**A synopsis of**

**‘*No place to hide: climate change, an introduction for New Zealanders’***

Jim Flynn (Potton & Burton (2016). ISBN978 0 947503 24 6) (85pp)

ABSTRACT (from the back cover):

Flynn’s strongest claim is that there are really two kinds of sceptics who must be rebutted: not just climate change deniers but also climate engineering deniers. He argues that we must face the fact that climate engineering is necessary to buy the time to achieve carbon-free energy, and that unless implemented soon, we will pass a point of no return. Proposals are needed that governments around the world can accept without committing political suicide.

PROLOGUE: FREEDOM & URGENCY

The carbon content of the atmosphere is crucial. The only substantive debate is about what consequences will occur at what levels [p1]. **The current negotiations for reducing carbon emissions are setting targets that are too low and deadlines that are far too late**. We must review proposals that buy time to keep temperature under control and use that time to develop really clean energy [p1].

**Both sides in the so-called climate debate are in denial. One side is denying scientific reality; the other side is denying political reality that the world’s leaders will not risk electoral defeat by compromising economic growth** [p2]. There is no solution without the use of clean energy [p2]. However its widespread adoption is too far into the future to stop irreversible climate change impacts [p2].

PART A: THE HISTORY OF OUR CLIMATE

*Chapter 1: Climate history - distant times*

Scientists have reconstructed the recent history of Earth’s temperatures using proxies that correlate with temperature including tree rings, corals, layers of sediments, pollen grains, ice cores, and boreholes [p5].

One billion years ago there was only a single supercontinent, Rhodenia, that 550 million years ago broke apart into 4 separate continents. These reassembled during the period 300 to 150 million years ago as the Pangaea supercontinent. Neither Rhodenia nor Pangaea featured land masses near either of Earth’s polar regions; in those eras there were no ice ages. Pangaea began to break up 200 million years ago into Eurasia (precursors of Eurasia and North America) and Gondwanaland (precursors of South America, Africa, Australasia, and Antarctica). The world assumed its present land distribution by about 56 million years ago when New Zealand was close to its present position and there were land masses in polar regions causing ice ages [p7].

**An ‘ice age’ is defined as any period whenever glaciers persist at Earth’s poles**. A ‘glaciation’ and an ‘interglacial’ are defined as those periods when glacial ice is advancing or contracting respectively [p8]. The most recent (Wurm or Otira) glaciation began 74,000 years ago, lasted 56,000 years, peaked 20,000 years ago, and ended 12,000 years ago. During this period, sea levels were 100 to 140 metres below current levels, suggesting dire consequences if today’s residual glaciers were to disappear entirely [p9].

*Chapter 2: Climate history – recent times*

During the past 11,000 years of the current interglacial, there have been six hot and five cold ‘snaps’ that impacted on humans [p11]. From 1100 to 1400AD there was a ‘Medieval Warm Period’ followed by an abrupt transition to a ‘Little Ice Age’ that lasted 450 years from 1400 to 1850 [p12]. Droughts and floods alternated, and famines were severe [p17]. After 1850 the world switched to the current warm period [p17].

Even relatively minor climate change can make conditions very unpleasant for humanity. **The current distribution of tectonic plates allows optimally-sized large polar ice caps that restrict temperature rise. Whether they persist or not will determine humanity’s future** [p18].

*Chapter 3: Today and today’s glaciers*

In addition to various small to moderate-sized glaciers, three great glaciers currently exist. One presently covers most of Greenland and is a remnant of the Arctic Glacier that, when fully extended, once covered northern Canada, Norway, Russia, and Alaska. The other two are the West Antarctic Glacier and the East Antarctic Glacier [p19].

