

# **Index**

Note: An "A" in page number sequences refers to relevant content found in the book's online Appendix, available at www.cambridge.org/dixon.

Adams, Dr. John, 106-107 air pollution. See also coal; energy use; global warming; lead; mercury; sea level rise carbon capture and storage (CCS) technology, 143-144 cooking fires, deaths from, 142 costs resulting from, 143, 266 deaths caused by, 142 electric cars, 144, 252, 253 fossil fuels, necessary reduction of, 143 American Petroleum Institute (API), 127 Arrhenius, Svante. See global warming: CO2 emissions, role of Atwater, Dr. Brian, 85, 86, 102, 103, 107 Barberi, Dr. Franco, 45, See also disaster preparedness, failures in: L'Aquila earthquake, ignored warnings Barka, Aykut, 113, See also earthquakes, measuring susceptibility to: propagating earthquake sequence bell curves, 199, 200 black swans, concept of, 2, 42, 85 boom and bust cycles, 148, A Boulton, Mathew, 118, See also coal: electricity production Bouma, Arnold, 104, See also earthquakes, measuring susceptibility to: Bouma sequence building codes. See also disaster preparedness; disaster preparedness, failures in; flooding; government; hurricanes; sea level rise construction companies lobbying against stronger, 38 corruption, effects of, 56 cost vs benefit, assessing, 40, 59-65 earthquake- vs. hurricane-resistance, 59

earthquake-resistant designs, 54, 55

Miami-Dade, Florida, 50 scientific uncertainty, dealing with, 62 unreinforced masonry buildings, upgrading, 51, 240 vertical acceleration, consideration of, 55 wealth, effects of, 56 CEO tenures, short, 3 Chaline, Eric, 20, See also disaster qualifications: slavery and genocides Christie, Agatha, 110 climate change. See global warming Cline, Isaak, 157 See also hurricanes, past: Galveston, Texas (1900) coal. See also air pollution; costs resulting from disasters; disaster preparedness, failures in; global warming; government; lead; mercury; sea level rise acid mine drainage, 119 air pollution, 118, 129 atmospheric pollution, 121 carbon capture and storage (CCS) technology, 266 Centralia, Pennsylvania, 120 CO2 emissions, 121 costs of using, 125, 138 deforestation, 119 electricity production, 118

externalities, failure to consider in

costs, 125

fires, underground, 120

enforcement of, necessary, 51, 55, 96,

foreign aid, necessary stipulations for, 58

102, 246, 263

Field act, 51

improving, 50

income-based, 65

Memphis, Tennessee, 62



## 288 INDEX

coal (cont.) government regulation and enforcement, 121, 138 groundwater contamination from fly ash, 118, 119, 131 health issues linked to, 121, 136 heavy metal byproducts, 118, 121, 128, 129 inefficiency vs. nuclear power, 119 liability for health and environmental impact, 138 Ontario government closes coal-fired power plants, 146 plants not complying with clean technology, 138, 139 premature deaths caused by, 138, 139, 141 public opinion of, 119 regulations, companies cheating, 121 strip-mining, 119, 120 strip-mining, safer techniques, 121 subsidence from underground tunnels, 119 US National Academies of Sciences, Engineering and Medicine report (2010), 136, 139 waste products, free dumping of, 137 communication. See also communication, breakdown of; disaster preparedness; Fukushima-Daiichi nuclear power plant; scientific reports; scientists conflicts of interest, disclosing, 242, 268 graphics and media, importance of including, 233, 234, 268 journalism, not-for-profit, 243 journalists, censoring of, 243 media, role of, 229, 237, 262, 265, 267, 268 responsibility toward, 242 scientific communication, improvements in, 232 scientific uncertainty and the public, 40-45, 62, 230, 263 skills, importance of, 231 transparency, necessity for, 79 communication, breakdown of. See also communication; disaster preparedness, failures in; government; scientific reports; scientists

government, role of, 205 journalists, censoring of, 242 media, role of, 5, 6, 205, 237 Non-Disclosure Agreements (NDAs), 93 public listening, role of poor, 205 technical jargon, use of, 203, 230 transparency, lack of, 93 corruption, 56 costs resulting from disasters. See also air pollution; disaster preparedness, failures in; disasters, human-made; earthquakes, past; flooding; Fukushima-Daiichi nuclear power plant; global warming; hurricanes, past; sea level rise; tsunamis calculating, challenges of, 11, 18, 19 cost of human life, determining, 64 costs, preventable, 8 fatalities, 17, 18, 20, 21, 22, 56 flooding, 22, 152 future income, lost, 17 hurricanes, 21 population growth, effects of, 8, 9, 10, 50. A preventable, 11, 62 risk, failure to accurately calculate, xvii. US eastern seaboard and Gulf of Mexico, 21 wars waged, 17, 20, 141, 142 creative destruction, concept of, 63 Daniell, Dr. James, 22, 151, See also costs resulting from disasters, flooding Dieterich, James, 113, See also earthquakes, measuring suseptibility to, propagating earthquake sequence disaster preparedness. See also building codes; communication; disaster preparedness, failures in; energy use; government; scientific reports; scientists "acts of God" designations, 15 advance warning systems, 235 agriculture, using at-risk areas for, 48 back-up power for critical facilities, 267 building in at-risk areas, xiii, 84, 90, 95, 96, 167, 181, 240, 260 communication, role of, xv, xvi, xviii,

