# 1NC vs Westwood AR

## 1

### 1nc – topicality

#### Interpretation—the aff may not specify a just government

#### Indefinite singulars imply a “rules reading” where the sentence expresses a generic normative evaluation, especially true in the context of the resolution which is written normatively. Cohen 01

Ariel Cohen (Ben-Gurion University of the Negev), “On the Generic Use of Indefinite Singulars,” Journal of Semantics 18:3, 2001 <https://core.ac.uk/download/pdf/188590876.pdf>

\*IS generic = Indefinite Singulars

French, then, expresses the two types of reading differently. In English, on¶ the other hand, generic BPs are ambiguous between inductivist and normative¶ readings. But even in English there is one type of generic that can express only¶ one of these readings, and this is the IS generic. While BPs are ambiguous¶ between the inductivist and the rules and regulations readings, ISs are not. In¶ the supermarket scenario discussed above, only (44.b) is true:¶ (44) a. A banana sells for $.49/lb.¶ b. A banana sells for $1.00/lb.¶ The normative force of the generic IS has been noted before. Burton-Roberts¶ (1977) considers the following minimal pair:¶ (45) a. Gentlemen open doors for ladies.¶ b. A gentleman opens doors for ladies.¶ He notes that (45.b), but not (45.a), expresses what he calls “moral necessity.”7¶ Burton-Roberts observes that if Emile does not as a rule open doors for ladies, his mother could utter [(45.b)] and thereby successfully imply that Emile was not, or was¶ not being, a gentleman. Notice that, if she were to utter. . . [(45.a)] she¶ might achieve the same effect (that of getting Emile to open doors for¶ ladies) but would do so by different means. . . For [(45.a)] merely makes a¶ generalisation about gentlemen (p. 188).¶ Sentence (45.b), then, unlike (45.a), does not have a reading where it makes¶ a generalization about gentlemen; it is, rather, a statement about some social¶ norm. It is true just in case this norm is in effect, i.e. it is a member of a set of¶ socially accepted rules and regulations.¶ An IS that, in the null context, cannot be read generically, may receive a¶ generic reading in a context that makes it clear that a rule or a regulation is¶ referred to. For example, Greenberg (1998) notes that, out of the blue, (46.a)¶ and (46.b) do not have a generic reading:¶ (46) a. A Norwegian student whose name ends with ‘s’ or ‘j’ wears green¶ thick socks.¶ b. A tall, left-handed, brown haired neurologist in Hadassa hospital¶ earns more than $50,000 a year.¶ However, Greenberg points out that in the context of (47.a) and (47.b),¶ respectively, the generic readings of the IS subject are quite natural:¶ (47) a. You know, there are very interesting traditions in Norway, concerning the connection between name, profession, and clothing. For¶ example, a Norwegian student. . .¶ b. The new Hadassa manager has some very funny paying criteria. For¶ example, a left-handed. . .¶ Even IS sentences that were claimed above to lack a generic reading, such¶ as (3.b) and (4.b), may, in the appropriate context, receive such a reading:¶ (48) a. Sire, please don’t send her to the axe. Remember, a king is generous!¶ b. How dare you build me such a room? Don’t you know a room is¶ square?

#### Rules readings are always generalized – specific instances are not consistent. Cohen 01

Ariel Cohen (Ben-Gurion University of the Negev), “On the Generic Use of Indefinite Singulars,” Journal of Semantics 18:3, 2001 https://core.ac.uk/download/pdf/188590876.pdf

In general, as, again, already noted by Aristotle, rules and definitions are not relativized to particular individuals; it is rarely the case that a specific individual¶ forms part of the description of a general rule.¶ Even DPs of the form a certain X or a particular X, which usually receive¶ a wide scope interpretation, cannot, in general, receive such an interpretation in the context of a rule or a definition. This holds of definitions in general, not¶ only of definitions with an IS subject. The following examples from the Cobuild¶ dictionary illustrate this point:¶ (74) a. A fanatic is a person who is very enthusiastic about a particular¶ activity, sport, or way of life.¶ b. Something that is record-breaking is better than the previous¶ record for a particular performance or achievement.¶ c. When a computer outputs something it sorts and produces information as the result of a particular program or operation.¶ d. If something sheers in a particular direction, it suddenly changes¶ direction, for example to avoid hitting something.

#### That outweighs—only our evidence speaks to how indefinite singulars are interpreted in the context of normative statements like the resolution. This means throw out aff counter-interpretations that are purely descriptive

#### Independently, “Just government” is a generic indefinite singular.

Leslie 12 Leslie, Sarah-Jane. “Generics.” In Routledge Handbook of Philosophy of Language, edited by Gillian Russell and Delia Fara, 355–366. Routledge, 2012. <https://www.princeton.edu/~sjleslie/RoutledgeHandbookEntryGenerics.pdf> SM recut RE

GENERICS VS. EXISTENTIALS

The interpretation of sentences containing bare plurals, indefinite singulars, or definite singulars can be either generic as in (1) respectively or existential/specific as in (2):

(1) Tigers are striped

A tiger is striped

The tiger is striped.

(2) Tigers are on the front lawn

A tiger is on the front lawn

The tiger is on the front lawn.

The subjects in (1) are prima facie the same as in (2), yet their interpretations in (1) are intuitively quite different from those in (2). In (2) we are talking about some particular tigers, while in (1) we are saying something about tigers in general.

There are some tests that are helpful in distinguishing these two readings. For example, the existential interpretation is upward entailing, meaning that the statement will always remain true if we replace the subject term with a more inclusive term. For example, if it is true that tigers are on the lawn, then it will also be true that animals are on the lawn. This is not so if the sentence is interpreted generically. For example, it is true that tigers are striped, but it does not follow that animals are striped (Lawler 1973 Laca 1990; Krifka et al 1995). Another test concerns whether we can insert an adverb of quantification (in the sense of Lewis 1975) with minimal change of meaning (Krifka et al 1995). For example, inserting “usually” in the sentences in (1) (e.g. “tigers are usually striped”) produces only a small change in meaning, while inserting “usually” in (2) dramatically alters the meaning of the sentence (e.g. “tigers are usually on the front lawn). (For generics such as “mosquitoes carry malaria”, the adverb “sometimes” is perhaps better used than “usually”.)

#### This applies to the res – 1] Upward entailment test – “a just government ought to recognize a right to strike” doesn’t imply that “a society ought to recognize a right to strike” because an unjust government might not recognize a right to strike 2] Adverb test -- “a just government usually ought to recognize an unconditional right of workers to strike” doesn’t substantially change the meaning of the res

#### They have to win counter-definitions to both “A” and “government”—if we win a violation for either it proves they are outside the bounds of the topic

#### Violation—they specified Egypt—there are at least 200 countries that could count as “just governments” under their def’n

#### Vote neg:

#### 1] Precision – if we win definitions the aff is not topical. The resolution is the only predictable stasis point for dividing ground—any deviation justifies the aff arbitrarily jettisoning words in the resolution at their whim which decks negative ground and preparation because the aff is no longer bounded by the resolution.

#### 2] Predictable limits—specifying a just government offers huge explosion in the topic since they get permutations of hundreds of just governments in the world depending on their definition of just government. Neg positions like the Economy DA, Advantage CPs, etc. are jettisoned when the aff specifies a country that we don’t have specific ev to. Limits explodes neg prep burden and draws un-reciprocal lines of debate, where the aff is always ahead, turns their pragmatics offense. The Egypt aff is so tiny – literally there is no literature surrounding it so I’m stuck with generic strategy.

**3] TVA solves – read the aff as advantage – most authors advocate for a change in a strike writ large**

#### Topicality is a voting issue that should be evaluated through competing interpretations – it tells the negative what they do and do not have to prepare for—there’s no way for the negative to know what constitutes a “reasonable interpretation” when we do prep – reasonability is arbitrary and causes a race to the bottom, proliferating abuse

#### Fairness and education are voting issues – only terminal impacts to debate

#### No RVIs—it’s your burden to be topical.

## 2

### 1nc – topicality

#### Interp: the aff must defend a just government.

#### Violation: Egypt is totalitarian

Sam Hamad, TRT World, April 16th, 2018 “In Egypt a pharaoh rises as a nation is destroyed” [https://www.trtworld.com/opinion/in-egypt-a-pharaoh-rises-as-a-nation-is-destroyed-16766] Accessed 1/18/19 SAO

This was a revolutionary artform – by referencing the ancient and famous artform of hieroglyphs painted and carved on the walls of Egypt’s most famous monuments, depicting both the past, present and future of the country, the artists sought to claim that moment – January 25, 2011 until July 3, 2013 – as the time when the people got to express themselves. The monument was the revolution, and Pharaoh—for the first time in Egypt’s long history—was the people. Egypt’s organs of control, the hated Central Security Forces, had retreated, its institutions of domination were in chaos as people swarmed into Tahrir to claim their future. But there’s a new pharaoh in town. And he determines not just the present and the future in terrifying new ways, but the past too. This gets to the very core of counter-revolution and the necessity of totalitarianism in Sisi’s Egypt. Take the recent ‘election’. To even use the word ‘election’ to describe what occurred at the end of last month over the course of 3 days is an exercise in the absurd. No election took place in Egypt. At least Mubarak had the twisted courtesy to call his own anti-democratic re-accessions to the Egyptian throne as ‘democratic ceremonies’, but the Sisi regime, caught as it often is between the facade of change and vicious tyrannical arrogance, went ahead with this ‘ceremony’ as if it was an actual election. In truth, Sisi was simply re-anointed as president without any fuss. To call what occurred ‘political’, by the normal standard, is as equally preposterous. The event was brazenly anti-political. The usual political process of elections, such as antagonism between competing ideological forces via debates and electioneering, were of course entirely absent. In fact, anything political concerning the election was crushed. Even among the small pool of what you might call the ‘tolerated opposition’ (known as feloul in the era of democracy following January 25), Sisi acted swiftly to neutralise any potential challenge that might stir something among the pliable, conditioned and broken electorate. Genuine opposition? The two most famous candidates that tried to stand against Sisi were former Mubarak-era Army Chief of Staff Sami Anan and Mubarak’s former Prime Minister Ahmed Shafik, who was also the figurehead of the counter-revolutionary campaign to stop Egypt’s first democratically elected president Mohamed Morsi triumphing in the genuine election of 2012. While both are hardly bastions of freedom and democracy in Egypt, it’s wrong to say that they didn’t present specific threats to Sisi. Anan, for example, had courted support among the remnants of the once mighty but now broken, banned and underground Muslim Brotherhood, while he selected Hisham Geneina as his running mate. During Morsi’s time in government, Geneina had been Egypt’s top auditor, tasked with mapping the scale of the kleptocracy that had mushroomed under the rule of Mubarak and the military. Geneina’s auditing found that in just three years alone an astonishing $76 billion in public funds had been lost to Egypt’s kleptocrats. Of course, they couldn’t have that. In 2016, Geneina was sentenced to one-year in prison under the ludicrous charges of ‘spreading false news’ and ‘disturbing the peace’. For Anan to appoint him as his running mate for the 2018 election was thus a major signal to Sisi that he had real intentions of criticising the status quo that Sisi upholds. After announcing his intention to run, Anan was arrested and ‘interrogated’ under the charge of ‘inciting against the armed forces’. Most of his campaign staff were also arrested, including his running mate Geneina. Whatever the regime said to Anan and his team, met its desired effect – they promptly shut up and made no further criticisms of Sisi. The process was similar with Shafik. After Morsi’s election, Shafik, seeking to protect himself and his looted wealth, had fled to the UAE. After he declared his intention to run, Sisi’s main patrons in the UAE would not let him leave the country. Shafik made as much noise as possible about his ‘imprisonment’ in the UAE, including an interview with Al Jazeera, forcing them to relent and let him leave. Shafik landed in Egypt and was immediately detained. He barely got to touch Egyptian soil before he was whisked away by the notorious Mukhabarat. It’s worth noting the immediate danger Shafik posed to Sisi. Though the internal dynamics of Egypt's ruling Supreme Council of the Armed Forces (SCAF) are extremely hard to extrapolate, it is known that they are not unanimously uncritical when it comes to Sisi's presidential rule. It just might be that Shafik, who once garnered so much support from the same elites who now support Sisi, could truly shake things up for Sisi were he to stand against him. Even though the vote is fixed, his candidacy could’ve put a strain on the already creaking foundations of Egypt's establishment. One potential fault line is that Shafik might represent a wing of the Egyptian ruling class who aren't so keen on the extent to which Sisi has ceded so much sovereignty to Saudi Arabia and the UAE. One of Sisi's most fraught times in power was the controversy over Egypt giving the islands of Tiran and Sanafir to Saudi Arabia. Not only did Sisi face widespread criticism from the public over this, but, for the first time since he seized power, he faced public criticism from ruling class loyalists. This was followed by more criticism from within the establishment following the assassination of 16 high-ranking police officers in el Bahariya. In both cases, one of the loudest critics was none other than Ahmed Shafik, who tied the island issue to what he called "bad events in recent times under Sisi's rule”, as well as accusing Sisi of "betrayal". The way Shafik and Anan have been treated has ignited rumors that SCAF may not have Sisi's back forever, particularly if he keeps ceding Egypt's territorial integrity to the UAE, Saudi and Israel, and if he fails to secure US support and loans for the Egyptian Army. Every single meaningful candidate was blocked from running, but someone had to run. Who else better to run in a fake election than someone who supports Sisi? Enter Moussa Mustafa Moussa, leader of the pro-Sisi El Ghad Party and someone who had been—until he was forced to run against Sisi to complete the ceremony—gathering signatures for the Sisi campaign and openly advocating Sisi’s continued rule. He was chosen to be the token 3 percent to Sisi’s 97 percent. Sisi's friends manifest his fears But while it’s easy to look at all of this as a farce, it paints the sinister reality of the kind of society being shaped in Sisi’s Egypt. While Mubarak’s brand of authoritarianism, often brutal, reigned supreme, there was room, often mere millimetres, for dissent and antagonism towards the regime. In Sisi’s Egypt, however, which is one that has as its modus operandi not just overturning everything about January 25 but making sure nothing like January 25 could ever happen again, the point is to stamp out even the slightest hint of hope of change. Mubarak’s mistakes, such as giving too much freedom to campuses and not clamping down on the internet, are now the main targets of Sisi’s totalitarian order. Hannah Arendt once wrote of the way in which the totalitarian state relates to the subject that “there are no dangerous thoughts – thinking itself is dangerous”. And this was at the heart of Egypt’s non-election. The point was to blunt thought itself – to intimately attach ‘politics’ (i.e. Sisi’s re-anointment) with the absence of thought. Creativity is at the heart of democracy – self-organisation and self-determination are creative acts. This is what the murals on the wall represented – Egyptians, outside of the elite, grasping creative control of their country. This is everything that Sisi seeks to destroy – everything he fears: democracy, a politically engaged and active youth, open to the world through the internet and at university, as well as people capable of thinking beyond their often-dismal lives in a decaying third world country. This itself leads to the huge contradiction at the heart of Egypt. Egypt, under the control of destructive tyrants, is falling apart. In connivance with Sisi, Saudi’s new sociopathic heir apparent announces Egyptian mega-cities and the regime plans to build a new capital city in Egypt. These projects serve the double injustice of benefitting and appealing to Egypt’s kleptocrats, foreign investors and rich tourists. Egypt’s third world masses, now over 100 million of them, are, as ever, left behind in dusty, decaying old Cairo, where they increasingly live in slums and even in their own and others’ graves. For the elites, there are city-sized theme parks on the horizon from their gated communities, but for the poor there is only social destruction. Though Sisi tries to underpin all this by instituting a new totalitarianism—with campuses, once sites of fierce protest, now more akin to prisons, while simply questioning the military is an offence—the reality is that under the surface dissent continues to bubble away.