Land ice is a glacier that rests on land like Greenland or Antarctica and contains no salt [p19]. Sea ice is ocean water that has frozen, rests (i.e. floats) on oceanic water, and contains salt. The mass of sea ice is tiny in comparison with the mass of land ice glaciers viz Arctic weighing 2.7 million billion tonnes (2.7 x 1015 tonnes), West Antarctic (2.1 x 1015 tonnes), and the biggest, East Antarctic (22.5 x 1015 tonnes) [p19]. **Polar ice caps largely determine the Earth’s surface temperature. Their glassy surface reflects solar radiation back into space. If they disappeared, human efforts to control atmospheric CO2 would be irrelevant because the consequent global temperature rise would be beyond human influence [p21].**

Climate scientists have attributed: rapid changes in temperature (e.g. hot and cold ‘snaps’) to changes in ocean currents (e.g. the ‘ocean conveyor’ that transports heat around the entire planet); and short term cooling effects to large volcanic eruptions [p23]. Today **there is no plausible cause of major climate change other than human-induced carbon emissions**. Humanity can now actually usurp the potency of plate tectonics to eliminate the polar glaciers that largely determine Earth’s surface temperature [p24].

PART B: CARBON AND OUR FUTURE

*Chapter 4: All about carbon*

Earth’s surface absorbs visible radiation (light) from the sun, causing heating. At the same time the Earth’s surface and the atmosphere emit infrared radiation back into space, causing cooling. Surface temperature would remain unchanged provided that heating and cooling effects were in balance. Nitrogen, oxygen, and argon comprise more than 99% of Earth’s atmosphere, are transparent to visible light and infrared radiation, and have no effect on temperature [p26].

CO2 and water vapour are minor constituents of the atmosphere that are also transparent to visible light but inhibit the escape of heat as infrared into space [p26]. Water vapour is continuously generated by evaporation and removed from the atmosphere by condensation [p27]. A combination of CO2 plus water vapour has three to five times the potency of CO2 alone in generating warmth [p28].

**Over geological eras, the influence of the changing distribution of the continents on climate undoubtedly was so massive that it swamped every other factor, including CO2 levels** [p29]. The quality of data for the past 800,000 years has revealed a remarkable correlation between Antarctic temperatures and atmospheric CO2 levels [p33]. Variations in CO2 levels of between 200 parts per million (hereafter ppm) and 270ppm are correlated with temperature fluctuations of 7°C [p34]. Between 1960 and 2008, atmospheric CO2 levels increased from 315ppm to 375ppm, raising mean global temperature by +0.6°C [p35].

The estimated human contribution to atmospheric CO2 through fossil fuel burning (**4-5Gt/yr**) and through deforestation (**2Gt/yr**) closely matches the observed overall annual nett increase in atmospheric CO2 (**4.5/6.5Gt/yr**) [p37]. This human contribution is modest compared with the natural addition of CO2 by soil oxidation/erosion (**61-62Gt/yr**) and respiration from organisms in the biosphere (**50Gt/yr**) and with the removal of CO2 by photosynthesis (**110Gt/yr**) and by diffusion into the oceans (**2.5Gt/yr**). The essential reason why the human contribution through fossil fuel burning and deforestation make so much difference is that the CO2 that nature adds and subtracts each year is closely in balance [p38].

*Chapter 5: Predictions*

Oxford scientists advise that, **assuming the persistence of current trends, climate models predict a temperature increase of +6°C by 2100 and the loss of the Greenland and West Antarctic Glaciers causing a sea level rise of about 12m [p39]**. The most recent 2016 estimates put sea level rise by 2100 as 2-5m (median rise of 3.5m). Even if CO2 is capped at 1000ppm by 2100, temperature is predicted to continue to rise and all three polar glaciers are predicted to be gone by 2300 [p39].

Permafrost is the subsoil with a high carbon content that is concentrated in massive deposits through northern Alaska, Canada, Greenland, and Siberia. Once converted to atmospheric CO2 by melting, permafrost could potentially increase CO2 levels by 800ppm. **Scientists warn of a ‘tipping point’ at which the temperature is sufficient to cause the irreversible melting of glaciers and permafrost, and also further warming irrespective of human efforts to reduce their carbon emissions** i.e. at a certain date, global warming may become a self-sustaining process [p42]. There is some disagreement about the date: most scientists suggest 2050 [p49].

Before the industrial revolution, the oceans vented CO2 in balance with its rate of absorption. Currently, CO2 concentration is increasing so rapidly that the oceans are absorbing more CO2 than they can release, resulting in acidification of the oceans that is threatening life in every marine ecosystem. Australia’s Great Barrier Reef is currently being destroyed by coral ‘bleaching’ [p44].