43, 262



INDEX 289

converting flood-prone areas, 11, 48 data, lack of sufficient, 49 "disaster bonds" for companies posing environmental risk, 251, 269 early warning systems, 55 flood-prone areas, elevating infrastructure in, 157 future disasters, size of, 84 Galveston, Texas hurricane (1900), changes implemented after, 157 hazard assessment and mitigation, 2, 7, 12, 61, 66, 84, 265, A historical records, assembling and studying, 25, 42, 52, 53, 81, 84, 85, 91, 99, 108, 109, 156 infrastructure, relocating, 45-50, 59, 95, 153, 162, 247, 266 infrastructure, upgrading, xiv, xvi, xvii, 5, 14, 23, 47, 55, 59, 60, 95, 96, 102, 108, 115, 240, 259, 260, 263, 267, A insurance, low premiums for relocating, 246 investment in, 12, 20, 60, 64, 93, 95, 166, 236, 260, 261, 262 measuring natural disasters, difficulties of. 52 media, role of, 265 motion sensors, 67 national safety agencies, need for, 260, 269 New Orleans, Louisiana, ignored warnings, 166 past disasters, learning from, 259, 265, 269 political importance of, 234, 235 power plants, need for disaster-resistant designs, 183, 264, 265, 267 predictions, difficulties with, 3, 43, 44, 46, 49, 83, 95, 102, 107 regulatory boards, need for independent, 258, 259, 261, 265, 269 research and technology, effect of, 252 safety and environmental practice audits, need for, 244, 251, 269 safety notifications for earthquakeresistant buildings, need for, 240 settlement history, role of, 96 "sin taxes" on pollutants and gold, need for, 247, 248, 265, 269 subsidies for mobile home tie-downs, 65

subsidies for relocating, 266 third-world CO2 emissions, lowering through shared intellectual property and technology, 256, 257, 269 transparency, necessity of, 239, 262, 265, 266, 268 wealth, role of, 58 workplace safety regulations, implementing, 263 disaster preparedness, failures in. See also building codes; communication, breakdown of; disasters, human-made; government; scientific reports: scientists building in at-risk areas, xvi, 3, 21, 36, 37, 63, 66, 81, 91, 96, 152, 157, 164, 244, 260 communication, role of, 3, 198 Costa Rica earthquake (1990), ignored warnings, 6 economic impact of, 96 flood-control levees, reliance on, 11, 49, 161, 172, A flood-related damage, despite fore-knowledge, 152 Florida's mangroves, depletion of natural protection from, 39, 46 fossil fuels, government subsidies for, 143, 266 Fukushima power plant, Japan, 2, 12, 17, 43, 84, 85 global warming, ignored warnings, 214 Haiti (2010) earthquake, ignored warnings, xiv, 58 infrastructure, building in at-risk areas, 11, 40, 45, 47 investment in, 63 Izmit, Turkey earthquake, ignored warnings, 114 Kashiwazaki Kariwa nuclear power plant disaster, Japan, 90, 92 L'Aquila earthquake, ignored warnings, 43.44 legal liability for, 43, 44, 64, 250, A long-term trends, failure to consider, 4, 5, 46, 95, 192, 228, 247, 265 New Orleans, Louisiana, ignored warnings, 2, 259 New York and New Jersey flooding, ignored warnings, 171, 172



## 290 INDEX

British Columbia, Canada, 95, 96, 101 disaster preparedness, failures in (cont.) regulation and enforcement, lack of, 92 Istanbul, Turkey, xvii, 94, 112, 114, 115 subsidies, lack of, 11 Japan, 86, 90, 98 Triangle Shirtwaist factory fire, Los Angeles, California, 10, 46, 47 New York, 17 Memphis, Tennessee, 61, 62 waste storage in at-risk areas, 115 Portland, Oregon, 95, 96 work safety regulations, lax, 63 San Francisco, California, 10, 46, 47 disaster qualifications Seattle, Washington, 10, 12, 94, 95, disease epidemics, 19 96 101 famine, 20 southern Hispaniola 58 heat waves, 21 US Pacific Northwest, xvii slavery and genocides, 20 earthquakes, measuring. See also disaster relief aid, international, 110 earthquakes, cause of; earthquakes, disasters, human-made. See also costs measuring susceptibility to; resuting from disasters: disaster earthquakes, past preparedness, failures in; government accelerometer, 51 Bangladesh clothing factory fires, 15 aliasing, 52, 53, A Brazillian dance club fire (2013), 62 challenges of, 81 Chernobyl, 14, 78, 140 clipping, 51, 53, 55 Cocoanut Grove nightclub fire, Boston difficulties of, 68 (1942), 62 drift, 52 Freedom Industries chemical spill, radiocarbon dating, 83, A Charleston, West Virginia (2014), 250 seismometers, 53, 67, 81 Hindenburg explosion (1937), 70 websites, monitoring, 237 Lac Megantic, Quebec train derailment earthquakes, measuring susceptibility to. See (2013), 250 also disaster preparedness; legal liability for, 132 earthquakes, cause of; earthquakes, Minamata disease, Japan, 132 past; fault zones; faults; plate nightclub fires caused by fireworks, 63 tectonics; subduction; subduction Triangle Shirtwaist factory fire, zones New York, 14, 15, 17, 62 Bouma sequence, 104 vs. natural disasters, xvi, 14, 20 box coring, 105 drought, 201, 219 challenges of, 96, 98 clustering, 67, 103, 108 earthquakes, cause of. See also disaster deposits, studying coastal, 102, 103 preparedness; earthquakes, graded bedding, 104 measuring susceptibility to; fault historical records, 103, A zones; faults; plate tectonics; plates, piston coring, 105 continental; plates, oceanic; propagating earthquake sequence, 112, subduction; subduction zones 113, 114, 115 plate motion, 23, 24 recurrence intervals, 46, 52, 106, 107, stick-slip and elastic rebound, 28, 29, 30, 115, A 31. 32. 47. A seismic reflection, 100, 101, 105, A strain accumulation and release, xiv, 98, settlement history, role of, 98 101. A trees, studying rings and radiocarbon vertical faults, 31 dating, 102, 103 earthquakes, future risk of. See also disaster trilateration, 102 turbidite deposits, studying, 101, 103, preparedness; earthquakes, cause of; earthquakes, measuring 104