#### Vote neg for limits – allowing totalitarian countries explodes the caselist of affs exponentially and allows the north korea aff etc. which obviously woiuldnt be topical

#### c/a paradigm issues

## 3

### 1nc – counterplan

#### States should construct isolated, continuously manned, self-sufficient underground and underwater refuges that can support at least 100 people.

#### Solves extinction from nuclear war

Karim **Jebari 15**. Royal Institute of Technology, KTH, Teknikringen. 06/2015. “Existential Risks: Exploring a Robust Risk Reduction Strategy.” Science and Engineering Ethics, vol. 21, no. 3, pp. 541–554.

Costs While this measure would be quite expensive, it would probably be much cheaper than even the most optimistic assessments of colonizing the moon. There are already shelters that could be refitted for this purpose. A nuclear reactor with highly enriched uranium, similar to that which powers large submarines, would probably be the most costly item. Thus, a comparison with an Ohio-class submarine, with a crew of 155, seems reasonable. This submarine costs 2 billion USD. Even if this shelter would be an order of magnitude more expensive, it would still cost only a fraction of what a Moon colony would cost on the most optimistic cost assessment. Furthermore, this facility would reduce the risk of black swan extinction events with existing and proven technology. It could also be implemented at a very short notice, compared with even the most optimistic plans to colonize the Moon. Conclusion The notion of black swan extinction events present us with a daunting task. How to even start thinking about risks that are unknown? The stakes are further raised when considering that, on a large number of normative theories, an existential catastrophe implies a staggering loss of value. Thus, it is unwise to ignore the risk such an event represents. In engineering safety, a number of heuristics and strategies are device to prevent a catastrophic failure in a large number of possible scenarios. These strategies could be employed in thinking about how to reduce the risk of a black swan extinction event. Safety barriers are an instance of such a strategy. These could be actual physical barriers in some systems, or subsystems that prevent catastrophic failure by compartmentalization and physical separation. This article has discussed an example implementation of this strategy: isolated, continuously manned and self-sufficient underground refuges that could protect a large enough number of people to ensure the continued existence of mankind. While building such a ‘‘doomsday shelter’’ is less glamorous than colonizing the Moon, it may give us much more risk reduction for the money invested. The conceptual sketch of the project in this paper should be further developed in an interdisciplinary research project, which could benefit from the extensive literature on isolated, self-containing habitats. Architecture, engineering, social psychology and decision theory would probably be needed to fully assess the costs, and social and technological challenges.

## Case

#### I’ll concede the affs scenarios that they solve nuclear war, but I will impact turn it. Nuke war’s their only real terminal impact – we’ll read the best evidence in this debate which will guarantee you vote negative – if we win nuke war doesn’t cause extinction and resolves different existential threats utilitarian calculus would dictate that we should allow nuclear war to happen. They read extinction first

#### Even if you think they have some adv I’ll lbl their aff

#### France news ev is about israel and iran

#### No internal link on US Aid advantage – free speech is the concern with the US not strikes – Harker Reads Yellow

**1AC Pamuk 9/15** [ Humeyra Pamuk is a senior correspondent and a writer for Reuters, currently covering U.S. foreign policy and the State Department. Reuters “U.S. to hold $130 mln of Egypt's military aid over human rights -State Dept” 9/.15/2021(article was published 9/14 but updated 9/15) <https://www.reuters.com/world/middle-east/us-hold-130m-egypts-military-aid-over-human-rights-sources-2021-09-14/> ] //aaditg

WASHINGTON, Sept 14 (Reuters) - **The Biden administration will withhold $130 million worth of military aid to Egypt until Cairo takes specific steps related to human rights,** a State Department spokesperson said on Tuesday. Secretary of State Antony Blinken's move is a break with his predecessors' policy of overriding a congressional check on military aid to Egypt. In the past, an exception was granted to free up Foreign Military Financing for Abdel Fattah al-Sisi's government, worth $300 million this fiscal year, on the basis that it was in the interest of U.S. national security. But rights groups, which had called on the administration to block the entire $300 million aid, expressed disappointment at the decision, saying it was a "betrayal" of the U.S. commitment to promote human rights. The State Department spokesperson said in an emailed statement: **"We are continuing to discuss our serious concerns about human rights in Egypt".** Blinken "will move forward with the use of $130 million if the Government of Egypt affirmatively addresses specific human-rights related conditions," the statement added. **There was no immediate response** to a request for comment from Egypt's state press centre. Earlier, a U.S. official speaking on the condition of anonymity said the administration would approve $170 million but would put a hold on the remaining $130 million, making that available in future fiscal years **if Egypt improves its record.** "What the Biden administration has really done is waive the minimal human rights conditions imposed by Congress on a fraction of U.S. aid, while keeping a small portion of $130 million blocked on even more watered down conditions," said Sarah Leah Witson, executive director of advocacy group Democracy for the Arab World Now (DAWN). **The United States has provided around $1.3 billion in foreign assistance to Egypt annually since the 2017 fiscal year, according to a congressional research report.** Sisi, who ousted the Muslim Brotherhood in 2013, has overseen a crackdown on dissent that has tightened in recent years. **Rights groups say tens of thousands have been detained**, including Brotherhood leaders and secular activists.

#### .

#### I’ll LBL Edwards – they read one card for why nuke war is bad but havent substantiated anything else

#### The evidence is in the context of thousands of nuclear arsenals – they haven’t read evidence that indicates such a large amount of nuclear weapons would be used – the most likely scenario is launch of a few nukes since most of our nukes aren’t ready to launch immediately anyways and lack of

#### Firestorms are an internal link to nuke winter, not an independent impact.

#### 3. Literally just about North Korea

#### 4. This isn’t impact specific uniqueness – just about Kim Jong Un and Trump which doesn’t apply to the current political climate

#### 5. Fallout doesn’t apply because it might cause some damage but their card says it’s just in the US

#### 6. None of this actually substantiates anything the aff says – literally everything in the aff is about Egypt and there’s no draw-in scenario for other countries??

#### 7. Even if we lose spark just vote neg on presumption because they don’t have a terminal impact

#### 8. Ice age and winter won’t cause extinction

#### a---Black carbon won’t reach the stratosphere- 70% rains out in the first month and aerosol growth shortens the residence time- that’s Reisner

#### b---Islands-

#### ---i- Inhabitants of islands are surrounded by warm oceans and local volcanism that provide heat, energy, and food. They literally survived Snowball Earth and have bunkers that enhance survivability further- that’s Turkin and Green

#### ---ii- They’re isolated and have non-traditional food sources

Turchin and Green 18 (Alexey Turchin – Scientist for the Foundation Science for Life Extension in Moscow, Russia, Founder of Digital Immortality Now, author of several books and articles on the topics of existential risks and life extension. Brian Patrick Green – Director of technology ethics at the Markkula Center for Applied Ethics, teaches AI ethics in the Graduate School of Engineering at Santa Clara University. <MKIM> “Islands as refuges for surviving global catastrophes”. September 2018. DOA: 7/20/19. https://www.emerald.com/insight/content/doi/10.1108/FS-04-2018-0031/full/html?fullSc=1&mbSc=1&fullSc=1)

Islands offer excellent protection against natural and/or **low-tech catastrophes** which are neither too large nor too small. Remoteness, isolation and the diverse conditions found on different islands could be helpful features to aid survival in the face of different types of catastrophes. Islands could provide protection against a human-to-human transmitted biological pandemic; as mentioned in the Introduction, some islands were able to escape the 1918 flu pandemic by implementing effective quarantine measures. Islands may help to survive a **long-term collapse in food production caused by nuclear winter**, agricultural pests and other catastrophes. Islands often have **non-traditional food sources**, such as birds and sea flora and fauna, which may provide independent subsistence for an indefinitely long period. On remote islands, **the extent of radioactive and chemical contamination from catastrophes would likely be smaller**. This is especially true of islands located in the Southern hemisphere close to the Antarctic, as **winds around the pole maintain some isolation from the rest of the atmosphere**. **Constant rains and winds may accelerate the decontamination of some islands** (like Kerguelen). In addition, **sea animals may be relatively less contaminated food sources**. Islands away from the equator could provide protection against some of the direct effects of a gamma ray burst (muons) (Cirkovi c and Vukoti c, 2016 ) if they were in the constant shadow of the Earth, below the horizon of the gamma ray source. In the case of global war or technological collapse, **many islands could become unreachable**. This would protect them against human-borne diseases, pirates, looters and certain autonomous weapon systems such as land-based or short-range drones. Additionally, remote and sparsely populated islands may not be interesting military targets. In case of war, it may be more expensive to reach them than to ignore them, though this depends on the nature of the war. For example, the Germans used remote unpopulated islands in the Arctic (Grossman, 2016) and in the Southern Ocean (Rogge and Frank, 1956) as secret bases during Second World War, and the allies later sent cruisers to Kerguelen to check if Germans were hiding there. It might be too expensive for a hostile AI to seek out and kill small groups of people in remote places, if they do not pose an immediate risk to the AI’s interests. However, over time, the AI’s risk calculation might change.

#### 9.No credible scenario for extinction—outdated fringe science and well-meaning threat inflation

Scouras 19 (James Scouras, Johns Hopkins University Applied Physics Laboratory, formerly served on the congressionally established Comission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, “Nuclear War as a Global Catastrophic Risk”, Cambridge Core, 9-2-2019, available at https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/nuclear-war-as-a-global-catastrophic-risk/EC726528F3A71ED5ED26307677960962, accessed 12-1-2019, HKR-cjh)