By 2100, small island nations are predicted to face extinction by sea level rise [p45]. The north-eastern provinces of China (600 million inhabitants) and all of Bangladesh (160 million inhabitants) face eventual inundation [p46]. Mass starvation as a consequence of climate-induced famine promises to be both a consequence and a solution to the problem of more people than food [48].

When scientists mention a ‘tipping point’ they are actually being literal. Beyond a certain year, further temperature rises become inevitable at least for a number of centuries. Most scientists set 2050 as the year when human carbon emissions will have increased the level of CO2 in the atmosphere to 500pmm [p49]. There are solutions to this threat that will emerge only if certain illusions are shed [p50].

*Chapter 6: Can we alter the future?*

**The greatest illusion is that nations will agree to cut their carbon emissions in time to escape the ‘tipping point’** [p51]. However unless world economic growth persists over this century, it is hard to see how poverty can be alleviated [p53]. Maintaining economic growth will require energy sources that are entirely clean (i.e. have zero carbon emissions) [p53]. **Although the public has become aware of the need to curb carbon emissions, the response of governments to date has been ‘feeble’; the Paris conference promised nothing better** [p53].

The Kyoto Protocol adopted in Kyoto in 1997 was the first international agreement to set binding reduction targets for carbon emissions [p54]. Subsequent negotiations have moved from city to city e.g. Bonn (2014) and Paris (2015) [p54]. On the level of rhetoric these targets are taken seriously. On the level of actually doing something, the reality is very different [p54]. As an example, to get a 50% reduction from the 1990 level of emissions, the world would need 2 million solar thermal plants or 8 million wind turbines or 12,000 nuclear power station (430 were operating at that time), or a mix of these three (solar, wind, nuclear) [p55].

The emissions ‘targets’ set at Paris in 2015 will become increasingly irrelevant and eventually a source of acrimony. With such daunting targets, it is easy to see why so little has been actually achieved [p55]. **Even if all nations met their Paris commitments, mean global temperature would nevertheless rise by +3C, exceeding the maximum +2°C limit agreed at Paris and a recommended ‘safe’ target limit of +1.5°C**[p55].

An article in *New Scientist* magazine (2016) has suggested that an effective strategy is ‘barely possible’. It argued that: (i) between 2015 and 2050, carbon emissions must be limited to a total of 800Gt causing a peak CO2 level of 500ppm and a temperature increase of +2°C; and (ii) between 2050 and 2100, ‘negative emissions’ would have to achieve the extraction of a total of 500Gt from the atmosphere. These negative emissions would reduce the atmospheric CO2 level to 430ppm and restrict the temperature increase to +1.5C which is considered to be a ‘safe’ level [p56].

However Flynn argues that this ‘barely possible’ strategy is ‘not remotely possible’ [p56]. Its two steps assume the virtual elimination of coal, oil, and natural gas well before 2050 and completely carbon-free generation of electricity [p56]. It would require a huge transformation: universal electric vehicles, aircraft run on biofuels etc. It would require a complete halt to deforestation [p56]. Even if a sane President had assumed office, the tremendous political power of the US coal, oil, and gas lobbies and their 2.7m workers and dependents has ‘the makings of a political nightmare’ [p57].

Preeminent climate scientist James Hansen has described the Paris conference as a ‘fraud’ and ‘worthless words’ for two reasons [p58]. Firstly, even if emissions were cut immediately by 80%, a ‘tipping point’ of CO2 level at 500ppm and an associate temperature rise of +2°C would be still reached [p58]. Secondly there is no feasible way of decarbonising the world’s economy within the next 50 years [p59]. Limiting economic growth in rich countries by cutting emissions, while allowing poor countries to grow to afford a reasonable standard of living for their populations, assumes a degree of altruism that no developed country possesses [p59]. Only economic growth can limit population: limiting population to contain growth reverses cause and effect [p60].

PART C: WHAT IS TO BE DONE?

*Chapter 7: alternatives to carbon-based energy*

Hansen (2008) has urged that carbon taxes are needed to discourage conversion of the vast fossil energy resources into usable reserves and to keep CO2 below a 450ppm ceiling [p63]. Oil, gas and coal reserves will last beyond 2100; hence high productivity should last beyond 2050, the ‘tipping point’. Beyond that the world economy may well implode, not preventing further global warming but instead adding to human misery [p63].