INDEX 291

earthquakes, past. See also building codes; carbon emissions tax, necessity of, 147, communication; costs resulting from 149, 219, 258, 269 disasters; disaster preparedness, carbon-free energy, transition to, 149 costs of 147 failures in; scientific reports; environmental responsibility, 117 scientists; tsunamis, past Alaska (1964), 67 fossil fuels, global supply of, 149 Bhuj (1819), 42 fracking technology, 149 Bhuj (2001), 40, 42 hydrogen gas, potential for, 264 Chile (1960), 67 Keystone pipeline, 258 oil reserves, deep-ocean, 149, A Costa Rica (2012) 5 Erzincan earthquake, Turkey (1939), 110 oil sand and shale reserves, 149, 258, A Fukushima, Japan (2011), 95 relative risk, calculating, 118 Grand Banks, Newfoundland (1929), 105 renewable energy sources, industry Haiti (2010), xiv, 57, 59 lobbying against, 147 renewable sources, transition toward, Izmit, Turkey (1999), 114 Japan (2007), 90, A 255, 266, 269 Japan (2011), xiv, xvii, 2, 67, 68, 69 safe and efficient, 118 L'Aquila, Italy (1703), 44 start-up companies, innovative, 147 L'Aquila, Italy (2009), 42, 44, 239 transmission efficiencies, improved, 256 Erdik, Dr. Mustafa, 115, See also London, England (1750), 15 Long Beach, California (1933), 51, 55, earthquakes, future risk of: Istanbul, 102 Turkey Malaysia (2015), 14, 16 Ethyl Corporation. See also lead; Tetra-Ethyl Messina, Italy (1908), 19 Lead (TEL); scientific reports; New Madrid, Tennessee (1811-1812), 61 scientists Oregon-Washington margin, 106 lobbying through API, 127 Parkfield, California (1966), 83 Tetra-Ethyl Lead (TEL), 123 San Francisco (1906), 28, 30, 31, 46, 47, A Ewing, Maurice, 105, See also earthquakes, Sanriku (1896), 86, 87 measuring susceptibility to: turbidite Sumatra (2004), 14, 19, 67, 68, 83, 84, A deposits, studying survey of largest, 68 Exxon. See Ethyl Corporation Tsugaru Peninsula, Japan (1983), 91 Earth's natural balance, maintaining, 34, A fault zones. See also disaster preparedness; electric cars disaster preparedness, failures in; batteries, 252 earthquakes, cause of; earthquakes, hybrids, 253 future risk of; earthquakes, past; Tesla, 253 faults; subduction zones; tsunamis, Elelman, Richard, 261, See also disaster Enriquillo-Plantain Garden fault, 57, 58 preparedness: regulatory boards, need for independent New Madrid fault, 62 energy use, xiii, See also air pollution; coal; Newport-Inglewood fault, 51 disaster preparedness; disaster North Anatolian fault, 110, 111, 112, A preparedness, failures in; geothermal San Andreas fault, 10, 28, 29, 46, 47, 82 power; global warming; government; faults. See also earthquakes, measuring lead; mercury; nuclear power; susceptibility to; fault zones; scientific reports; scientists; solar subduction; subduction zones power; sea level rise; wind power offshore, 91 blue LEDs, invention of, 252 seismogenic faults, 66 carbon dioxide release during trenching and radiocarbon dating, 82, 83, fracking, 149 85, A