\*footnotes 2 and 4 included

It might be thought that we know enough about the risk of nuclear war to appropriately manage that risk. The consequences of unconstrained nuclear attacks, and the counterattacks that would occur until the major nuclear powers exhaust their arsenals, would far exceed any cataclysm humanity has suffered in all of recorded history. The likelihood of such a war must, therefore, be reduced as much as possible. But this rather simplistic logic raises many questions and does not withstand close scrutiny. Regarding consequences, does unconstrained nuclear war pose an existential risk to humanity? The consequences of existential risks are truly incalculable, including the lives not only of all human beings currently living but also of all those yet to come; involving not only Homo sapiens but all species that may descend from it. At the opposite end of the spectrum of consequences lies the domain of “limited” nuclear wars. Are these also properly considered global catastrophes? After all, while the only nuclear war that has ever occurred devastated Hiroshima and Nagasaki, it was also instrumental in bringing about the end of the Pacific War, thereby saving lives that would have been lost in the planned invasion of Japan. Indeed, some scholars similarly argue that many lives have been saved over the nearly threefourths of a century since the advent of nuclear weapons because those weapons have prevented the large conventional wars that otherwise would likely have occurred between the major powers. This is perhaps the most significant consequence of the attacks that devastated the two Japanese cities. Regarding likelihood, how do we know what the likelihood of nuclear war is and the degree to which our national policies affect that likelihood, for better or worse? How much confidence should we place in any assessment of likelihood? What levels of likelihood for the broad spectrum of possible consequences pose unacceptable levels of risk? Even a very low (nondecreasing) annual likelihood of the risk of nuclear war would result in near certainty of catastrophe over the course of enough years. Most fundamentally and counterintuitively, are we really sure we want to reduce the risk of nuclear war? The successful operation of deterrence, which has been credited – perhaps too generously – with preventing nuclear war during the Cold War and its aftermath, depends on the risk that any nuclear use might escalate to a nuclear holocaust. Many proposals for reducing risk focus on reducing nuclear weapon arsenals and, therefore, the possible consequences of the most extreme nuclear war. Yet, if we reduce the consequences of nuclear war, might we also inadvertently increase its likelihood? It’s not at all clear that would be a desirable trade-off. This is all to argue that the simplistic logic described above is inadequate, even dangerous. A more nuanced understanding of the risk of nuclear war is imperative. This paper thus attempts to establish a basis for more rigorously addressing the risk of nuclear war. Rather than trying to assess the risk, a daunting objective, its more modest goals include increasing the awareness of the complexities involved in addressing this topic and evaluating alternative measures proposed for managing nuclear risk. I begin with a clarification of why nuclear war is a global catastrophic risk but not an existential risk. Turning to the issue of risk assessment, I then present a variety of assessments by academics and statesmen of the likelihood component of the risk of nuclear war, followed by an overview of what we do and do not know about the consequences of nuclear war, emphasizing uncertainty in both factors. Then, I discuss the difficulties in determining the effects of risk mitigation policies, focusing on nuclear arms reduction. Finally, I address the question of whether nuclear weapons have indeed saved lives. I conclude with recommendations for national security policy and multidisciplinary research. 2 Why is nuclear war a global catastrophic risk? One needs to only view the pictures of Hiroshima and Nagasaki shown in figure 1 and imagine such devastation visited on thousands of cities across warring nations in both hemispheres to recognize that nuclear war is truly a global catastrophic risk. Moreover, many of today’s nuclear weapons are an order of magnitude more destructive than Little Boy and Fat Man, and there are many other significant consequences – prompt radiation, fallout, etc. – not visible in such photographs. Yet, it is also true that not all nuclear wars would be so catastrophic; some, perhaps involving electromagnetic pulse (EMP) attacks 2 Many mistakenly believe that the congressionally established Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack concluded that an EMP attack would, indeed, be catastrophic to electronic systems and consequently to people and societies that vitally depend on those systems. However, the conclusion of the commission, on whose staff I served, was only that such a catastrophe could, not would, result from an EMP attack. Its executive report states, for example, that “the damage level could be sufficient to be catastrophic to the Nation.” See www.empcommision.org for publicly available reports from the EMP Commission. See also Frankel et al., (2015).2 using only a few high-altitude detonations or demonstration strikes of various kinds, could result in few casualties. Others, such as a war between Israel and one of its potential future nuclear neighbors, might be regionally devastating but have limited global impact, at least if we limit our consideration to direct and immediate physical consequences. Nevertheless, smaller nuclear wars need to be included in any analysis of nuclear war as a global catastrophic risk because they increase the likelihood of larger nuclear wars. This is precisely why the nuclear taboo is so precious and crossing the nuclear threshold into uncharted territory is so dangerous (Schelling, 2005; see also Tannenwald, 2007). While it is clear that nuclear war is a global catastrophic risk, it is also clear that it is not an existential risk. Yet over the course of the nuclear age, a series of mechanisms have been proposed that, it has been erroneously argued, could lead to human extinction. The first concern3 arose among physicists on the Manhattan Project during a 1942 seminar at Berkeley some three years before the first test of an atomic weapon. Chaired by Robert Oppenheimer, it was attended by Edward Teller, Hans Bethe, Emil Konopinski, and other theoretical physicists (Rhodes, 1995). They considered the possibility that detonation of an atomic bomb could ignite a self-sustaining nitrogen fusion reaction that might propagate through earth’s atmosphere, thereby extinguishing all air-breathing life on earth. Konopinski, Cloyd Margin, and Teller eventually published the calculations that led to the conclusion that the nitrogen-nitrogen reaction was virtually impossible from atomic bomb explosions – calculations that had previously been used to justify going forward with Trinity, the first atomic bomb test (Konopinski et al., 1946). Of course, the Trinity test was conducted, as well as over 1000 subsequent atomic and thermonuclear tests, and we are fortunately still here. After the bomb was used, extinction fear focused on invisible and deadly fallout, unanticipated as a significant consequence of the bombings of Japan that would spread by global air currents to poison the entire planet. Public dread was reinforced by the depressing, but influential, 1957 novel On the Beach by Nevil Shute (1957) and the subsequent 1959 movie version (Kramer, 1959). The story describes survivors in Melbourne, Australia, one of a few remaining human outposts in the Southern Hemisphere, as fallout clouds approached to bring the final blow to humanity. In the 1970s, after fallout was better understood to be limited in space, time, and magnitude, depletion of the ozone layer, which would cause increased ultraviolet radiation to fry all humans who dared to venture outside, became the extinction mechanism of concern. Again, one popular book, The Fate of the Earth by Jonathan Schell (1982), which described the nuclear destruction of the ozone layer leaving the earth “a republic of insects and grass,” promoted this fear. Schell did at times try to cover all bases, however: “To say that human extinction is a certainty would, of course, be a misrepresentation – just as it would be a misrepresentation to say that extinction can be ruled out” (Schell, 1982). Finally, the current mechanism of concern for extinction is nuclear winter, the phenomenon by which dust and soot created primarily by the burning of cities would rise to the stratosphere and attenuate sunlight such that surface temperatures would decline dramatically, agriculture would fail, and humans and other animals would perish from famine. The public first learned of the possibility of nuclear winter in a Parade article by Sagan (1983), published a month or so before its scientific counterpart by Turco et al. (1983). While some nuclear disarmament advocates promote the idea that nuclear winter is an extinction threat, and the general public is probably confused to the extent it is not disinterested, few scientists seem to consider it an extinction threat. It is understandable that some of these extinction fears were created by ignorance or uncertainty and treated seriously by worst-case thinking, as seems appropriate for threats of extinction. But nuclear doom mongering also seems to be at play for some of these episodes. For some reason, portions of the public active in nuclear issues, as well as some scientists, appear to think that arguments for nuclear arms reductions or elimination will be more persuasive if nuclear war is believed to threaten extinction, rather than merely the horrific cataclysm that it would be in reality (Martin, 1982). 4 As summarized by Martin, “The idea that global nuclear war could kill most or all of the world’s population is critically examined and found to have little or no scientific basis.” Martin also critiques possible reasons for beliefs or professed beliefs about nuclear extinction, including exaggeration to stimulate action.4 To summarize, nuclear war is a global catastrophic risk. Such wars may cause billions of deaths and unfathomable suffering, as well set civilization back centuries. Smaller nuclear wars pose regional catastrophic risks and also national risks in that the continued functioning of, for example, the United States as a constitutional republic is highly dubious after even a relatively limited nuclear attack. But what nuclear war is not is an existential risk to the human race. There is simply no credible scenario in which humans do not survive to repopulate the earth.

#### 10. Civil defense investments prevent nuclear war from causing extinction under any reasonable estimates.

Charles L. Sanders 17. Scientists for Accurate Radiation Information, PhD in radiobiology, professor in nuclear engineering at Washington State University and the Korea Advanced Institute of Science and Technology. 2017. “Radiological Weapons.” Radiobiology and Radiation Hormesis, Springer, Cham, pp. 13–44. link.springer.com, doi:10.1007/978-3-319-56372-5\_2.

