissions: Analysis of four counties in Connecticut and
550 Massachusetts (USA). Environ Health Perspect. 2014;122(2):138-44.

551

552 38. Ebisu K, Bell ML. Airborne PM2.5 chemical components and low birth weight in the
553 northeastern and mid-atlantic regions of the United States. Environ Health Perspect.
554 2012;120(12):1746-52.

555

556 39. WHO. Ambient air pollution: a global assessment of exposure and burden of disease.
557 Ambient air pollution: a global assessment of exposure and burden of disease 2016.

558

559 40. Ma J, Ward E, Siegel R, Jamal A. Temporal trends in mortality in the United States, 1969-
560 2013. JAMA. 2015;314(16):1731-9.

561

562 41. Whiteside M, Herndon JM. Coal fly ash aerosol: Risk factor for lung cancer. Journal of
563 Advances in Medicine and Medical Research. 2018;25(4):1-10.

564

565 42. Maher BA, Ahmed IAM, Karloukovski V, MacLauren DA, Foulds PG, et al. Magnetite pollution
566 nanoparticles in the human brain. Proc Nat Acad Sci. 2016;113(39):10797-801.

567

568 43. Whiteside M, Herndon JM. Aerosolized coal fly ash: Risk factor for neurodegenerative
569 disease. Journal of Advances in Medicine and Medical Research. 2018;25(10):1-11.

570

571 44. Sparling DW, Lowe TP. Environmental hazards of aluminum to plants, invertebrates, fish, and
572 wildlife. Rev Environ Contam Toxicol. 1996;145:1-127.

573

574 45. Exley C, Rotheray E, Goulson D. Bumblebee pupae contain high levels of aluminum. PLoS
575 ONE. 2015;10(6):e0127665.

576

577 46. Idso S, Brazel A. Climatological effects of atmospheric particulate pollution. Nature.
578 1978;274(5673):781.

579

580 47. Torrent J, Barrón V. Diffuse reflectance spectroscopy of iron oxides. *Encyclopedia of surface*
581 *and Colloid Science*. 2002;1:1438-46.

582

583 48. Moteki N, Adachi K, Ohata S, Yoshida A, Harigaya T, Koike M, et al. Anthropogenic iron oxide
584 aerosols enhance atmospheric heating. *Nature communications*. 2017;8:15329.

585

586 49. Yoshida A, Moteki N, Ohata S, Mori T, Tada R, Dagsson-Waldhauserová P, et al. Detection
587 of light-absorbing iron oxide particles using a modified single-particle soot photometer. *Aerosol*
588 *Science and Technology*. 2016;50(3):1-4.

589

590 50. Zhiyuan C, Shichang K, Dahe Q. Seasonal features of aerosol particles recorded in snow
591 from Mt. Qomolangma (Everest) and their environmental implications. *Journal of Environmental*
592 *Sciences*. 2009;21(7):914-9.

593

594 51. Cziczo DJ, Froyd KD, Hoose C, Jensen EJ, Diao M, Zondlo MA, et al. Clarifying the dominant
595 sources and mechanisms of cirrus cloud formation. *Science*. 2013;340(6138):1320-4.

596

597 52. Garimella S. A vertically-integrated approach to climate science: from measurements and
598 machine learning to models and policy: Massachusetts Institute of Technology; 2016.

599

600 53. Garimella S, Rothenberg DA, Wolf MJ, Christopoulos KD, et al. Climate implications of coal
601 fly ash particles due to ice cloud formation. 2017.

602

603 54. Weatherhead EC, Andersen SB. The search for signs of recovery of the ozone layer. *Nature*.
604 2006;441(7089):39.

605

606 55. Strahan SE, Douglass AR. Decline in Antarctic Ozone Depletion and Lower Stratospheric
607 Chlorine Determined From Aura Microwave Limb Sounder Observations. *Geophysical Research*
608 *Letters*. 2018;45(1):382-90.

609

610 56. Ball WT, Alsing J, Mortlock DJ, Staehelin J, Haigh JD, Peter T, et al. Evidence for a
611 continuous decline in lower stratospheric ozone offsetting ozone layer recovery. *Atmospheric*
612 *Chemistry and Physics*. 2018;18(2):1379-94.

613

614 57. Hossaini R, Chipperfield M, Montzka S, Rap A, Dhomse S, Feng W, editors. Ozone
615 Destruction in the Upper Troposphere/Lower Stratosphere from Short-Lived Halogens and Climate
616 Impacts. EGU General Assembly Conference Abstracts; 2014.

617

618 58. Herndon JM, Hoisington RD, Whiteside M. Deadly ultraviolet UV-C and UV-B penetration to
619 Earth's surface: Human and environmental health implications. J Geog Environ Earth Sci Intn.
620 2018;14(2):1-11.

621

622 59. NRC. Trace-element Geochemistry of Coal Resource Development Related to Environmental
623 Quality and Health: National Academy Press; 1980.

624

625 60. Rice KM, Walker Jr EM, Wu M, Gillette C, Blough ER. Environmental mercury and its toxic
626 effects. Journal of preventive medicine and public health. 2014;47(2):74.

627

628 61. Murphy D, Thomson D, Mahoney M. In situ measurements of organics, meteoritic material,
629 mercury, and other elements in aerosols at 5 to 19 kilometers. Science. 1998;282(5394):1664-9.

630

631 62. Bust GS, Mitchell CN. History, current state, and future directions of ionospheric imaging.
632 Reviews of Geophysics. 2008;46(1).

633

634

635 63. Freeland E. Under an Ionized Sky. Feral House, Port Townsend WA. 2018.

636

637

638 64. Kulikov YY, Frolov V, editors. Influence of HF powerful radio waves on the ozone number
639 density in the earth's atmosphere. Physics and Engineering of Microwaves, Millimeter and
640 Submillimeter Waves (MSMW), 2010 International Kharkov Symposium on; 2010: IEEE.