## 292 INDEX

Fermi's paradox, xiii warming; sea level rise; storm surge; Field, Charles, 51, See also building codes: tsunamis, future risk of Field act Bangladesh, 50, 171, 172 Fort Lauderdale, Florida, 173 first derivative, temperature vs. time, 227 flooding. See also building codes; disaster Gulf of Mexico, 10 preparedness; disaster preparedness, Jakarta, Indonesia, 166 failures in; global warming; Miami Beach, Florida, 173, 174, 177 government; hurricanes, past; sea Mississippi River, 49 Missouri River, 49 level rise; storm suurge; tsunamis, New Orleans, Louisiana, 12, 158, 161, building in at-risk areas, 244, 260 164 A coastal, 154 New York and New Jersey, 180, 181 compaction of artificial fill, 166, 172 Norfolk, Virginia, 179 damage, increasing severity of, 172 Phillipines, 9 US eastern seaboard, 10, 178, 181, 247 deforestation worsening damage from, 152, 171 flood-related disasters. See also building El Nino, role of, 156 codes; costs resulting from disasters; extraction of oil and natural gas, 161, 166 disaster preparedness, failures in; financial inertia, 164 hurricanes, past; tsunamis, past; sea level rise; storm surge flood-resistant building designs, 162, 167 geographic inertia, 164 Alberta (2013), 151 green space, converting vulnerable areas Bangladesh (1991), xvii, 170 to, 164, 266 Bangladesh (1998), 170 green space, elimination of, 153 Britain (1953), 151 groundwater, pumping, 161, 166 Galveston, Texas (1900), xvii, 155-157 "hardscape", use of, 153, 266 India (2013), 22 levees, 160, 161, A Miami Beach, Florida, 177 National Flood Safety Board, need Mississippi River (1927), 18 for, 260 Mississippi River (1993), 11 natural barriers to, preserving, 154, 245, Mississippi River (2011), 10 260, 266 Missouri River (2011), 10 nuclear power plants, risk to coastal, New Orleans, Louisiana (2005), xiv, xvii, 183, 267 151, 171, 172 oxidation of marsh and delta New York and New Jersey (2012), 10, 151, 180.181 deposits, 166 rebuilding and relocating, subsidies for, Norfolk, Virginia, 179 163, 164, 165, 166 Philippines (2013), 151, 154 river deltas, 158, 159, 160, 166, 172, A Fourier, Joseph, 190, See also global warming: river flood plains, 152 greenhouse effect run-off contamination, 153 Fukushima-Daiichi nuclear power plant. See sedimentation, process of, 159, 160 also communication: disaster storm surge, 21, 155, 172, 181 preparedness, failures in; subsidence, rate of, xiv, 160, 161, 166, earthquakes, past: Japan (2011); 172, 179, 267, A nuclear power; tsunamis, past: Japan upgrading infrastructure in at-risk (2011); Tokyo Electric Power areas, 184 Company (TEPCO) back-up power failure, 1, 69 wetlands, drained, 161, 266 flooding, future risk of. See also building communication, role of, 1, 85 codes; disaster preparedness; conspiracy theiries post-disaster, 80 hurricanes, future risk of; global contamination pathways, 76, 77, 79



INDEX 293

core meltdowns, 1, 2, 70, 71 costs of disaster, 7, 80 design flaws, 1, 69, 71, 81, 86 disaster history, ignored, xvii, 85, 87, 88 earthquake, preparedness for, 69, 95 Geological Survey of Japan, risks communicated by, 89 hydrogen gas, release of, 71 Kashiwazaki Kariwa disaster, lack of action after, 90 mistakes made following disaster, 71 nuclear power, effect on future of, 71, 72, 79, 80, 254 ocean contamination, 76 on-site radiation measurement systems, failure of, 73 plant managers, unprepared, 69 "point source" for future tracer studies, 75 radioactive contaminants, leaked, 71, 74, 77, 78, 79 radioactive contaminants, measuring, 53, 74, 75, 76, A shut down by Japanese government, 79 transparency, lack of, 76 tsunami, unpreparedness for, xvii, 69, 86, 259 General Motors (GM), 123, 165, See also **Ethyl Corporation** geodesv. 47 geothermal power Central America, potential in, 256 global warming. See also air pollution; coal; communication, breakdown of; costs resulting from disasters; disaster preparedness, failures in; energy use; flooding; government; lead; mercury; sea level rise; scientific reports; scientists

222, *A*Berkely Earth Surface Temperatures project, 193
carbon-based technology, reliance on, 215, 255, *A*climate models, 204, 219
CO2 emissions, role of, 186, 188, 189, 190, 211, 214, 227, 228, *A* 