2.5 Survival of Nuclear War The penetrating nature of γ-rays requires substantial shielding with denser materials in high-dose fallout regions. No lethality is expected from a radiation dose rate of 100 mGy/h. An initial dose rate from fallout of 1.0 Gy/h would not be lethal if minimum protection is taken (e.g., staying indoors). An initial dose rate of 10 Gy/h is lethal unless substantially shielded. A shelter providing a protection factor of 100 would suffice. A dose rate of 100 Gy/h would be lethal unless in the best of radiation shelters that give a protection factor of ≥500. However, the area downwind from a nuclear detonation with these high-dose rates would be limited. To protect yourself from fallout, it is essential to find shelter. The dose protection factor of a shelter is the protection afforded someone inside the shelter from radiation originating from the outside. For example, a dose protection factor of 5 means that the radiation level inside the shelter is five times less than the radiation level outside the shelter at the surface of the ground. Dose protection factors vary widely according to building construction, floor level in a multistory building, and proximity to other buildings. A dose protection factor of 5 can be assumed for most woodframe buildings. Most basements provide protection factors of about 50 in at least one area. Building a simple 6-foot trench shelter in your backyard covered with a few feet of dirt on a door would provide protection from thermal and blast effects and a protection factor of 500 from radiation fallout (Table 2.4). Provision of shelters that can withstand 100 psi blast waves, such as subway and utility tunnels, could save nearly 70% of the American urban population from a 9000-MT attack. US ICBM silos are built to withstand up to 2000 psi [60]. Americans are dreadfully ignorant on the subject of civil defense against nuclear war. Americans don’t want to talk about shelters. Most who take shelters seriously are considered on the lunatic survivalist fringe. The current US rudimentary fallout shelter system can only protect a tiny fraction of the population. There are probably less than one in a 100 Americans who would know what to do in the case of nuclear war and even fewer with any contingency plans. The civil defense system should, instead, provide stockpiles of food, water, medical supplies, radiological instruments, and shelters in addition to warning systems, emergency operation and [[TABLE 2.4 OMITTED]] communication systems, and a trained group of radiological monitors and shelter managers. There is a need for real-time radiation measurements in warning the public to seek shelter and prevent panic [61]. Shelters and a warning system providing sufficient time to go to a shelter are the most important elements of civil defense. The purpose of a shelter is to reduce the risks of injury from blast and thermal flux from nearby detonations and from nuclear fallout at distances up to hundreds of miles downwind from nuclear detonations. There are several requirements for an adequate shelter: 1. Availability—Is there space for everyone? 2. Accessibility—Can people reach the shelter in time? 3. Survivability—Can the occupants survive for several days once they are in the shelter? That is, is there adequate food, water, fresh air, sanitation, tools, clothing, blankets, and medical supplies? 4. Protection Factor—Does the shelter provide sufficient protection against radiation fallout? 5. Egress—Is it possible to leave the shelter or will rubble block you? There are several good publications that provide information for surviving nuclear war [62–64]. Two that offer good practical advice are Nuclear War Survival Skills by Kearny [65], and Life after Doomsday by Clayton [66]. Fallout is often visible in the form of ash particles. The ash can be avoided, wiped, or washed off the body or nearby areas. All internal radiation exposure from the air, food, and water can be minimized by proper ventilation and use of stored food and water. Radioactivity in food or water cannot be destroyed by burning, boiling or, using any chemical reactions. Instead it must be avoided by putting distance or mass between it and you. Radioactive ash particles will not induce radioactivity in nearby materials. If your water supply is contaminated with radioactive fallout, most of the radioactivity can be removed simply by allowing time for the ash particles to settle to the bottom and then filtering the top 80% of the water through uncontaminated clay soil which will remove most of the remaining soluble radioactivity. Provision should be made for water in a shelter: 1 quart per day or 3.5 gallons per person for a nominal 14-day shelter period. A copy of a book by Werner would be helpful for health care [67]. During the 1950s, there was firm governmental support for the construction and stocking of fallout shelters. In Eisenhower’s presidency, the National Security Council proposed a $40 billion system of shelters and other measures to protect the civilian population from nuclear war. Similar studies by the Rockefeller Foundation, the Rand Corporation, and the MIT had earlier made a strong case for shelter construction. President Kennedy expected to identify 15 million shelters, saving 50 million lives. Even at that time, there were many who felt this was a dangerous delusion giving a false sense of security. However, the summary document of Project Harbor (Publication 1237) concerning civil defense and the testimony before the 88th Congress (HR-715) both strongly supported an active civil defense program by the US government. A latter 1977 report to Congress concluded that the USA lacked a comprehensive civil defense program and that the American population was mostly confused as to what action to take in the event of nuclear war. President Carter advocated CRP (Crisis Relocation Planning) as the central tenet of a new civil defense program. President Reagan in 1981 announced a new civil defense program costing 4.2 billion dollars over a 7-year period; this program included CRP and the sheltering of basic critical industries in urban and other target areas. President Reagan believed that civil defense will reduce the possibility that the USA could be coerced in time of crisis by providing for survival of a substantial portion of her population as well as continuity for the government. Stockpile, sheltering, and education could be a relatively cheap insurance policy against Soviet attack [68]. With the fall of the U.S.S.R. came a lack of continuing interest in preparation to survive a nuclear war in subsequent administrations. The Pentagon recommended to the Reagan administration that the USA adopt a Soviet-style civil defense program, combining evacuation with fallout shelters. It was suggested that the Americans use doors wrapped in plastic to cover hastily dug trenches in their backyards. The US strategy is like poker while the Soviets’ is like chess. If we bluff and lose, we lose the game. If the Soviets bluff and lose, they only lose one piece. The Soviets have prepared for “social control” following nuclear war, while many Americans believe that all would die. Thus, a prerequisite for any substantial change in US civil defense policy requires a change in popular attitude about survival. Reagan planed for a hypothetical postwar future society in almost bizarre detail. In one additional touch worthy of Dr. Strangelove himself, it was proposed that a select group of volunteers—men and women with a carefully chosen range of skills and talents—live on the continuously moving, subterranean train and that the underground community be equipped with nuclear reactors and hydroponic gardens to sustain life in what was termed “the post-attack environment” [69]. Carl Sagan called for rejecting civil defense, appearing on television to denounce SDI military weapons [70]. Some would prefer surrender to any risk of nuclear war [71]. In 1986 the states of Oregon and Washington withdrew from an emergency drill organized by the FEMA as a protest against “planning for nuclear war.” The drill involved a hypothetical attack on these two states with 48 warheads. According to Oregon Rep. Wayne Fawbush: If you lead people to believe that a nuclear exchange can be survived, you promote the possibility of it happening. If the US was better prepared to survive a nuclear attack, then others would be less likely to launch one. Thus civil defense does not signal a willingness to wage war, but a willingness to deter war by making it less tempting to a potential aggressor. It was to the Soviets politically advantage to hyperbolically emphasize the ‘dreadful’ effects of nuclear weapons to promote American disarmament. The consequences of using nuclear weapons defy human imagination … all-out nuclear war would cause the death of more than 200 million people and 60 million more would be mutilated … Such a nuclear war would inevitably lead to global catastrophe … 80 percent of doctors would perish, 80 percent of hospital beds would be destroyed as would nearly all supplies of blood, antibiotics and other medicines … epidemics would start, radiation will remain a threat…Understand me well. We do not wish to frighten the world with these apocalyptic figures and facts. No, we wish to show the realities of a nuclear war and what needs to be done to prevent it [72]. The Federal Emergency Management Agency (FEMA) was formed in 1979, consolidating in one agency the various federal bureaucracies involved in disaster management. The 1986 FEMA plan calls for sheltering local, state, and federal officials from nuclear war, while everyone else will have to shift for themselves. Land records will be taken into shelters. The federal government denies that this is an elitist strategy but that it is rather to insure that emergency-management infrastructure survives to direct the recovery of the surviving general population. The FEMA admits that as many as half our citizens or more would be lost to the direct and indirect effects of the weapons themselves, and millions more would die in the chaos of the post-attack environment. Current FEMA strategy also calls for return to the traditions of the 1950s when school children were instructed to curl under their desks when they saw a bright flash of light. The USA is woefully unprepared for nuclear war because of radiophobia (Table 2.5). The FEMA is absent before the American public about advice. To be politically correct, the FEMA just assumes that it will never happen. To educate the public in their mind is to enhance the probability of nuclear war. A false emphasis is on prevention of nuclear war not on preparation. The National Radiological Defense Agency of the FEMA is responsible for providing radiation detection instruments, training of personnel in their use, and educating large segments of the American population about radiation hazards. A low budget and even lower public visibility have made this program largely ineffectual. The FEMA had actively promoted CRP as a method to move these more vulnerable populations prior to a war. The current goal of CRP is 80% survival of the US population following a 6559-MT attack on the USA; according to this scenario, 45 million Americans would die. During the initial phase of CRP, 150 million people would be expected to travel from 50 to 300 miles to designated low-risk areas. They will join about 75 million, totaling a shelter population of 195 million. For some the concept of CRP is flawed, unworkable, and dishonest, being in itself a [[TABLE 2.5 OMITTED]] significant threat to instigating a war since its implementation would be a sign to an enemy that we are preparing to fight a total nuclear war. To others it is common sense that we should plan for all contingencies. No one disagrees that to achieve 80% US survival will require several days to carry out evacuation and a whole lot more preparation, organization, and staffing than now exists. Richard Beal, former director for crisis management systems and planning under President Reagan, believes that “national security planning is a myth” because information uncertainty is the normal course in a crisis and that no one has devised a reliable system for tracking the implementation of presidential decisions in crises. The current White House executives have little or no experience with previous crises, making it very difficult to swiftly and accurately analyze crises using available intelligence and information. Some experts believe that civil defense will have no effect on initiation or outcome of a nuclear war. Lauriston Taylor wrote: Nobody in his right mind believes that a nuclear war can be won by anyone-civil defense or no civil defense. No worse tragedy can befall man. Unfortunately, the worst situation that can be computed today, involving a maximum mutual attack by two opponents, will not destroy man, in spite of all the nonsense that has been written to the contrary … On the basis of the worst double attack scenario that can be visualized today, it is anticipated that about 80% of the US population would die within 30 days of the attack. That means that 20% will be left in survivable condition … in varying degrees of distress, almost beyond our imagination to comprehend. Incidentally, this is almost exactly the American population just 100 years ago … Civil defense is in no sense a preparation for war. The existence or nonexistence of civil defense preparations by any party to nuclear war will have no influence on such a war coming about [73]. Paradoxically, it was Taylor who received an accidental whole-body exposure of 10 Gy and believed that 2 mGy/d (730 mGy/y) was safe while living to 102 years (Chap. 1). Nevertheless, Taylor had gotten taken up by doomsday frenzy. During the Cold War, the USA was wanting to exaggerate the effects of nuclear weapons testing to deter the U.S.S.R. from nuclear expansion and other countries from developing nuclear weapons. The U.S.S.R. did the same exaggeration when they had achieved the same capability as the USA, emphasizing that there would be no winners in a nuclear war. Their motivation was not to prevent radiation harm to its population but was political to discourage others to develop nuclear weapons. Exaggerations of the effects of nuclear war will paralyze us. We could accomplish much for so little, spending only 1% of our defense budget on civil defense. The USA has carried out little public education on how to survive nuclear war. In contrast, the U.S.S.R. had carried out an extensive educational program for all its citizens on how to survive a nuclear war. Its citizens are instructed on how to construct a simple, underground trench shelter in less than a day. The Soviets had a highly organized civil defense program, with a planned-for evacuation of cities and construction of underground shelters for some of their industries and for governmental personnel. Civil defense in the U.S.S.R. was part of everyday life as well as a propaganda tool. In peacetime, the U.S.S.R. civil defense program employed 115,000 people under military control; this could be rapidly expanded during wartime to 15,000,000. The first priority of Soviet civil defense is the survival of its political leaders. Because of this emphasis, part of the US strategy was to target Soviet leaders. The CIA predicted 25–35 million deaths in the U.S.S.R. if they had less than a week to evacuate their cities prior to total nuclear war with the USA and 100 million deaths if no warning was given [74]. Only ten million Soviets would die in total war with the USA if given 7–10 days for total evacuation and preparation [75]. In general, Europeans have in the past taken a much more serious and professional view about civil defense than do Americans. American shelters are often considered socially divisive, even though Americans are the most heavily insured people in the world. The reality is that Europeans believe with much justification that simple shelters are remarkably effective in protecting from the effects of nuclear weapons. European countries have extensive civil defense programs. Before 1990 in Switzerland, nearly two-thirds of their population had been provided shelter protection; by 1990, all their population was sheltered. Civil defense training is compulsory for all Swedes with significant support from volunteer agencies [76].

#### 11. Only takes 100 to repopulate– studies.

Corey S. Powell 18, 8-13-2018, "How many humans would it take to keep our species alive? One scientist's surprising answer," NBC News, https://www.nbcnews.com/mach/science/how-many-humans-would-it-take-keep-our-species-alive-ncna900151//HM

In recent years, astronomers have found thousands of planets orbiting nearby stars, making the old science-fiction trope of off-world colonies seem a bit less absurd. But it was the 2016 discovery of a potentially habitable Earth-size planet around Proxima Centauri, the nearest star after the sun, that really got people thinking: Are we too vulnerable to asteroid strikes and other cataclysms to stick with our single planet? Could we safeguard our species by sending a space ark to a new home, a la "Battlestar Galactica" or the movie "Passengers?" Frédéric Marin is among those who are doing the hard thinking. The University of Strasbourg astrophysicist has been focusing not on the engineering issues of interstellar travel (which lie beyond current technology) but on the biology side of the question: How many crew members would be needed for an interstellar voyage that might last dozens of generations? In other words, what is the minimum number of people required to deliver and successfully plant a self-sustaining population of Homo sapiens on another Earth? “I was reading a lot on the human psychological aspect of spaceflight, and I realized that all books I’ve read and all the movies I’ve seen that were dealing with multiple-generation ships were very naïve,” Marin says. “Since I have access to huge computing power and state-of-the-art simulation tools, I decided to solve this on my spare time.” So when he wasn’t busy simulating galaxies and black holes, Marin created a computer program that mimics the progress of a breeding population. Then he used the program, dubbed Heritage, to simulate the risks a spacefaring population would face, including the effects of inbreeding as well as of catastrophic events like a deadly pandemic or being hit by some celestial object. A paper about his research was published in February in the Journal of the British Interplanetary Society. The magic number The number Marin came up with is 98. Just 98 healthy people would be needed to operate the ship over many generations and to set up a healthy (non-inbred) population on another world, he estimates. That number holds even for his test case of a space ark mission lasting more than 6,000 years, although he allows for the population aboard the ark to grow over time — up to about 500, perhaps. The implications of this finding go far beyond the sorts of spaceships we might be able to build in another century or two. “Our results apply to any enclosed environment where emigration and immigration are not possible,” Marin says. “The same elements are essential for any self-sustaining colony, so our code can easily compute the survival rate of a group of humans after a local or global catastrophe as well.” So even if billions of humans were wiped out by some catastrophe, as long as a suitable group of 98 survived and were able to mate, Marin says, they could carry enough genetic diversity to propagate the species and rebuild the population. Rival calculation Marin acknowledges that 98 sounds like an awfully small number. But he insists it makes sense, even knowing that Cameron Smith, an anthropologist at Portland State University in Oregon, looked at the same basic problem in 2014 and came up with a minimum crew size of 14,000. “Genetic minimum viable population doesn’t deal with real-world concerns,” Smith says, adding that he based his calculation on the demographics of actual populations on Earth. Many hunter-gatherer societies survive in groups of about 100, but even isolated tribes always interact with and have offspring with neighboring groups. Even a population of 14,000 strikes Smith as a modest number if you’re counting on it to sustain our species. “Suppose a catastrophe comes along and it knocks out 70 percent of the population,” he says. “Now the demographic structure of the population has been so disrupted that you can no longer find appropriate mating partners. One little catastrophe and the whole thing could fall apart.” The settling of the South Pacific is an interesting case study, according to Smith. That’s because Polynesians populated the islands one by one, much as we might eventually populate other planets. Of course, the Polynesians had abundant open land for population growth and were followed by a stream of other migrants who could keep things going if they got wiped out.

#### 12. No famine impact

David Denkenberger et al. 17 {International Journal of Disaster Risk Reduction, Global Catastrophic Risk Institute. 1-5-2017. “Feeding Everyone if the Sun is Obscured and Industry is ~~Disabled~~ [Shut Down].” https://www-sciencedirect-com.proxy.lib.umich.edu/science/article/pii/S2212420916305453}//JM

For combined sun blocking and industrial failure scenarios, the reduced output of conventional agriculture would present a threat of causing mass starvation. This study showed that one solution in the short term is extracting edible calories from killed leaves using distributed mechanical processes. Then a constrained food web could be formed where part of the remainder from this could be fed to chickens, and the rest coupled with leaf litter could have mushrooms grown on it. A second group of solutions is growing mushrooms on dead trees and the residue going to cellulose digesting animals such as cattle and rabbits. Typically, in these catastrophes the sun is not blocked completely, so some agriculture would be possible based off of existing farming in extreme environments (e.g. growing UV and cold tolerant crops in the tropics). Furthermore, the cooling climate would cool the upper layer of the ocean, causing upwelling of nutrient-rich deep ocean water. This would facilitate algae growth in the ocean, feeding fish; retrofitting of ships to be sail powered could enable significant fishing. The results of this study show these solutions could enable the feeding of everyone given minimal preparation, and this preparation should be a high priority now.

#### Spark proper

#### Extinction is inevitable from future technology — nanotech, our simulation gets shut down, AI, biotech, particle accelerators, and black swans

Bruce **Sterling**, 6-1-20**18**, "When Nick Bostrom says “Bang”," WIRED, https://www.wired.com/beyond-the-beyond/2018/06/nick-bostrom-says-bang/

4.1 Deliberate misuse of nanotechnology

In a mature form, molecular nanotechnology will enable the construction of bacterium-scale self-replicating mechanical robots that can feed on dirt or other organic matter [22-25]. Such replicators could eat up the biosphere or destroy it by other means such as by poisoning it, burning it, or blocking out sunlight. A person of malicious intent in possession of this technology might cause the extinction of intelligent life on Earth by releasing such nanobots into the environment.[9]

The technology to produce a destructive nanobot seems considerably easier to develop than the technology to create an effective defense against such an attack (a global nanotech immune system, an “active shield” [23]). It is therefore likely that there will be a period of vulnerability during which this technology must be prevented from coming into the wrong hands. Yet the technology could prove hard to regulate, since it doesn’t require rare radioactive isotopes or large, easily identifiable manufacturing plants, as does production of nuclear weapons [23].

Even if effective defenses against a limited nanotech attack are developed before dangerous replicators are designed and acquired by suicidal regimes or terrorists, there will still be the danger of an arms race between states possessing nanotechnology. It has been argued [26] that molecular manufacturing would lead to both arms race instability and crisis instability, to a higher degree than was the case with nuclear weapons. Arms race instability means that there would be dominant incentives for each competitor to escalate its armaments, leading to a runaway arms race. Crisis instability means that there would be dominant incentives for striking first. Two roughly balanced rivals acquiring nanotechnology would, on this view, begin a massive buildup of armaments and weapons development programs that would continue until a crisis occurs and war breaks out, potentially causing global terminal destruction. That the arms race could have been predicted is no guarantee that an international security system will be created ahead of time to prevent this disaster from happening. The nuclear arms race between the US and the USSR was predicted but occurred nevertheless.