There is an overwhelming imperative looming over politics: economic growth cannot be stopped without abandoning the world’s poor. Nonetheless every year that passes shows that the current tools for decarbonising the economy cannot stop humanity from reaching the ‘tipping point’, the day when feedback mechanisms (higher temperatures, melting icecaps and permafrost etc) recreate the world without our permission [p68].

*Chapter 8: Two solutions*

Carbon provided 90% of energy in 1800, but by 2100, given present trends, hydrogen potentially could provide 90% [p69]. In 2013, the National Ignition Facility (NIF) in California achieved ‘ignition’, the fusion of heavy hydrogen into helium by lasers thereby releasing nuclear energy without generating any radioactive by-products [p71]. The laser fusion process is expected to be commercialised by 2030, enabling carbon-neutral power to begin replacing fossil energy power plants by 2050 [p71]. The National Spherical Torus Experiment (NSTX) in the US and the International Thermonuclear Experimental Reactor (ITER) in France both use magnetic fields rather than lasers to fuse heavy hydrogen into helium [p72]. A commercial prototype of ITER is anticipated also by 2030.

Climate engineering refers to deliberate large-scale intervention in the Earth’s climate system aiming to reduce global warming [73]. Counteracting the effects of increasing emissions from now to 2050 (or 2085) could be achieved by preventing an extra 2% (or 6%) of sunlight reaching the Earth’s surface [p73]. Currently 30% of incident sunlight is reflected back into space [74]. An increase to 32% by 2050 (or 36% by 2085) could have as-yet unknown effects on weather patterns and rainfall [p74].

The most advanced proposal for a physical sunshield comprises 16 trillion lightweight (1 gram) ‘flyers’ that would be injected into the Sun-Earth Lagrangian point 1.5 million km above the planet by 20 mile long electrically-powered artillery guns firing one capsule of ‘flyers’ into space every 5 minutes for 10 years [p74]. An alternative proposal involves pumping 100,000 tonnes of liquid sulphur dioxide into the stratosphere every year creating aerosol clouds of sulphates that would effectively act as a sunshield [p75].

A different approach proposed by Salter involves a fleet of 1500 unmanned ships dragging turbines through the water to create sea spray that is then pumped some 25 metres into the air as vaporised salt [p75]. This spray would cause existing clouds 1km above the Earth to become brighter, thereby reflecting more sunlight back into space [p75].

In Flynn’s assessment, Salter’s sea-spray ships are the best option [p75]. The mirror approach is prohibitively expensive, slow to take effect, and would be unacceptable to those countries that would lose much of their rainfall [p75]. Aerosol sulphates would wash out as acid rain, would require continuous replacement, and could damage the ozone layer [p76].

Flynn argues that the member countries of the United Nations (essentially the great powers) should be the ones to fund long-term clean energy and immediate climate engineering [p77]. Any nation that take steps towards energy efficiency would reduce its reliance on carbon-based power [p77]. Progress includes developments in solar and wind power [p77]. Small nations with the right rivers could do much to end their reliance on coal by installing osmotic power plants which are feasible wherever large quantities’ of fresh water flows into the ocean [p78]. The United Nations should compensate Brazil for protecting its rainforest which currently represents 10% of the world’s stored carbon [p78].

If post-Paris climate conferences stopped making gestures and faced reality, the situation is by no means hopeless [p80]. But we cannot drift for much longer [p80]. What is needed is some sort of global planning [p80]. While saving the Amazon rainforest and minimising ocean acidification are important, clean energy and climate engineering are fundamental to any effective long term strategy [p80]. Laser and perhaps plasma fusion offers real hope of carbon-free energy before 2100 [p80]. Salter’s sea-spray ships could postpone temperature rise until that time [p80]. Accordingly there is some prospect of stripping 2050 of its significance as the ‘tipping point’ year.