costs resulting from, 220

arctic sea ice, melting, 206, 209, 216,

documentaries, 205, 223 economic consequences of, 216-220 fatalities caused by, 220 future storms, severity of, 22, 36, 216, 267 greenhouse effect, 186, 190, A health effects of, 216, A heat waves and cold winters, 21, 200, 205, 206, 209, 216, 220 human survival, effects on, 226 long-term thinking, necessity of, 142, 194, 212, 215, 224, 228, A low carbon alternatives, transition to, 214, 215 marine life, effects on, 189, 216 mass-extinction events, role in, 227 measuring and tracking, 194, A media, role of, 197, 205, 206, 209-212, 2.2.0 Nenana Ice Classic, "ice-off" dates, 192 ocean acidity, 190, 216, 219, A politicians, role of, 212 poor communication, role of, xiv population growth, role of, 227, A public knowledge on, lack of, 195, 215 rate of warming, 225, 226 realclimate.org, creation of, 205 refugees and mass migration due to effects of, 216, 218, 255 response to, 190, 191, 197, 205, 214, 216 scientific communication, role of, 190, 196, 197, 198, 204, 215 skepticism, 186, 187, 190, 191, 195, 197, 199, 205, 206, 212, 215, A species survival, effect on, 225, 226 tracking and measuring, 194, 199-202, 208, 222, 224 tropical diseases, expanding range for, 216, 217 UN Conference on Climate Change, Paris (2015), 245 UN-sponsored climate summit. Paris (2015), commitment to limit CO2 emissions, 195 vs. natural warming events, 224, 226 Goldfinger, Dr. Chris, 108, See also earthquakes, measuring susceptibility to: recurrence intervals, earthquakes, measuring susceptibility to: recurrence period



## 294 INDEX

government. See also building codes; coal; Moscow, Russia (2010), 200 communication; costs resulting from Texas (2011), 201, 202 disasters; disaster preparedness; US mid-west (2012), 200 wildfires, 10 disaster preparedness, failures in; energy use; scientific reports; Heezen, Dr. Bruce, 105, See also earthquakes, scientists measuring susceptibility to: turbidite aid, reliance on, 37 deposits, studying carbon taxes to fund research and Hightower, Dr. Jane, 131, See also mercury: development, potential for, 255 toxicity censorship of information hurricanes. See also building codes: disaster communicated to public, 245 preparedness; flood-related disasters; false sense of security, promoting, 49 flooding; flooding, future risk of; federal crop insurance program, need global warming; hurricanes, for. 48 measuring; hurricanes, past hazard risk, denial of, 185 at-risk areas, 10, 37, 181 industries and regulators, cozy relationship causes of, 181 between, 12, 79, 89, 92, 260 hurricane season, 36 insurance schemes, federally natural heat redistribution, 36 subsidized, 49 ocean surface temperature, effect of, moral hazard bailouts, 166 181.182 political cycles, effects of short, 3, 257 hurricanes, measuring power plants, support for unclean, 257 Saffir-Simpson Hurricane Scale, 155, 181 regulation for coal-fired power plants, hurricanes, past. See also building codes; lack of, 257 communication; costs resulting from role of xiv disasters; disaster preparedness, scientists' warnings, not acting on, 43 failures in; flood-related disasters; state of emergency declarations, 11 global warming; scientific reports; subsidies for building in disaster-prone scientists areas, 246 Florida Keys, Florida (1935), 46 Galveston, Texas (1900), 156 subsidies for renewable energy, 145 subsidized loans, 12 Galveston, Texas (1915), 157 zoning, 12, 50, 263 Hurricane Andrew (1992), 51, 155 Griggs, Garry, 106, See also earthquakes, Hurricane Betsy (1965), 166 measuring susceptibility to: turbidite Hurricane Camille (1969), 155, 166 Hurricane Ike (2008), 157 deposits, studying Hurricane Irene (2011), 10 hardscape, 153, 266 Hurricane Katrina (2005), xiv, 10, 14, 50, Hassol, Susan, 203, 204, See also 151, 155, 158, 260, A communication, breakdown of: Hurricane Patricia (2015), 156 technical jargon, use of Hurricane Sandy (2012), 10, 151, 180, 181 hazard, natural vs. human-caused, xvi, 14, 19, Indianola, Texas (1875), 156 20, 21, 262 Lake Okechobee, Florida (1928), 46 heat waves. See also costs resulting from Miami, Florida (1926), 46, 50 disasters; drought; global warming; wildfires industrial revolution, environmental impact cause of, 21 of, 118, 123, 134, 227, A central US (2012), 220 influenza, 19 Innospec. See also Ethyl Corporation; costs and damages, 10, 21 Europe (2003), 19, 200 Tetra-Ethyl Lead (TEL)

Europe (2013), 22

third world, continued sale of TEL to, 123



INDEX 295

Ito, Joichi, 76, See also Fukushima-Daiichi nuclear power plant: radioactive contaminants, leaked

Kanamori, Dr. Hiroo, 86, See also tsunamis: earthquake size, lack of correlation with

Kastens, Dr. Kim, 106, See also earthquakes, measuring susceptibility to: turbidite deposits, studying

Keeling, Charles, 188, 190, *See also* global warming: CO2 emissions, role of King Canute, 184

Kremer, Katrina, 101, 109, See also earthquakes, measuring susceptibility to: seismic reflection

Kulm, Dr. LaVerne, 106, See also earthquakes, measuring susceptibility to: turbidite deposits, studying

lead. See also air pollution; coal; costs
resulting from disasters; energy use;
global warming; industrial
revolution, environmental impact of;
mercury; scientific reports;
scientists; Tetra-Ethyl Lead (TEL)
air-borne atmospheric pollution, 122,