4.2 Nuclear holocaust[winter]

The US and Russia still have huge stockpiles of nuclear weapons. But would an all-out nuclear war really exterminate humankind? Note that: (i) For there to be an existential risk it suffices that we can’t be sure that it wouldn’t. (ii) The climatic effects of a large nuclear war are not well known (there is the possibility of a nuclear winter). (iii) Future arms races between other nations cannot be ruled out and these could lead to even greater arsenals than those present at the height of the Cold War. The world’s supply of plutonium has been increasing steadily to about two thousand tons, some ten times as much as remains tied up in warheads ([9], p. 26). (iv) Even if some humans survive the short-term effects of a nuclear war, it could lead to the collapse of civilization. A human race living under stone-age conditions may or may not be more resilient to extinction than other animal species.

4.3 We’re living in a simulation and it gets shut down

A case can be made that the hypothesis that we are living in a computer simulation should be given a significant probability [27]. The basic idea behind this so-called “Simulation argument” is that vast amounts of computing power may become available in the future (see e.g. [28,29]), and that it could be used, among other things, to run large numbers of fine-grained simulations of past human civilizations. Under some not-too-implausible assumptions, the result can be that almost all minds like ours are simulated minds, and that we should therefore assign a significant probability to being such computer-emulated minds rather than the (subjectively indistinguishable) minds of originally evolved creatures. And if we are, we suffer the risk that the simulation may be shut down at any time. A decision to terminate our simulation may be prompted by our actions or by exogenous factors.

While to some it may seem frivolous to list such a radical or “philosophical” hypothesis next the concrete threat of nuclear holocaust, we must seek to base these evaluations on reasons rather than untutored intuition. Until a refutation appears of the argument presented in [27], it would intellectually dishonest to neglect to mention simulation-shutdown as a potential extinction mode.

4.4 Badly programmed superintelligence

When we create the first superintelligent entity [28-34], we might make a mistake and give it goals that lead it to annihilate humankind, assuming its enormous intellectual advantage gives it the power to do so. For example, we could mistakenly elevate a subgoal to the status of a supergoal. We tell it to solve a mathematical problem, and it complies by turning all the matter in the solar system into a giant calculating device, in the process killing the person who asked the question. (For further analysis of this, see [35].)

4.5 Genetically engineered biological agent

With the fabulous advances in genetic technology currently taking place, it may become possible for a tyrant, terrorist, or ~~lunatic~~ to create a doomsday virus, an organism that combines long latency with high virulence and mortality [36].

Dangerous viruses can even be spawned unintentionally, as Australian researchers recently demonstrated when they created a modified mousepox virus with 100% mortality while trying to design a contraceptive virus for mice for use in pest control [37]. While this particular virus doesn’t affect humans, it is suspected that an analogous alteration would increase the mortality of the human smallpox virus. What underscores the future hazard here is that the research was quickly published in the open scientific literature [38]. It is hard to see how information generated in open biotech research programs could be contained no matter how grave the potential danger that it poses; and the same holds for research in nanotechnology.

Genetic medicine will also lead to better cures and vaccines, but there is no guarantee that defense will always keep pace with offense. (Even the accidentally created mousepox virus had a 50% mortality rate on vaccinated mice.) Eventually, worry about biological weapons may be put to rest through the development of nanomedicine, but while nanotechnology has enormous long-term potential for medicine [39] it carries its own hazards.

4.6 Accidental misuse of nanotechnology (“gray goo”)

The possibility of accidents can never be completely ruled out. However, there are many ways of making sure, through responsible engineering practices, that species-destroying accidents do not occur. One could avoid using self-replication; one could make nanobots dependent on some rare feedstock chemical that doesn’t exist in the wild; one could confine them to sealed environments; one could design them in such a way that any mutation was overwhelmingly likely to cause a nanobot to completely cease to function [40]. Accidental misuse is therefore a smaller concern than malicious misuse [23,25,41].

However, the distinction between the accidental and the deliberate can become blurred. While “in principle” it seems possible to make terminal nanotechnological accidents extremely improbable, the actual circumstances may not permit this ideal level of security to be realized. Compare nanotechnology with nuclear technology. From an engineering perspective, it is of course perfectly possible to use nuclear technology only for peaceful purposes such as nuclear reactors, which have a zero chance of destroying the whole planet. Yet in practice it may be very hard to avoid nuclear technology also being used to build nuclear weapons, leading to an arms race. With large nuclear arsenals on hair-trigger alert, there is inevitably a significant risk of accidental war. The same can happen with nanotechnology: it may be pressed into serving military objectives in a way that carries unavoidable risks of serious accidents.

In some situations it can even be strategically advantageous to deliberately make one’s technology or control systems risky, for example in order to make a “threat that leaves something to chance” [42].

4.7 Something unforeseen

We need a catch-all category. It would be foolish to be confident that we have already imagined and anticipated all significant risks. Future technological or scientific developments may very well reveal novel ways of destroying the world.

Some foreseen hazards (hence not members of the current category) which have been excluded from the list of bangs on grounds that they seem too unlikely to cause a global terminal disaster are: solar flares, supernovae, black hole explosions or mergers, gamma-ray bursts, galactic center outbursts, supervolcanos, loss of biodiversity, buildup of air pollution, gradual loss of human fertility, and various religious doomsday scenarios. The hypothesis that we will one day become “illuminated” and commit collective suicide or stop reproducing, as supporters of VHEMT (The Voluntary Human Extinction Movement) hope [43], appears unlikely. If it really were better not to exist (as Silenus told king Midas in the Greek myth, and as Arthur Schopenhauer argued [44] although for reasons specific to his philosophical system he didn’t advocate suicide), then we should not count this scenario as an existential disaster. The assumption that it is not worse to be alive should be regarded as an implicit assumption in the definition of Bangs. Erroneous collective suicide is an existential risk albeit one whose probability seems extremely slight. (For more on the ethics of human extinction, see chapter 4 of [9].)

4.8 Physics disasters

The Manhattan Project bomb-builders’ concern about an A-bomb-derived atmospheric conflagration has contemporary analogues.

There have been speculations that future high-energy particle accelerator experiments may cause a breakdown of a metastable vacuum state that our part of the cosmos might be in, converting it into a “true” vacuum of lower energy density [45]. This would result in an expanding bubble of total destruction that would sweep through the galaxy and beyond at the speed of light, tearing all matter apart as it proceeds.

Another conceivability is that accelerator experiments might produce negatively charged stable “strangelets” (a hypothetical form of nuclear matter) or create a mini black hole that would sink to the center of the Earth and start accreting the rest of the planet [46].

These outcomes seem to be impossible given our best current physical theories. But the reason we do the experiments is precisely that we don’t really know what will happen. A more reassuring argument is that the energy densities attained in present day accelerators are far lower than those that occur naturally in collisions between cosmic rays [46,47]. It’s possible, however, that factors other than energy density are relevant for these hypothetical processes, and that those factors will be brought together in novel ways in future experiments.

The main reason for concern in the “physics disasters” category is the meta-level observation that discoveries of all sorts of weird physical phenomena are made all the time, so even if right now all the particular physics disasters we have conceived of were absurdly improbable or impossible, there could be other more realistic failure-modes waiting to be uncovered. The ones listed here are merely illustrations of the general case.

#### Growth causes a global toxification crisis - risks extinction

Ehrlichand Ehrlich 13 [Paul R. Ehrlich, Professor of Biology and President of the Center for Conservation Biology at Stanford University, and Adjunct Professor at the University of Technology, Sydney, Anne H. Ehrlich, Senior Research Scientist in Biology at Stanford and focuses her research on policy issues related to the environment, “Can a collapse of global civilization be avoided?”, Proc Biol Sci. Mar 7, 2013; 280(1754), \\wyo-bb]

Another possible threat to the continuation of civilization is global toxification. Adverse symptoms of exposure to synthetic chemicals are making some scientists increasingly nervous about effects on the human population [77–79]. Should a global threat materialize, however, no planned mitigating responses (analogous to the ecologically and politically risky ‘geoengineering’ projects often proposed to ameliorate climate disruption [80]) are waiting in the wings ready for deployment. Much the same can be said about aspects of the epidemiological environment and the prospect of epidemics being enhanced by rapid population growth in immune-weakened societies, increased contact with animal reservoirs, high-speed transport and the misuse of antibiotics [81]. Nobel laureate Joshua Lederberg had great concern for the epidemic problem, famously stating, ‘The survival of the human species is not a preordained evolutionary program’ [82, p. 40]. Some precautionary steps that should be considered include forbidding the use of antibiotics as growth stimulators for livestock, building emergency stocks of key vaccines and drugs (such as Tamiflu), improving disease surveillance, expanding mothballed emergency medical facilities, preparing institutions for imposing quarantines and, of course, moving as rapidly as possible to humanely reduce the human population size. It has become increasingly clear that security has many dimensions beyond military security [83,84] and that breaches of environmental security could risk the end of global civilization.

global civilization.

#### War is inevitable---BUT, the longer we wait, the worse it gets.

Seth **Baum &** Anthony **Barrett 18**. Global Catastrophic Risk Institute. 2018. “A Model for the Impacts of Nuclear War.” SSRN Electronic Journal. Crossref, doi:10.2139/ssrn.3155983.

On the other end of the spectrum, the norm could be weaker. The Hiroshima and Nagasaki bombings provided a vivid and enduring image of the horrors of nuclear war—hence the norm can reasonably be described as a legacy of the bombings. Without this image, there would be less to motivate the norm. A weaker norm could in turn have led to a nuclear war occurring later, especially during a near-miss event like the Cuban missile crisis. A later nuclear war would likely be much more severe, assuming some significant buildup of nuclear arsenals and especially if “overkill” targeting was used. A new nuclear war could bring a similarly wide range of shifts in nuclear weapons norms. It could strengthen the norm, hastening nuclear disarmament. Already, there is a political initiative drawing attention to the humanitarian consequences of nuclear weapons use in order to promote a new treaty to ban nuclear weapons as a step towards complete nuclear disarmament (Borrie 2014). It is easy to imagine this initiative using any new nuclear attacks to advance their goals. Alternatively, it could weaken the norm, potentially leading to more and/or larger nuclear wars. This is a common concern, as seen for example in debates over low-yield bunker buster nuclear weapons (Nelson 2003). Given that the impacts of a large nuclear war could be extremely severe, a shift in nuclear weapons norms could easily be the single most consequential effect of a smaller nuclear war.

#### And current arsenal sizes ensure no extinction---BUT, it’ll spur political will for meaningful disarmament.

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Although nuclear war is the oldest of these technogenic threats to civilization and human survival, and although important steps to restraint, particularly at the end of the Cold War, have been achieved, the nuclear world is increasingly changing in major ways, and in almost entirely dangerous directions. The third “bombs away” phase of the great debate on the nuclear-political question is more consequentially divided than in the first two phases. Even more ominously, most of the momentum lies with the forces that are pulling states toward nuclear-use, and with the radical actors bent on inflicting catastrophic damage on the leading states in the international system, particularly the United States. In contrast, the arms control project, although intellectually vibrant, is largely in retreat on the world political stage. The arms control settlement of the Cold War is unraveling, and the world public is more divided and distracted than ever. With the recent election of President Donald Trump, the United States, which has played such a dominant role in nuclear politics since its scientists invented these fiendish engines, now has an impulsive and uninformed leader, boding ill for nuclear restraint and effective crisis management. Given current trends, it is prudent to assume that sooner or later, and probably sooner, nuclear weapons will again be the used in war. But this bad news may contain a “silver lining” of good news. Unlike a general nuclear war that might have occurred during the Cold War, such a nuclear event now would probably not mark the end of civilization (or of humanity), due to the great reductions in nuclear forces achieved at the end of the Cold War. Furthermore, politics on “the day after” could have immense potential for positive change. The survivors would not be likely to envy the dead, but would surely have a greatly renewed resolution for “never again.” Such an event, completely unpredictable in its particulars, would unambiguously put the nuclear-political question back at the top of the world political agenda. It would unmistakeably remind leading states of their vulnerability It might also trigger more robust efforts to achieve the global regulation of nuclear capability. Like the bombings of Hiroshima and Nagasaki that did so much to catalyze the elevated concern for nuclear security in the early Cold War, and like the experience “at the brink” in the Cuban Missile Crisis of 1962, the now bubbling nuclear caldron holds the possibility of inaugurating a major period of institutional innovation and adjustment toward a fully “bombs away” future.