641

642

643 65. Kulikov YY, Frolov V. Influence of an artificially disturbed ionosphere on the mesospheric
644 ozone. Russian Journal of Physical Chemistry B. 2013;7(6):692-5.

645

646

647 66. Bertell R. Planet Earth, the Latest Weapon of War: A Critical Study into the Military and the
648 Environment. London: The Women's Press; 2000.

649

650

651 67. <https://wikileaks.org/clinton-emails/emailid/11791>: Accessed June 8, 2018

652

653 68. Cohen W. Address by Defense Secretary Cohen: Terrorism, Weapons of Mass Destruction,
654 and U. S. Strategy. 1997.

655

656

657 69. Cole LA. Clouds of Secrecy: The Army's Germ Warfare Tests over Populated areas. Oxford,
658 Maryland: Rowman & Littlefield Publishers, Inc.; 1988.

659

660

661 70. Miller RL. Under the Cloud: The Decades of Nuclear Testing. Woodlands, Texas: Two-Sixty
662 Press; 1991.

663

664

665 71. Fradkin PL. Fallout: An American Nuclear Tragedy. Boulder, Colorado: Johnson Books; 2004.

666

667

668 72. Institute of Medicine NRC. Exposure of the American people to iodine-131 from Nevada
669 nuclear-bomb tests: Review of the National Cancer Institute report and public health implications.
670 Washington, DC: National Academy Press, 1999.
671
672
673 73. Reiss LZ. Strontium-90 absorption by deciduous teeth. *Science*. 1961;134(3491):1669-73.
674
675
676 74. Whiteside M, Herndon JM. Aerosolized coal fly ash: Risk factor for COPD and respiratory
677 disease. *Journal of Advances in Medicine and Medical Research*. 2018;26(7):1-13.
678
679
680 75. Raup DM. Biological extinction in earth history. *Science*. 1986;231(4745):1528-33.
681
682
683 76. Barnosky AD, Matzke N, Tomiya S, Wogan GO, Swartz B, Quental TB, et al. Has the Earth's
684 sixth mass extinction already arrived? *Nature*. 2011;471(7336):51.
685
686
687 77. Dirzo R, Young HS, Galetti M, Ceballos G, Isaac NJ, Collen B. Defaunation in the
688 Anthropocene. *Science*. 2014;345(6195):401-6.
689
690
691 78. Hallmann CA, Sorg M, Jongejans E, Siepel H, Hofland N, Schwan H, et al. More than 75
692 percent decline over 27 years in total flying insect biomass in protected areas. *PLoS ONE*.
693 2017;12(10):e0185809.
694
695
696 79. Ceballos G, Ehrlich PR, Dirzo R. Biological annihilation via the ongoing sixth mass extinction
697 signaled by vertebrate population losses and declines. *Proceedings of the National Academy of
698 Sciences*. 2017;114(30):E6089-E96.
699
700
701 80. Wignall PB. Large igneous provinces and mass extinctions. *Earth-Science Reviews*.
702 2001;53(1):1-33.
703
704
705 81. Ogden DE, Sleep NH. Explosive eruption of coal and basalt and the end-Permian mass
706 extinction. *Proceedings of the National Academy of Sciences*. 2012;109(1):59-62.
707
708
709 82. Grasby SE, Sanei H, Beauchamp B. Catastrophic dispersion of coal fly ash into oceans
710 during the latest Permian extinction. *Nature Geoscience*. 2011;4(2):104.
711
712
713 83. Brand U, Blamey N, Garbelli C, Grieshaber E, Posenato R, Angiolini L, et al. Methane
714 Hydrate: Killer cause of Earth's greatest mass extinction. *Palaeoworld*. 2016;25(4):496-507.
715
716
717 84. Visscher H, Looy CV, Collinson ME, Brinkhuis H, Van Konijnenburg-Van Cittert JH, Kürschner
718 WM, et al. Environmental mutagenesis during the end-Permian ecological crisis. *Proceedings of the
719 National Academy of Sciences of the United States of America*. 2004;101(35):12952-6.
720
721
722 85. Herndon JM. New concept on the origin of petroleum and natural gas deposits. *J Petrol
723 Explor Prod Technol* 2017;7(2):345-52.
724
725

726 86. Collett TS, Ginsburg GD. Gas hydrates in the Messoyakha gas field of the West Siberian
727 Basin-a re-examination of the geologic evidence. International Journal of Offshore and Polar
728 Engineering. 1998;8(01).
729
730
731 87. Polson D, Bollasina M, Hegerl G, Wilcox L. Decreased monsoon precipitation in the Northern
732 Hemisphere due to anthropogenic aerosols. Geophys. Res. Lett. 2014;41(16):6023-9.
733
734
735 88. Robock A, Oman L, Stenchikov GL. Regional climate responses to geoengineering with
736 tropical and Arctic SO₂ injections. J. Geophys. Res. Atm. 2008;113(D16).
737
738
739 89. Ellsberg D. Secrets: A memoir of Vietnam and the Pentagon Papers: Penguin; 2003.
740
741
742 90. https://www.defense.gov/News/Speeches/Speech_View/Article/605617/ Accessed July 2,
743 2018
744
745
746 91. Health Effects Institute 2018. State of Global Air 2018. Data source: Global Burden of
747 Disease Study 2016. IHME, 2017 - available from www.stateofglobalair.org Accessed July 2, 2018
748
749
750 92. Rhodes R. The making of the atomic bomb: Simon and Schuster; 1986, 2012.
751
752
753 93. Rhodes R. Dark Sun: The Making of the Hydrogen Bomb: Simon and Schuster; 1996.
754
755