124, 125, 126 blood-lead concentrations in

humans, 123 car batteries, recycling, 122

children, severe health risks to, 123

children, severe risks to development, 122, 123, 126, A

coal-fired power plants, byproduct of, 122 government regulations and

enforcement, 122, 123

Greenland ice cores, studies of concentrations in, 126

health problems linked to, 122

ingestion through food, 122 leaded gasoline, 122, 123, A

leaded paint, 123, A

longevity of pollution from, 123

soil contamination, 123, 124, A

Lisowski, Dr. Michael, 100

Lisowski. Dr. Michael. See also earthquakes, measuring susceptibility to: trilateration

lithosphere, 23, 25, 27, 32, 161, A

Mann, Dr. Michael, 194, 205, See also global warming: tracking and measuring

mass-extinction events. See also global warming; volcanic eruptions, past

Anthropocene extinction, question of, 36

Cretaceous extinction, 34, 35, 227

Deccan Traps (India), 35

fossils helping to date, 35

Permian extinction, 34, 35

Siberian volcanic eruptions, 35

mercury. See also air pollution; coal; communication, breakdown of; costs resulting from disasters; disaster preparedness, failures in; energy use; global warming; industrial revolution, environmental impact of;

lead; scientific reports; scientists

batteries, recycling, 132

bioaccumulation, 129, 131

coal, byproduct of, 128, 135, 136

cremation facilities, contamination through, 133

egg shells of sea birds, studies

through, 134

fish, levels in, 130, 132

gold-mining, 128, 248

industrial processes, contamination from, 131

longevity of pollution from, 123

low tolerance, evolution, 134, 136 marine life, effects on, 128, 129

methyl mercury, US Food and Drug

Administration limit for, 130

Minamata Convention (2013), 247

Minamata disease, 132

naturally occurring, 132, 133, 134, 136

open-ocean concentrations, 129, 134

pregnant women, severe risks to, 131 PVC production, 128

seafood warning labels, industry

resistance of, 132

toxicity, 130, 131, 132, 134

trenching, studies through, 134

US Environmental Protection Agency limit for drinking water, 131

warning labels, seafood industry resistance of, 265

Midgley, Thomas, 123, 136, See also Tetra-Ethyl Lead (TEL)



## 296 INDEX

mid-ocean spreading centers, 24 public opinion of risks, 141, 254 Mid-Atlantic Ridge, 24 radiation released during accidents, 73, Minoura, Dr. Koji, 87, 88, 91, See also 74, 77, 117, A tsunamis, measuring susceptibility radiation sensors, necessity of to: turbidite deposits, studying functional, 264 mountain formation risks associated with, 117, 119 Alps, 42 thorium-fueled nuclear reactors, Appalachian Mountains, 42 potential for, 254 Himalayan Mountains, 40, 41, 42 vs. other power sources, xvii mountain formations. See also plate waste storage, 61, 117, 119, 183 Yucca Mountain repository, Nevada, mutual funds 61, 183 buying shares in safe businesses, 12 oceanic crust Nakaya, Shiyu, 91, See also earthquakes, age of, 26 past: Tsugaru Peninsula, Japan (1983) basalt component, 23 Nanayama, Dr. Futoshi, 86, See also composition of, 23 Fukushima-Daiichi nuclear power forming of, 24 plant: disaster history, ignored hydrous minerals, 26 Needleman, Dr. Herbert, 127, 194, See also volcanism, 26 lead: children, severe health risks to oceanic depth, 24 nuclear power. See also building codes; Octel Corporation. See Innospec communication; disaster Okal, Emile, 68, 84, See also subduction preparedness; disaster preparedness, zones failures in; disasters, human-made; Orient Express, 111, 113, 115 energy use; Fukushima-Daiichi Pacific "Ring of Fire", 25, 26, 67, 256 nuclear power plant; radioactive contaminants; scientific reports; Patterson, Clair, 127 scientists geochronology work, 125 Greenland ice cores, study of lead in, 126 Cesium (Cs), 77, A Chernobyl (1986), 73 lobbying against by API, 127 clean energy, as decent source of, xvii, Pint of Science, 232 117, 144, 254 plate tectonics, xiv, 23 Comprehensive Nuclear Test Ban Treaty broad plate boundary zones, 41, 42, A discovery of, 47, 96, 98 Organization (CTBTO), 76 faults, 28, 29 contamination pathways, potential, 76 disaster-resistant designs, 264 motion, rate and direction of, 24, 25, 47 natural rhythm, 24 environmentalists' opinion of, 119, 141 explosions, potential for, 72 subduction, plate location after, 28 extreme events as measuring point for superposition, 7, 82 costs and fatalities, 139 plates, continental. See also earthquakes, future deaths from radiation release, measuring susceptibilty to; 74. 139 earthquakes, past; plate tectonics; Germany phases out, 72 plates, oceanic; subduction; hydrogen gas, creation of, 72 sunduction zones Nuclear Regulatory Commission African plate, 112 (NRC), 259 Anatolian plate, 110, 112 post-disaster monitoring, necessity Arabian plate, 112 of, 264 Caribbean plate, 57 premature deaths caused by, 139, 141 Central American plate, 27