#### Industrial civilization wouldn’t recover.

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Imagine that the world as we know it ends tomorrow. There’s a global catastrophe: a pandemic virus, an asteroid strike, or perhaps a nuclear holocaust. The vast majority of the human race perishes. Our civilisation collapses. The post-apocalyptic survivors find themselves in a devastated world of decaying, deserted cities and roving gangs of bandits looting and taking by force. Bad as things sound, that’s not the end for humanity. We bounce back. Sooner or later, peace and order emerge again, just as they have time and again through history. Stable communities take shape. They begin the agonising process of rebuilding their technological base from scratch. But here’s the question: how far could such a society rebuild? Is there any chance, for instance, that a post-apocalyptic society could reboot a technological civilisation? Let’s make the basis of this thought experiment a little more specific. Today, we have already consumed the most easily drainable crude oil and, particularly in Britain, much of the shallowest, most readily mined deposits of coal. Fossil fuels are central to the organisation of modern industrial society, just as they were central to its development. Those, by the way, are distinct roles: even if we could somehow do without fossil fuels now (which we can’t, quite), it’s a different question whether we could have got to where we are without ever having had them. So, would a society starting over on a planet stripped of its fossil fuel deposits have the chance to progress through its own Industrial Revolution? Or to phrase it another way, what might have happened if, for whatever reason, the Earth had never acquired its extensive underground deposits of coal and oil in the first place? Would our progress necessarily have halted in the 18th century, in a pre-industrial state? It’s easy to underestimate our current dependence on fossil fuels. In everyday life, their most visible use is the petrol or diesel pumped into the vehicles that fill our roads, and the coal and natural gas which fire the power stations that electrify our modern lives. But we also rely on a range of different industrial materials, and in most cases, high temperatures are required to transform the stuff we dig out of the ground or harvest from the landscape into something useful. You can’t smelt metal, make glass, roast the ingredients of concrete, or synthesise artificial fertiliser without a lot of heat. It is fossil fuels – coal, gas and oil – that provide most of this thermal energy. In fact, the problem is even worse than that. Many of the chemicals required in bulk to run the modern world, from pesticides to plastics, derive from the diverse organic compounds in crude oil. Given the dwindling reserves of crude oil left in the world, it could be argued that the most wasteful use for this limited resource is to simply burn it. We should be carefully preserving what’s left for the vital repertoire of valuable organic compounds it offers. But my topic here is not what we should do now. Presumably everybody knows that we must transition to a low-carbon economy one way or another. No, I want to answer a question whose interest is (let’s hope) more theoretical. Is the emergence of a technologically advanced civilisation necessarily contingent on the easy availability of ancient energy? Is it possible to build an industrialised civilisation without fossil fuels? And the answer to that question is: maybe – but it would be extremely difficult. Let’s see how. We’ll start with a natural thought. Many of our alternative energy technologies are already highly developed. Solar panels, for example, represent a good option today, and are appearing more and more on the roofs of houses and businesses. It’s tempting to think that a rebooted society could simply pick up where we leave off. Why couldn’t our civilisation 2.0 just start with renewables? Well, it could, in a very limited way. If you find yourself among the survivors in a post-apocalyptic world, you could scavenge enough working solar panels to keep your lifestyle electrified for a good long while. Without moving parts, photovoltaic cells require little maintenance and are remarkably resilient. They do deteriorate over time, though, from moisture penetrating the casing and from sunlight itself degrading the high-purity silicon layers. The electricity generated by a solar panel declines by about 1 per cent every year so, after a few generations, all our hand-me-down solar panels will have degraded to the point of uselessness. Then what? New ones would be fiendishly difficult to create from scratch. Solar panels are made from thin slices of extremely pure silicon, and although the raw material is common sand, it must be processed and refined using complex and precise techniques – the same technological capabilities, more or less, that we need for modern semiconductor electronics components. These techniques took a long time to develop, and would presumably take a long time to recover. So photovoltaic solar power would not be within the capability of a society early in the industrialisation process. Perhaps, though, we were on the right track by starting with electrical power. Most of our renewable-energy technologies produce electricity. In our own historical development, it so happens that the core phenomena of electricity were discovered in the first half of the 1800s, well after the early development of steam engines. Heavy industry was already committed to combustion-based machinery, and electricity has largely assumed a subsidiary role in the organisation of our economies ever since. But could that sequence have run the other way? Is there some developmental requirement that thermal energy must come first? On the face of it, it’s not beyond the bounds of possibility that a progressing society could construct electrical generators and couple them to simple windmills and waterwheels, later progressing to wind turbines and hydroelectric dams. In a world without fossil fuels, one might envisage an electrified civilisation that largely bypasses combustion engines, building its transport infrastructure around electric trains and trams for long-distance and urban transport. I say ‘largely’. We couldn’t get round it all together. When it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff While the electric motor could perhaps replace the coal-burning steam engine for mechanical applications, society, as we’ve already seen, also relies upon thermal energy to drive the essential chemical and physical transformations it needs. How could an industrialising society produce crucial building materials such as iron and steel, brick, mortar, cement and glass without resorting to deposits of coal? You can of course create heat from electricity. We already use electric ovens and kilns. Modern arc furnaces are used for producing cast iron or recycling steel. The problem isn’t so much that electricity can’t be used to heat things, but that for meaningful industrial activity you’ve got to generate prodigious amounts of it, which is challenging using only renewable energy sources such as wind and water. An alternative is to generate high temperatures using solar power directly. Rather than relying on photovoltaic panels, concentrated solar thermal farms use giant mirrors to focus the sun’s rays onto a small spot. The heat concentrated in this way can be exploited to drive certain chemical or industrial processes, or else to raise steam and drive a generator. Even so, it is difficult (for example) to produce the very high temperatures inside an iron-smelting blast furnace using such a system. What’s more, it goes without saying that the effectiveness of concentrated solar power depends strongly on the local climate. No, when it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff. But that doesn’t mean the stuff we burn necessarily has to be fossil fuels. Let’s take a quick detour into the pre-history of modern industry. Long before the adoption of coal, charcoal was widely used for smelting metals. In many respects it is superior: charcoal burns hotter than coal and contains far fewer impurities. In fact, coal’s impurities were a major delaying factor on the Industrial Revolution. Released during combustion, they can taint the product being heated. During smelting, sulphur contaminants can soak into the molten iron, making the metal brittle and unsafe to use. It took a long time to work out how to treat coal to make it useful for many industrial applications. And, in the meantime, charcoal worked perfectly well. And then, well, we stopped using it. In retrospect, that’s a pity. When it comes from a sustainable source, charcoal burning is essentially carbon-neutral, because it doesn’t release any new carbon into the atmosphere – not that this would have been a consideration for the early industrialists. But charcoal-based industry didn’t die out altogether. In fact, it survived to flourish in Brazil. Because it has substantial iron deposits but few coalmines, Brazil is the largest charcoal producer in the world and the ninth biggest steel producer. We aren’t talking about a cottage industry here, and this makes Brazil a very encouraging example for our thought experiment. The trees used in Brazil’s charcoal industry are mainly fast-growing eucalyptus, cultivated specifically for the purpose. The traditional method for creating charcoal is to pile chopped staves of air-dried timber into a great dome-shaped mound and then cover it with turf or soil to restrict airflow as the wood smoulders. The Brazilian enterprise has scaled up this traditional craft to an industrial operation. Dried timber is stacked into squat, cylindrical kilns, built of brick or masonry and arranged in long lines so that they can be easily filled and unloaded in sequence. The largest sites can sport hundreds of such kilns. Once filled, their entrances are sealed and a fire is lit from the top. The skill in charcoal production is to allow just enough air into the interior of the kiln. There must be enough combustion heat to drive out moisture and volatiles and to pyrolyse the wood, but not so much that you are left with nothing but a pile of ashes. The kiln attendant monitors the state of the burn by carefully watching the smoke seeping out of the top, opening air holes or sealing with clay as necessary to regulate the process. Brazil shows how the raw materials of modern civilisation can be supplied without reliance on fossil fuels Good things come to those who wait, and this wood pyrolysis process can take up to a week of carefully controlled smouldering. The same basic method has been used for millennia. However, the ends to which the fuel is put are distinctly modern. Brazilian charcoal is trucked out of the forests to the country’s blast furnaces where it is used to transform ore into pig iron. This pig iron is the basic ingredient of modern mass-produced steel. The Brazilian product is exported to countries such as China and the US where it becomes cars and trucks, sinks, bathtubs, and kitchen appliances. Around two-thirds of Brazilian charcoal comes from sustainable plantations, and so this modern-day practice has been dubbed ‘green steel’. Sadly, the final third is supplied by the non-sustainable felling of primary forest. Even so, the Brazilian case does provide an example of how the raw materials of modern civilisation can be supplied without reliance on fossil fuels. Another, related option might be wood gasification. The use of wood to provide heat is as old as mankind, and yet simply burning timber only uses about a third of its energy. The rest is lost when gases and vapours released by the burning process blow away in the wind. Under the right conditions, even smoke is combustible. We don’t want to waste it. Better than simple burning, then, is to drive the thermal breakdown of the wood and collect the gases. You can see the basic principle at work for yourself just by lighting a match. The luminous flame isn’t actually touching the matchwood: it dances above, with a clear gap in between. The flame actually feeds on the hot gases given off as the wood breaks down in the heat, and the gases combust only once they mix with oxygen from the air. Matches are fascinating when you look at them closely. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this To release these gases in a controlled way, bake some timber in a closed container. Oxygen is restricted so that the wood doesn’t simply catch fire. Its complex molecules decompose through a process known as pyrolysis, and then the hot carbonised lumps of charcoal at the bottom of the container react with the breakdown products to produce flammable gases such as hydrogen and carbon monoxide. The resultant ‘producer gas’ is a versatile fuel: it can be stored or piped for use in heating or street lights, and is also suitable for use in complex machinery such as the internal combustion engine. More than a million gasifier-powered cars across the world kept civilian transport running during the oil shortages of the Second World War. In occupied Denmark, 95 per cent of all tractors, trucks and fishing boats were powered by wood-gas generators. The energy content of about 3 kg of wood (depending on its dryness and density) is equivalent to a litre of petrol, and the fuel consumption of a gasifier-powered car is given in miles per kilogram of wood rather than miles per gallon. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this. But you can do a lot more with wood gases than just keep your vehicle on the road. It turns out to be suitable for any of the manufacturing processes needing heat that we looked at before, such as kilns for lime, cement or bricks. Wood gas generator units could easily power agricultural or industrial equipment, or pumps. Sweden and Denmark are world leaders in their use of sustainable forests and agricultural waste for turning the steam turbines in power stations. And once the steam has been used in their ‘Combined Heat and Power’ (CHP) electricity plants, it is piped to the surrounding towns and industries to heat them, allowing such CHP stations to approach 90 per cent energy efficiency. Such plants suggest a marvellous vision of industry wholly weaned from its dependency on fossil fuel. Is that our solution, then? Could our rebooting society run on wood, supplemented with electricity from renewable sources? Maybe so, if the population was fairly small. But here’s the catch. These options all presuppose that our survivors are able to construct efficient steam turbines, CHP stations and internal combustion engines. We know how to do all that, of course – but in the event of a civilisational collapse, who is to say that the knowledge won’t be lost? And if it is, what are the chances that our descendants could reconstruct it? In our own history, the first successful application of steam engines was in pumping out coal mines. This was a setting in which fuel was already abundant, so it didn’t matter that the first, primitive designs were terribly inefficient. The increased output of coal from the mines was used to first smelt and then forge more iron. Iron components were used to construct further steam engines, which were in turn used to pump mines or drive the blast furnaces at iron foundries. And of course, steam engines were themselves employed at machine shops to construct yet more steam engines. It was only once steam engines were being built and operated that subsequent engineers were able to devise ways to increase their efficiency and shrink fuel demands. They found ways to reduce their size and weight, adapting them for applications in transport or factory machinery. In other words, there was a positive feedback loop at the very core of the industrial revolution: the production of coal, iron and steam engines were all mutually supportive. In a world without readily mined coal, would there ever be the opportunity to test profligate prototypes of steam engines, even if they could mature and become more efficient over time? How feasible is it that a society could attain a sufficient understanding of thermodynamics, metallurgy and mechanics to make the precisely interacting components of an internal combustion engine, without first cutting its teeth on much simpler external combustion engines – the separate boiler and cylinder-piston of steam engines? It took a lot of energy to develop our technologies to their present heights, and presumably it would take a lot of energy to do it again. Fossil fuels are out. That means our future society will need an awful lot of timber. An industrial revolution without coal would be, at a minimum, very difficult In a temperate climate such as the UK’s, an acre of broadleaf trees produces about four to five tonnes of biomass fuel every year. If you cultivated fast-growing kinds such as willow or miscanthus grass, you could quadruple that. The trick to maximising timber production is to employ coppicing – cultivating trees such as ash or willow that resprout from their own stump, becoming ready for harvest again in five to 15 years. This way you can ensure a sustained supply of timber and not face an energy crisis once you’ve deforested your surroundings. But here’s the thing: coppicing was already a well-developed technique in pre-industrial Britain. It couldn’t meet all of the energy requirements of the burgeoning society. The central problem is that woodland, even when it is well-managed, competes with other land uses, principally agriculture. The double-whammy of development is that, as a society’s population grows, it requires more farmland to provide enough food and also greater timber production for energy. The two needs compete for largely the same land areas. We know how this played out in our own past. From the mid-16th century, Britain responded to these factors by increasing the exploitation of its coal fields – essentially harvesting the energy of ancient forests beneath the ground without compromising its agricultural output. The same energy provided by one hectare of coppice for a year is provided by about five to 10 tonnes of coal, and it can be dug out of the ground an awful lot quicker than waiting for the woodland to regrow. It is this limitation in the supply of thermal energy that would pose the biggest problem to a society trying to industrialise without easy access to fossil fuels. This is true in our post-apocalyptic scenario, and it would be equally true in any counterfactual world that never developed fossil fuels for whatever reason. For a society to stand any chance of industrialising under such conditions, it would have to focus its efforts in certain, very favourable natural environments: not the coal-island of 18th-century Britain, but perhaps areas of Scandinavia or Canada that combine fast-flowing streams for hydroelectric power and large areas of forest that can be harvested sustainably for thermal energy. Even so, an industrial revolution without coal would be, at a minimum, very difficult. Today, use of fossil fuels is actually growing, which is worrying for a number of reasons too familiar to rehearse here. Steps towards a low-carbon economy are vital. But we should also recognise how pivotal those accumulated reservoirs of thermal energy were in getting us to where we are. Maybe we could have made it the hard way. A slow-burn progression through the stages of mechanisation, supported by a combination of renewable electricity and sustainably grown biomass, might be possible after all. Then again, it might not. We’d better hope we can secure the future of our own civilisation, because we might have scuppered the chances of any society to follow in our wake.