*EPILOGUE*

*Good will toward men*

In researching his book, Flynn reached two ‘unpalatable’ conclusions: **some form of climate engineering is necessary and the best hope for the world’s poor, and for stabilising the world’s population, is sustaining economic growth at its present level [p81].**

Optimism is hardly in order, but reshaping the history of the 21st century could read like this: sufficient Salter sea-spray ships are launched to lower current temperatures by 1°C; if temperatures could be reduced by 1°C by 2035-2040, the ‘tipping point’ could be avoided, halting feedback mechanisms of higher temperatures and glacial and permafrost melting from kicking in and overriding whatever humans do; dramatic progress toward clean power between 2016 and 2100 could allow economic growth to continue while emissions decreased; acidification of the oceans could be minimised; Africa could become prosperous enough to limit its own population, allowing the world’s total population to stabilise at 11 billion; zero CO2 emissions by 2100 would allow Salter sea-spray ships to be retired after (say) 100 years [p82].

Developments that are easy to follow and may arouse a sense of urgency include: yearly data about the decline of the Greenland and West Antarctic glaciers; summaries of IPCC reports that provide updates on whether the industrial powerhouse nations are setting and abiding by targets that actually lower emissions [p82].

One of the authors of the most recent IPCC report offered hope that humanity could avoid the ‘tipping point’ by progressively reducing human carbon emissions from their 2010 levels (much lower than today’s) by 40% to 70% by 2050. It is this ‘quixotic’ hope that has pushed so many advocates of a liveable Earth to despair [p83]. The only hope lies in giving political elites something they can do without committing political suicide by restricting economic growth [p83].

Flynn argues that the New Zealand government should go to the next UN climate conference with a coherent plan. It should ask the UN to commission 30 of Salter’s sea-spray ships at a cost of US$100 million (0.3% of the UN’s annual budget) noting that Russia is demanding that IPPC reports include an ‘insurance policy’ of climate engineering [p83]. The Energy and Resources Minister should ask the Russians what they have in mind. Every mayor of every New Zealand coastal city should approach the Energy and Resources Minister with the same message [p83]. The Government should contribute to a UN fund of about US$4 billion to compensate nations for not developing (i.e. deforesting) the Amazon basin [p83]. On a GNP shared basis, New Zealand’s contribution would be $15 million out of this country’s annual aid budget of $550 million [p83]).

In the 19th century, an international consensus on the wickedness of slavery made it indefensible [p84]. Sadly, politics today stands in the way of a similar consensus on climate change [p84]. If clean energy provided a foundation for continued economic growth, the alleviation of poverty, and a limit on global population, ‘everyone ought to be pleased’ [p85].

‘Psychological vetoes’ to progress do not solely come from climate change deniers [p85]. Many of the ‘alarmed’ contribute by describing climate engineering as: a ‘band aid’ that leaves the ‘central problem’ untouched; as counterproductive; as an expedient that nations would use to justify their failure to curb emissions [p85]. The ‘alarmed’ may be willing to face scientific reality but they also appear unable to face another kind of reality [p85]. They are essentially naïve about the politics and economics that doom much of what is being done now to failure and, worse, they have not assimilated the reality that the world’s best climate scientists such as Hansen appear to have thrown in the towel [p85].

To reiterate: **even the best conceivable emissions cuts would not save humanity from the ‘tipping point’ unless emission cuts were also accompanied by climate engineering to hold the line on temperature [p85].**

Making people better informed is rarely enough to solve problems of great consequence, but climate change may be a rare exception [p85]. Serious people, media people, and the political elite must start talking sense to one another. There may be a new ‘tipping point’ generated by ideas in physics, chemistry, politics, economics, and ethics that reinforce one another [p85].

Those who calculate they will die before the ‘tipping point’ and disengage have effectively declared war on humanity by ignoring the wellbeing of the people of the future just as they are ignoring the misery of many people of the present [p85]. Character must rise to the occasion [p85]. Most of us care about those who live in distant lands [p85]. We must care no less about what happens to humanity beyond our own lifespan [p85]. We are buying our good lives at the price of denying good lives to others [p85].

Climate change is an intellectual challenge but it is also a test of human solidarity [p85]. If we fail that test, we are not worth much: ‘No man rises far above the ranks’ [p85].

Synopsis (3679 words) by George Preddey PhD

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