INDEX 297

composition of, 24 continental crust, 24 density difference from oceanic plates, 24 41 Eurasian plate, 25, 27, 40, 41, 67, 110, 112 Indian plate, 40, 41 North American plate, 25, 27, 57, 96, 97 Phillipine plate, 67 South American plate, 25, 27 plates, oceanic. See also earthquakes, measuring susceptibility to; eartquakes, past; plate tectonics; plates, continental; subduction; subduction zones Cocos plate, 25 Explorer plate, 97 Gorda plate, 97 Juan de Fuca plate, 96, 97 Nazca plate, 25 Pacific plate, 23, 25, 67 polar vortex, 206 population growth, 8, 9, 10, 50, A Poynter, Nelson, 243, See also communication: journalism, not-for-profit Prescott, Dr. William, 100, See also earthquakes, measuring susceptibility to: trilateration Protti, Dr. Marino, 6, See also disaster preparedness: Costa Rica earthquake

radioactive contaminants. See also disaster preparedness, failures in; Fukushima-Daiichi nuclear power plant; government; nuclear power alpha and beta particles, 78, A cancer cases, link to increase in, 80 Cesium (Cs), 75, 77, 78, A dumping of, 79 tracers for studying natural processes, 75 weapons testing, from, 75 refugees, 50, 216, 217, 218, 244, 255, See also global warming; sea level rise Reid, H. F, 28, 47, See also earthquakes, cause of: stick-slip and elastic rebound reporting the controversy, 211 Riggs, Dr. Stanley, 173, See also sea level rise: beaches, effect on popular tourist

Sagan, Carl, xiii Savage, Dr. Jim, 100, See also earthquakes, measuring susceptibility to: trilateration Schmidt Family Foundation, 189, See also global warming: marine life, effects on Schumpeter, Joseph, 63, See also creative destruction, concept of scientific literacy, lack of, xiv, 3 scientific reports. See also communication; communication, breakdown of; disaster preparedness; disaster preparedness, failures in; government; scientifists clarity, lack of, 139, 164, 197, 231 clarity, models of, 196, 266 communicating uncertainties, 198 simple messaging, necessity of, 198, 268 scientists. See also communication: communication, breakdown of; disaster preparedness; disaster preparedness, failures in; government; scientific reports communication skills, improvements to, 205 conflicts of interest, declaring, 241 credibility, mistakes affecting, 231 data, difficulty of communicating complex, 204, 230 defamation by politicians, 239, 268 defamation for industry criticisms, 128, 194, 238 hostility toward, xiv media communication. misrepresentation in, 43 "revolving door" phenomenon, 92 risk, communicating knowledge of, xiv, 3, 43, 58, 139, 196 role of, xiv whistle-blower protection, necessity of, 238, 239, 268 sea level rise, xiv, See also air pollution; building codes; communication; communication, breakdown of: costs resulting from disasters; disaster preparedness; energy use; floodrelated disasters; flooding; flooding,

future risk of; global warming;

scientific reports; scientists



## 298 INDEX

sea level rise (cont.) government subsidies for, 145, 146 alpine glaciers, melting, 168 hydrogen fuel, potential for, 254 beaches, effect on popular tourist, photosynthesis, potential for 172-175, 178 synthetic, 254 cause of. See global warming renewable energy alternative, 145 costs resulting from, 21, 172, 177, technologies, improving solar, 146 179, 244 third world potential for, 256 financial aid for third world to convert solar thermal power. See also energy use at-risk areas to green space, 245 solar-thermal power, 147, 148 flood events, effect on, xvii, 38, 39 Somerville, Dr. Richard, 203, 204, See also glacial isostatic adjustment (GIA), 178, A scientists: jargon, use of scientific global warming, product of, 167 Spiegelhalter, Dr. David, 43, 44, See also GRACE satellite mission, 168-170 disaster preparedness: insurance prices as deterrant for living in communication, role of at-risk areas, 245 Standard Oil. See Ethyl Corporation long-term thinking, consequences of lack Stein, Dr. Ross, 113, 114, See also of. 214 earthquakes, measuring low-lying coastal areas, increasing risk to, susceptibility to: propagating 9, 50, 170, A earthquake sequence Stein, Dr. Seth, 59, 60, 83 peripheral bulge, 179, 180 polar ice caps, melting, 168, 171 Steno, Nicolas, 6, 81, See also plate tectonics: prediction technology, opportunities superposition for, 177 storm surge. See also disaster preparedness; rate of, 167, A disaster preparedness, failures in; refugees due to, issue of, 50 flood-related disasters; flooding; saline water, damage from, 177 flooding, future risk of; hurricanes, satellite measurements, 167 future risk of; hurricanes, past; sea storm sewers, flooded, 173 level rise; scientific reports subsidies for relocating, 267 barrier islands, risk to, 157 sunny-day flooding, 173 coastal areas, risk to, 266 tax incentives for donating coastal natural barriers to, eliminating, 157 properties, 245 sea walls, 157 thermal expansion, 168 subduction. See also plate tectonics; plates, topographic maps, measuring using, 176 continental; plates, oceanic; sediment, 6, See also flood-related disasters; subduction zones; volcanic flooding, flooding, future risk of; sea eruptions; volcanic eruptions, past level rise catastrophic disasters, cause of, 25, 27, composition of, 23 32, 67, 83, 84, 96, 99, 263, A deposits, studying, 102 earthquakes, cause of, 26 "hot spot" volcanoes, 28 rate of sedimentation, 100, A trenches, formation of, 25, 26, 32 seismic reflection, role in, 99, 100 Sieh, Kerry, 83, See also earthquakes, volcanism, 25, 26, 33 measuring: radiocarbon dating subduction zones, 27, 32, 83, 84, 96, 235, solar power. See also energy use 263, A costs of, 145 "aseismic", 98, 99 Cascadia, 96, 97, 99, 100, 103, 106, A efficiency, 146, 266 study of, 99 energy costs, rising, 145 feesibility for larger facilities, 145 sunny-day flooding, 173 Florida's lack of utilization of, 147 superstition and natural disasters, 14, Germany's investment in, 146 16, 17