#### Rigorous climate simulations prove that hydrophilic black carbon would cause to atmospheric precipitation – results in a rainout effect that quickly reverses nuclear cooling

Reisner et al. 18 (Jon Reisner – Climate and atmospheric scientist at the Los Alamos National Laboratory. Gennaro D’Angelo – Climate scientist at the Los Alamos National Laboratory, Research scientist at the SETI institute, Associate specialist at the University of California, Santa Cruz, NASA Postdoctoral Fellow at the NASA Ames Research Center, UKAFF Fellow at the University of Exeter. Eunmo Koo - Scientist at Applied Terrestrial, Energy, and Atmospheric Modeling (ATEAM) Team, in Computational Earth Science Group (EES-16) in Earth and Environmental Sciences Division and Co-Lead of Parallel Computing Summer Research Internship (PCSRI) program at the Los Alamos National Laboratory, former Staff research associate at UC Berkeley. Wesley Even - Computational scientist in the Computational Physics and Methods Group at Los Alamos National Laboratory. Matthew Hecht – Atmospheric scientist at the Los Alamos National Laboratory. Elizabeth Hunke - Lead developer for the Los Alamos Sea Ice Model (CICE) at the Los Alamos National Laboratory responsible for development and incorporation of new parameterizations, model testing and validation, computational performance, documentation, and consultation with external model users on all aspects of sea ice modeling, including interfacing with global climate and earth system models. Darin Comeau – Climate scientist at the Los Alamos National Laboratory. Randy Bos - Project leader at the Los Alamos National Laboratory, former Weapons Effects program manager at Tech-Source. James Cooley – Computational scientist at the Los Alamos National Laboratory specializing in weapons physics, emergency response, and computational physics. <MKIM> “Climate impact of a regional nuclear weapons exchange:An improved assessment based on detailed source calculations”. 3/16/18. DOA: 7/13/19. <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JD027331>)

\*BC = Black Carbon

The no-rubble simulation produces a significantly more intense fire, with more fire spread, and consequently a significantly stronger plume with larger amounts of BC reaching into the upper atmosphere than the simulation with rubble, illustrated in Figure 5. While the no-rubble simulation **represents the worst-case scenario** involving vigorous fire activity, **only a relatively small amount of carbon makes its way into the stratosphere** during the course of the simulation. But while small compared to the surface BC mass, stratospheric BC amounts from the current simulations are significantly higher than what would be expected from burning vegetation such as trees (Heilman et al., 2014), e.g., the higher energy density of the building fuels and the initial fluence from the weapon produce an intense response within HIGRAD with initial updrafts of order 100 m/s in the lower troposphere. Or, in comparison to a mass fire, wildfires will burn only a small amount of fuel in the corresponding time period (roughly 10 minutes) that a nuclear weapon fluence can effectively ignite a large area of fuel producing an impressive atmospheric response. Figure 6 shows vertical profiles of BC multiplied by 100 (number of cities involved in the exchange) from the two simulations. The total amount of BC produced is in line with previous estimates (about 3.69 Tg from no-rubble simulation); however, the majority of BC resides **below the stratosphere** (3.46 Tg below 12 km) and can be **readily impacted by scavenging from precipitation** either via pyro-cumulonimbus produced by the fire itself (not modeled) or other synoptic weather systems. While the impact on climate of these more realistic profiles will be explored in the next section, it should be mentioned that **these estimates are** still **at the high end**, considering the inherent simplifications in the combustion model that lead to **overestimating BC production**. 3.3 Climate Results Long-term climatic effects critically depend on the initial injection height of the soot, with larger quantities reaching the upper troposphere/lower stratosphere inducing a greater cooling impact because of longer residence times (Robock et al., 2007a). Absorption of solar radiation by the BC aerosol and its subsequent radiative cooling tends to heat the surrounding air, driving an initial upward diffusion of the soot plumes, an effect that depends on the initial aerosol concentrations. **Mixing and sedimentation** tend to **reduce this process**, and low altitude emissions are also significantly impacted by precipitation if aging of the BC aerosol occurs on sufficiently rapid timescales. But once at stratospheric altitudes, aerosol dilution via coagulation is hindered by low particulate concentrations (e.g., Robock et al., 2007a) and lofting to much higher altitudes is inhibited by gravitational settling in the low-density air (Stenke et al., 2013), resulting in more stable BC concentrations over long times. Of the initial BC mass released in the atmosphere, most of which is emitted below 9 km, **70% rains out within the first month** and 78%, or about 2.9 Tg, is removed within the first two months (Figure 7, solid line), with the remainder (about 0.8 Tg, dashed line) being transported above about 12 km (200 hPa) within the first week. This outcome differs from the findings of, e.g., Stenke et al. (2013, their high BC-load cases) and Mills et al. (2014), who found that most of the BC mass (between 60 and 70%) is lifted in the stratosphere within the first couple of weeks. This can also be seen in Figure 8 (red lines) and in Figure 9, which include results from our calculation with the initial BC distribution from Mills et al. (2014). In that case, only 30% of the initial BC mass rains out in the troposphere during the first two weeks after the exchange, with the remainder rising to the stratosphere. In the study of Mills et al. (2008) this percentage is somewhat smaller, about 20%, and smaller still in the experiments of Robock et al. (2007a) in which the soot is initially emitted in the upper troposphere or higher. In Figure 7, the e-folding timescale for the removal of tropospheric soot, here interpreted as the time required for an initial drop of a factor e, is about one week. This result compares favorably with the “LT” experiment of Robock et al. (2007a), considering 5 Tg of BC released in the lower troposphere, in which 50% of the aerosols are removed within two weeks. By contrast, the initial e-folding timescale for the removal of stratospheric soot in Figure 8 is about 4.2 years (blue solid line), compared to about 8.4 years for the calculation using Mills et al. (2014) initial BC emission (red solid line). The removal timescale from our forced ensemble simulations is close to those obtained by Mills et al. (2008) in their 1 Tg experiment, by Robock et al. (2007a) in their experiment “UT 1 Tg”, and © 2018 American Geophysical Union. All rights reserved. by Stenke et al. (2013) in their experiment “Exp1”, in all of which 1 Tg of soot was emitted in the atmosphere in the aftermath of the exchange. Notably, the e-folding timescale for the decline of the BC mass in Figure 8 (blue solid line) is also close to the value of about 4 years quoted by Pausata et al. (2016) for their long-term “intermediate” scenario. In that scenario, which is also based on 5 Tg of soot initially distributed as in Mills et al. (2014), the factor-of2 shorter residence time of the aerosols is caused by particle growth via coagulation of BC with organic carbon. Figure 9 shows the BC mass-mixing ratio, horizontally averaged over the globe, as a function of atmospheric pressure (height) and time. The BC distributions used in our simulations imply that the upward transport of particles is substantially less efficient compared to the case in which 5 Tg of BC is directly injected into the upper troposphere. The semiannual cycle of lofting and sinking of the aerosols is associated with atmospheric heating and cooling during the solstice in each hemisphere (Robock et al., 2007a). During the first year, the oscillation amplitude in our forced ensemble simulations is particularly large during the summer solstice, compared to that during the winter solstice (see bottom panel of Figure 9), because of the higher soot concentrations in the Northern Hemisphere, as can be seen in Figure 11 (see also left panel of Figure 12). Comparing the top and bottom panels of Figure 9, the BC reaches the highest altitudes during the first year in both cases, but the concentrations at 0.1 hPa in the top panel can be 200 times as large. Qualitatively, the difference can be understood in terms of the air temperature increase caused by BC radiation emission, which is several tens of kelvin degrees in the simulations of Robock et al. (2007a, see their Figure 4), Mills et al. (2008, see their Figure 5), Stenke et al. (2013, see high-load cases in their Figure 4), Mills et al. (2014, see their Figure 7), and Pausata et al. (2016, see one-day emission cases in their Figure 1), due to high BC concentrations, but it amounts to only about 10 K in our forced ensemble simulations, as illustrated in Figure 10. Results similar to those presented in Figure 10 were obtained from the experiment “Exp1” performed by Stenke et al. (2013, see their Figure 4). **In that scenario as well, somewhat less that 1 Tg of BC remained in the atmosphere after the initial rainout**. As mentioned before, the BC aerosol that remains in the atmosphere, lifted to stratospheric heights by the rising soot plumes, undergoes sedimentation over a timescale of several years (Figures 8 and 9). This mass represents the effective amount of BC that can force climatic changes over multi-year timescales. In the forced ensemble simulations, it is about 0.8 Tg after the initial rainout, whereas it is about 3.4 Tg in the simulation with an initial soot distribution as in Mills et al. (2014). Our more realistic source simulation involves the worstcase assumption of no-rubble (along with other assumptions) and hence serves as an upper bound for the impact on climate. As mentioned above and further discussed below, our scenario induces perturbations on the climate system similar to those found in previous studies in which the climatic response was driven by roughly 1 Tg of soot rising to stratospheric heights following the exchange. Figure 11 illustrates the vertically integrated mass-mixing ratio of BC over the globe, at various times after the exchange for the simulation using the initial BC distribution of Mills et al. (2014, upper panels) and as an average from the forced ensemble members (lower panels). All simulations predict enhanced concentrations at high latitudes during the first year after the exchange. In the cases shown in the top panels, however, these high concentrations persist for several years (see also Figure 1 of Mills et al., 2014), whereas the forced ensemble simulations indicate that the BC concentration starts to decline after the first year. In fact, in the simulation represented in the top panels, mass-mixing ratios larger than about 1 kg of BC © 2018 American Geophysical Union. All rights reserved. per Tg of air persist for well over 10 years after the exchange, whereas they only last for 3 years in our forced simulations (compare top and middle panels of Figure 9). After the first year, values drop below 3 kg BC/Tg air, whereas it takes about 8 years to reach these values in the simulation in the top panels (see also Robock et al., 2007a). Over crop-producing, midlatitude regions in the Northern Hemisphere, the BC loading is reduced from more than 0.8 kg BC/Tg air in the simulation in the top panels to 0.2-0.4 kg BC/Tg air in our forced simulations (see middle and right panels). The more rapid clearing of the atmosphere in the forced ensemble is also signaled by the soot optical depth in the visible radiation spectrum, which drops below values of 0.03 toward the second half of the first year at mid latitudes in the Northern Hemisphere, and everywhere on the globe after about 2.5 years (without never attaining this value in the Southern Hemisphere). In contrast, the soot optical depth in the calculation shown in the top panels of Figure 11 becomes smaller than 0.03 everywhere only after about 10 years. The two cases show a similar tendency, in that the BC optical depth is typically lower between latitudes 30º S-30º N than it is at other latitudes. This behavior is associated to the persistence of stratospheric soot toward high-latitudes and the Arctic/Antarctic regions, as illustrated by the zonally-averaged, column-integrated mass-mixing ratio of the BC in Figure 12 for both the forced ensemble simulations (left panel) and the simulation with an initial 5 Tg BC emission in the upper troposphere (right panel). The spread in the globally averaged (near) surface temperature of the atmosphere, from the control (left panel) and forced (right panel) ensembles, is displayed in Figure 13. For each month, the plots show the largest variations (i.e., maximum and minimum values), within each ensemble of values obtained for that month, relative to the mean value of that month. The plot also shows yearly-averaged data (thinner lines). The spread is comparable in the control and forced ensembles, with average values calculated over the 33-years run length of 0.4-0.5 K. This spread is also similar to the internal variability of the globally averaged surface temperature quoted for the NCAR Large Ensemble Community Project (Kay et al., 2015). These results imply that surface air temperature differences, between forced and control simulations, which lie within the spread may not be distinguished from effects due to internal variability of the two simulation ensembles. Figure 14 shows the difference in the globally averaged surface temperature of the atmosphere (top panel), net solar radiation flux at surface (middle panel), and precipitation rate (bottom panel), computed as the (forced minus control) difference in ensemble mean values. The sum of standard deviations from each ensemble is shaded. Differences are qualitatively significant over the first few years, when the anomalies lie near or outside the total standard deviation. Inside the shaded region, differences may not be distinguished from those arising from the internal variability of one or both ensembles. The surface solar flux (middle panel) is the quantity that appears most affected by the BC emission, with qualitatively significant differences persisting for about 5 years. The precipitation rate (bottom panel) is instead affected only at the very beginning of the simulations. The red lines in all panels show the results from the simulation applying the initial BC distribution of Mills et al. (2014), where the period of significant impact is much longer owing to the higher altitude of the initial soot distribution that results in longer residence times of the BC aerosol in the atmosphere. When yearly averages of the same quantities are performed over the IndiaPakistan region, the differences in ensemble mean values lie within the total standard deviations of the two ensembles. The results in Figure 14 can also be compared to the outcomes of other previous studies. In their experiment “UT 1 Tg”, Robock et al. (2007a) found that, when only 1 Tg of soot © 2018 American Geophysical Union. All rights reserved. remains in the atmosphere after the initial rainout, temperature and precipitation anomalies are about 20% of those obtained from their standard 5 Tg BC emission case. Therefore, the largest differences they observed, during the first few years after the exchange, were about - 0.3 K and -0.06 mm/day, respectively, comparable to the anomalies in the top and bottom panels of Figure 14. Their standard 5 Tg emission case resulted in a solar radiation flux anomaly at surface of -12 W/m2 after the second year (see their Figure 3), between 5 and 6 time as large as the corresponding anomalies from our ensembles shown in the middle panel. In their experiment “Exp1”, Stenke et al. (2013) reported global mean surface temperature anomalies not exceeding about 0.3 K in magnitude and precipitation anomalies hovering around -0.07 mm/day during the first few years, again consistent with the results of Figure 14. In a recent study, Pausata et al. (2016) considered the effects of an admixture of BC and organic carbon aerosols, both of which would be emitted in the atmosphere in the aftermath of a nuclear exchange. In particular, they concentrated on the effects of coagulation of these aerosol species and examined their climatic impacts. The initial BC distribution was as in Mills et al. (2014), although the soot burden was released in the atmosphere over time periods of various lengths. Most relevant to our and other previous work are their one-day emission scenarios. They found that, during the first year, the largest values of the atmospheric surface temperature anomalies ranged between about -0.5 and -1.3 K, those of the sea surface temperature anomalies ranged between -0.2 and -0.55 K, and those of the precipitation anomalies varied between -0.15 and -0.2 mm/day. All these ranges are compatible with our results shown in Figure 14 as red lines and with those of Mills et al. (2014, see their Figures 3 and 6). As already mentioned in Section 2.3, the net solar flux anomalies at surface are also consistent. This overall agreement suggests that the **inclusion of organic carbon aerosols, and** ensuing **coagulation** with BC, **should not dramatically alter the climatic effects** resulting from our forced ensemble simulations. Moreover, aerosol growth would likely **shorten the residence time of the BC particulate in the atmosphere** (Pausata et al., 2016), possibly **reducing the duration of these effects.**

#### Quantum vacuum mining destroys the universe- its feasible and inevitable

Folger 8 – Tim Folger, Contributing Editor at Discover Magazine, Writer for National Geographic, MA in Journalism from New York University, BA in Physics from UC Santa Cruz, “Nothingness of Space Could Illuminate the Theory of Everything”, Discover Magazine, 7-18, http://discovermagazine.com/2008/aug/18-nothingness-of-space-theory-of-everything

When the next revolution rocks physics, chances are it will be about nothing—the vacuum, that endless infinite void. In a discipline where the stretching of time and the warping of space are routine working assumptions, the vacuum remains a sort of cosmic koan. And as in the rest of physics, its nature has turned out to be mind-bendingly weird: Empty space is not really empty because nothing contains something, seething with energy and particles that flit into and out of existence. Physicists have known that much for decades, ever since the birth of quantum mechanics. But only in the last 10 years has the vacuum taken center stage as a font of confounding mysteries like the nature of dark energy and matter; only recently has the void turned into a tantalizing beacon for cranks. As one blond celebrity heiress and embodiment of emptiness might say, nothing is hot.

To investigate the mysteries of the void, some physicists are using the biggest scientific instrument ever built—the just-completed Large Hadron Collider, a huge particle accelerator straddling the French-Swiss border. Others are designing tabletop experiments to see if they can plumb the vacuum for ways to power strange new nanotech devices. “The vacuum is one of the places where our knowledge fizzles out and we’re left with all sorts of crazy-sounding ideas,” says John Baez, a mathematical physicist at the University of California at Riverside. Whether in the visionary search for the engine of cosmic expansion or the near-fruitless quest for perpetual free energy, the vacuum is where it’s happening. By mining the vacuum’s riches, a true theory of everything may yet emerge.

Empty space wasn’t always so mystifying. Until the 1920s physicists viewed the vacuum much as the rest of us still do: as a featureless nothingness, a true void. That all changed with the birth of quantum mechanics. According to that theory, the space around a particle is filled with countless “virtual” particles rapidly bursting into and out of existence like an invisible fireworks display.

Those virtual quantum particles are more than a theoretical abstraction. Sixty years ago a Dutch physicist named Hendrik Casimir suggested a simple experiment to show that virtual particles can move objects in the real world. What would happen, he asked, to two metal plates placed very close together in a complete vacuum? In the days before quantum mechanics, physicists would have said that the plates would just sit there. But Casimir realized that the net pressure of all the virtual particles—the stuff of empty space—outside the plates should exert a minuscule force, a nudge from nothing that would push the plates together.

Physicists tried for decades to measure the Casimir force with great precision, but it wasn’t until 1997 that technology caught up with theory. In that year, physicist Steve Lamoreaux, now at Yale, managed to detect the feeble Casimir force on two small surfaces separated by a few thousandths of a millimeter. Its strength was about equal to the force that would be exerted against the palm of one’s hand by the weight of a single red blood cell.

At first most physicists regarded the Casimir force as a quantum oddity, something of no practical value. Now that has changed: Forward thinkers see it as an important energizer for the tiniest of machines, devices on the nano scale, and a few labs are working on ways to use the force to defy the conventional limitations of mechanical design. Federico Capasso, a physicist at Harvard, leads a small team that is trying to create a repulsive Casimir force by tinkering with the shapes of plates or with the coatings used to cover them. His entire set of experiments fits on a desktop, and the objects he works with are so small that most of them cannot be seen without a microscope.

“Once you have a repulsive force between two plates, you should be able to eliminate static friction,” Capasso says. That could lead to a host of useful applications, including tiny frictionless bearings or nanogears that spin without touching. “But the experiments are enormously difficult, so I cannot tell you when and how.”

For all its strangeness, the Casimir force may be the one property of empty space that does not baffle today’s physicists. It is garden-variety quantum mechanics, weird but not unexpected. The same can’t be said about dark energy, a truly astonishing discovery made by astronomers a decade ago while observing distant exploding stars. The explosions revealed a universe expanding at an ever-faster rate, a finding at odds with previous expectations that the expansion of the cosmos should be slowing down, braked by the collective gravitational pull of all the matter out there. Some unknown form of energy—physicists call it dark energy simply for lack of a more descriptive term—appears to be built into the very fabric of space, countering the gravitational pull of matter and pushing everything in the universe apart. Some theorists speculate that dark energy might cause a runaway expansion of the universe, resulting in a so-called Big Rip some 50 billion years from now that would tear the cosmos to pieces, shredding even atoms.

The observations have allowed physicists to estimate the quantity of dark energy by deducing the force needed to produce the accelerating effect. The result is a minuscule amount of energy for every cubic meter of vacuum. Since most of the cosmos consists of empty space, though, that little bit adds up, and the total amount of dark energy completely dominates the dynamics of the universe.

With the discovery of dark energy came difficult questions: What is this energy, and where does it come from? Physicists simply do not know. According to quantum mechanics, the energy of empty space comes from the virtual particles that dwell there. But when physicists use the equations of quantum theory to calculate the amount of that virtual energy, they get a ridiculously huge number—about 120 orders of magnitude too large. That much energy would literally blow the universe apart: Objects a few inches from us would be carried away to astronomical distances; the universe would literally double in size every 10-43 second, and it would keep doubling at that rate until all the vacuum energy was gone. This may be the most colossal gap between observation and theory in the history of science. And it means that physicists are missing something fundamental about the way the universe works.

“We’ve made a prediction on the basis of our best theories, and it is wrong, wildly wrong,” says Sean Carroll, a theoretical physicist at the California Institute of Technology. “That means we don’t just tweak a parameter here and there; we really have to think deeply about what our theories are.”

Even if no one knows where the energy of empty space comes from or why it has the value it does, there is now no doubt that it exists. And if there is energy to be had, there is inevitably somebody out there thinking of how to exploit it. The notion of limitless energy from empty space has inspired legions of wannabe physicists who dream of developing the ultimate perpetual-motion device, a machine that would solve the world’s energy problems forever. A quick Internet search for the words free energy and vacuum turns up pages and pages of schemes for tapping the vacuum’s energy. I ask John Baez if such efforts are as hopeless as previous perpetual-motion machines. Are they equally crazy and doomed to failure?

“Perhaps not as doomed as trying to prove the world is flat,” Baez says. “One thing I can say is that I sure hope it doesn’t work, because if you could extract energy from the vacuum, it would mean that the vacuum is not stable. For normal physicists,” he adds with a laugh, “the definition of the vacuum is that it’s the lowest-energy situation possible—it has less energy than anything else.” In short, Baez says, while we may be able to get energy from the vacuum, success “would mean the universe is far more unstable than we ever dreamed.”

The reasoning goes like this: If the vacuum is not at the lowest energy state possible, then at some point in the future, the vacuum could fall to a lower state, pulsing out energy that would threaten the very structure of the cosmos. If some clever engineer were ever to extract energy from the vacuum, it could set off a chain reaction that would spread at the speed of light and destroy the universe. Free energy, yes, but not what the inventors had in mind.

#### The military is developing isomer bombs---even just testing will destroy the Universe

Bekkum 4 – Gary S. Bekkum, Founder of Spacetime Threat Assessment Report Research, Founder of STARstream Research, Futurist, “American Military is Pursuing New Types of Exotic Weapons”, Pravda, 8-30, http://www.starstreamresearch.com/dark\_matters.htm

Recently the British science news journal "New Scientist" revealed that the American military is pursuing new types of exotic bombs - including a new class of isomeric gamma ray weapons. Unlike conventional atomic and hydrogen bombs, the new weapons would trigger the release of energy by absorbing radiation, and respond by re-emitting a far more powerful radiation. In this new category of gamma-ray weapons, a nuclear isomer absorbs x-rays and re-emits higher frequency gamma rays. The emitted gamma radiation has been reported to release 60 times the energy of the x-rays that trigger the effect.

The discovery of this isomer triggering is fairly recent, and was first reported in a 1999 paper by an international group of scientists. Although this controversial development has remained fairly obscure, it has not been hidden from the public.

Beyond the visible part of defense research is an immense underground of secret projects considered so sensitive that their very existence is denied.

These so-called "black budget programs" are deliberately kept from the public eye and from most political leaders. CNN recently reported that in the United States the black budget projects for 2004 are being funded at a level of more than 20 billion dollars per year.

In the summer of 2000 I contacted Nick Cook, the former aviation editor and aerospace consultant to Jane's Defence Weekly, the international military affairs journal. Cook had been investigating black budget super-secret research into exotic physics for advanced propulsion technologies.

I had been monitoring electronic discussions between various American and Russian scientists theorizing about rectifying the quantum vacuum for advanced space drive. Several groups of scientists, partitioned into various research organizations, were exploring what NASA calls "Breakthrough Propulsion Physics" - exotic technologies for advanced space travel to traverse the vast distances between stars. Partly inspired by the pulp science fiction stories of their youth, and partly by recent reports of multiple radar tracking tapes of unidentified objects performing impossible maneuvers in the sky, these scientists were on a quest to uncover the most likely new physics for star travel. The NASA program was run by Marc Millis, financed under the Advanced Space Transportation Program Office (ASTP). Joe Firmage, then the 28-year-old Silicon Valley CEO of the three billion dollar Internet firm US Web, began to fund research in parallel with NASA.

Firmage hired a NASA Ames nano-technology scientist, Creon Levit, to run the "International Space Sciences Organization", a move which apparently alarmed the management at NASA. The San Francisco based Hearst Examiner reported that NASA's Office of Inspector General assigned Special Agent Keith Tate to investigate whether any proprietary NASA technology might have been leaking into the private sector.

Cook was intrigued when I pointed out the apparent connections between various private investors, defense contractors, NASA, INSCOM (American military intelligence), and the CIA. While researching exotic propulsion technologies Cook had heard rumors of a new kind of weapon, a "sub-quantum atomic bomb", being whispered about in what he called the "dark halls" of defense research.

Sub-quantum physics is a controversial re-interpretation of quantum theory, based on so-called pilot wave theories, where an information field controls quantum particles. The late Professor David Bohm showed that the predictions of ordinary quantum mechanics could be recast into a pilot wave information theory. Recently Anthony Valentini of the Perimeter Institute has suggested that ordinary quantum theory may be a special case of pilot wave theories, leaving open the possibility of new and exotic non-quantum technologies.

Some French, Serbian and Ukrainian physicists have been working on new theories of extended electrons and solitons, so perhaps a sub-quantum bomb is not entirely out of the question.

Even if the rumors of a sub-quantum bomb are pure fantasy, there is no question that mainstream physicists seriously contemplate a phase transition in the quantum vacuum as a real possibility. The quantum vacuum defies common sense, because empty space in quantum field theory is actually filled with virtual particles. These virtual particles appear and disappear far too quickly to be detected directly, but their existence has been confirmed by experiments that demonstrate their influence on ordinary matter.

"Such research should be forbidden!"

In the early 1970's Soviet physicists were concerned that the vacuum of our universe was only one possible state of empty space. The fundamental state of empty space is called the "true vacuum". Our universe was thought to reside in a "false vacuum", protected from the true vacuum by "the wall of our world". A change from one vacuum state to another is known as a phase transition. This is analogous to the transition between frozen and liquid water. Lev Okun, a Russian physicist and historian recalls Andrei Sakharov, the father of the Soviet hydrogen bomb, expressing his concern about research into the phase transitions of the vacuum. If the wall between vacuum states was to be breached, calculations showed that an unstoppable expanding bubble would continue to grow until it destroyed our entire universe! Sakharov declared that "Such research should be forbidden!"

According to Okun, Sakharov feared that an experiment might accidentally trigger a vacuum phase transition.