INDEX 299

Taleb, Nassim, 1, 2, See also black swans, tectonics; subduction; subduction concept of zones teaching the controversy, 211 earthquake size, lack of correlation with, Tetra-Ethyl Lead (TEL). See also air pollution; 81 86 disaster preparedness, failures in; landslides, underwater, 108 river deltas, 109, A Ethyl Corporation; global warming; government; industrial revolution, tsunamis, future risk of. See also building environmental impact of; Innospec; codes; disaster preparedness; flooding, future risk of; scientific health issues linked to, 122 reports; sea level rise; tsunamis, industrial use of, 123 measuring susceptibility to industry backlash against health Geneva, Switzerland, xvii, 12, 94, 101, criticisms of, 126, 128 108, 110 outlawed in US and UK, 123 Japan, 86 time-lapse photography, 222, 223, 224, 234 southern Hispaniola, 57 Tokyo Electric Power Company (TEPCO). tsunamis, measuring susceptibility to historical records, assembling and See also communication; disaster preparedness; disaster preparedness, studying, 109, A failures in; Fuushima-Daiichi radiocarbon dating, 7, 109 nuclear power plant; nuclear power; seismic reflection, 109 scienitfic reports turbidite deposits, studying, 87, 103-110 "act of God", portrayal of disaster as, 85 tsunamis, past. See also disaster "cold shutdown", use of term, 79 preparedness, failures in; core meltdowns at Fukushima-Daiichi, 70 earthquakes, past; flood-related earthquake risk, ignored warnings, 84, disasters; Fukushima-Daiichi 85.89 nuclear power plant Alaska (1964), 67 International Atomic Energy Agency (IAEA) investigation, 80 Chile (1960), 67 liability for role in accident, avoidance of, Fukushima, Japan (1896), 86 Grand Banks, Newfoundland (1929), 105 post-disaster reports, initial, 73, 80 Japan (1700 AD), 103 radioactive contaminants, low-balled Japan (1896), 86, 88 estimates of released, 73, 78, 79 Japan (2011), xiv, xvii, 2, 32, 67, 86 radioactive contamination, denial of, 79 Jogan tsunami, Japan (869 AD), 87, 91 transparency, xv, xviii, 56, 66, 76, 78, Messina, Italy (1908), 19 80, 92, 146, 239, 240, 244, 250, Oregon-Washington margin, 106 262, 263 Sumatra (2004), 14, 19, 20, 32 trenches, deep ocean. See also plates, Tyndall, John, 190, 211, See also global continental; plates, oceanic; plate warming: CO2 emissions, role of typhoons. See also flood-related disasters tectonics; sediment; subduction; subduction zones Typhoon Haiyan (2013), 22, 151, 155 creation of 25 Typhoon Nargis (2008), 154 oceanic plates, death of, 25, 27 typhoons, at-risk areas, 37 sediment-filled, 99, See sediment: rate of sedimentation US Geological Survey, 85, 102, 113, A subduction zones, in, 27, 97, 99 volcano monitoring, 21 tropical disease, expansion, 216, 217, A volcanic chains tsunami stones, 87 tsunamis, cause of, 14, 32, A, See also Cascadia, 96 earthquakes, cause of; plate cause of, 23, 24



# 300 INDEX

volcanic eruptions. See also disaster preparedness advance-warning factor, 21, 236 costs resulting from, 236 volcanic eruptions, future risk of Chile, 235 El Salvador, 21 Indonesia, 235 Japan, 235 New Zealand, 235 United States, 235 volcanic eruptions, natural benefits of CO2 balance, 24, 27, 34, A dating Greenland ice cores, 25 soil fertility from volcanic ash, 25, 48 surface water balance, 24, 26, 27 volcanic eruptions, past. See also mass extinction events global extinction events, 22 Mount Mazama, 107

Mt Vesuvius, 50 Mt. Pinatubo, 21 Mt. St. Helens (1989), 21, 236 Siberia. *See* mass-extinction events: Siberian volcanic eruptions

Watt, James, 118, See also coal: electricity production
wildfires, 219
wind power. See also energy use
cost of, 147
government subsidies for, 146
Wright, Frank Lloyd, 55, See also building
codes: earthquake-resistant
designs

Yamaguchi, Dr. David, 102, See also earthquakes, measuring susceptibility to: trees, studying rings and radiocarbon dating