



Canadian Friends
Service Committee
(QUAKERS)

SYNTHETIC BIOLOGY: 2016 UPDATE #1

By combining biology, computer science, and engineering, synthetic biologists are creating novel life forms. Canadian Friends Service Committee is the peace and social justice agency of Quakers in Canada. Grounded in our values of peace, integrity, equality, simplicity, and respect for all creation, we are led to respond to the rapidly advancing field of synthetic biology (SB).

CFSC's specific mandate is listed in the Appendix. It includes sharing easily accessible updates about SB to raise public awareness. The following is the first update of 2016.

As you read each piece of news we invite you to consider three queries:

1. How can we address the ecological dimension of synthetic biology? e.g. impacts on biodiversity, synthetic organisms being untested by evolution and ecosystems;
2. How can we address the social dimension of synthetic biology? e.g. equitable distribution of benefits, needs of the vulnerable; and
3. How can we address the spiritual dimension of synthetic biology? e.g. the sacred in living beings and in nature as regards SB; the valuing of technology as compared to human wisdom and inner truth.

Please share any thoughts or feedback (however brief or detailed):

Email matt@quakerservice.ca or call 416-920-5213



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We'll start this edition with an increasingly relevant quote from the 2014 book *The Anthropocene*¹:



"The danger that artificial life could escape from laboratories in the process of synthetic biology is just one aspect of the problem.

The greater danger is that scientists change fundamental attitudes to life for the worse: an industrial biology that produces animals as if they were flat-screen TVs [...] and treats living creatures as mere "technology platforms" [...]

[Synthetic biology] represents one of the most sensitive research projects of all time, and the entry into a new dimension of life and human power [...]

Who is in control? How should a society that uses nature as mere biomass and raw material deal responsibly with the knowledge of how to synthesize life?"

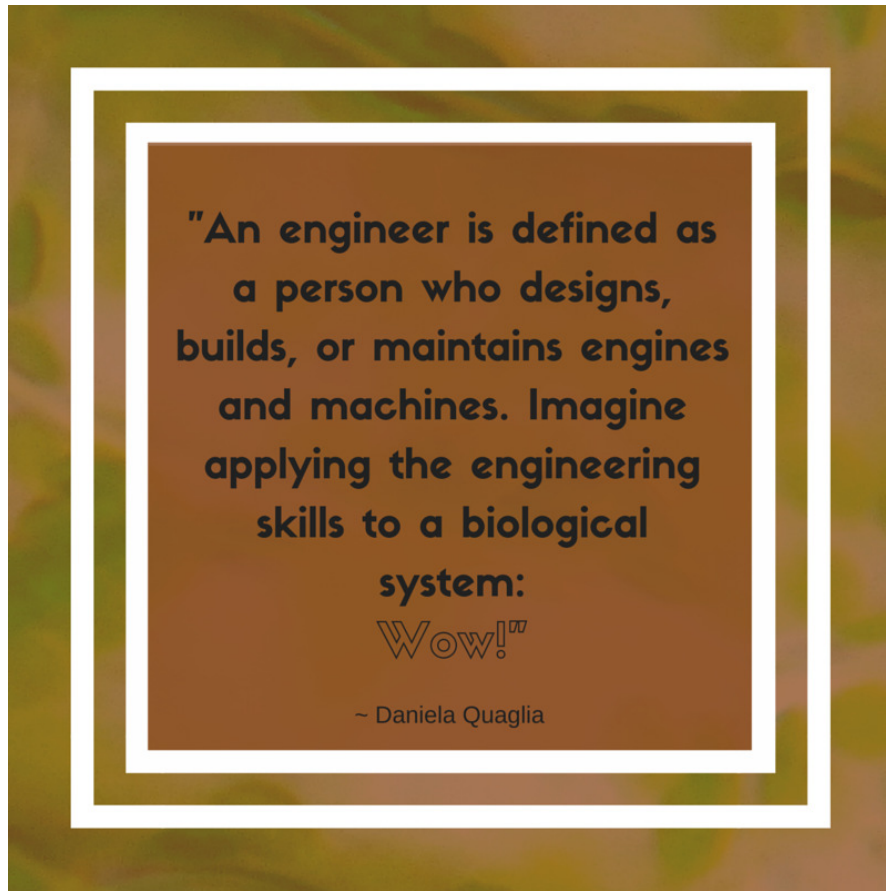
**CHRISTIAN SCHWÄGERL,
THE ANTHROPOCENE**

Contrast Schwägerl's words with the excitement of a scientist writing in the *Huffington Post*²:

¹ Schwägerl, Christian. *The Anthropocene: The Human Era and How It Shapes Our Planet*. Synergetic Press, 2014.

² Quaglia, Daniela. (2015, August 14). *Synthetic Biology: the Dawn of a New Era*, The Huffington Post [blog].

Retrieved from http://www.huffingtonpost.com/daniela-quaglia/synthetic-biology-the-daw_b_7990020.html



Since our last update, synthetic biology has been everywhere in the news, and likely no use of SB has gotten more attention than gene drives. ETC Group explains a gene drive is "designed to relentlessly drive a specific genetic trait through an entire species or population"³, even if that trait would not offer an evolutionary advantage.

Many articles herald gene drives as a potential solution to diseases like Zika virus and malaria. Through making male mosquitoes that produce offspring which do not live, the hope is to kill off entire mosquito populations. Before meaningful public discussion about gene drives has happened, real world tests have already begun with SB mosquitoes in several countries, conducted by the company Oxitec (owned by Intrexon).⁴

How powerful is a SB gene drive? Here's one illustration,

"Last year, scientists in California reported that they had used gene editing (together with another new biotechnology called gene drive) to introduce a mutation that disabled both

³ Stop The Gene Bomb! ETC Group Comment on NAS Report on Gene Drives. (2016, June 8). Retrieved from <http://www.etcgroup.org/content/stop-gene-bomb-etc-group-comment-nas-report-gene-drives>

⁴ Kay, Jennifer. (2016, March 11). Things to know about GMO mosquito test proposed for Florida. Associated Press. Retrieved from <http://www.apnewsarchive.com/2016/Federal-review-of-a-proposal-to-test-genetically-modified-mosquitoes-in-Florida-is-being-fast-tracked-as-part-of-the-US-government-s-emergency-response-to-the-spread-of-the-Zika-virus/>

normal copies of a pigmentation gene on a fruit-fly chromosome. The change made the insects turn pale yellow — as did their offspring, their offspring's offspring and so on. The change was so powerful that, had any of the California flies escaped, it has been estimated that somewhere between one in five and one in two of all the fruit flies in the world would be yellow today.”⁵

The National Academies of Sciences, Engineering, and Medicine recently released a lengthy report which cautions that gene drives should not be done outside of lab settings and carefully controlled field trials. The National Academies note that, “As of May 2016, no ecological risk assessment has been conducted for a gene-drive modified organism.”⁶ MIT professor Kevin Esvelt asks, “Do you really have the right to run an experiment where if you screw up, it affects the whole world?”⁷

CFSC has found very little media consideration of gene drives' possible social, political, or ecological impacts - all key issues Friends raised in their SB study groups in 2013.⁸ A few articles have noted the lack of any international regulatory framework for gene drives as an issue which should be resolved.⁹

While acknowledging the potential of gene drives to benefit people, industry and governments have showed reluctance to accept that a correspondingly serious level of risk exists. The National Academies study, for instance, fails to adequately consider how the profit motive will influence the use of gene drives, and who will benefit or be harmed by them.

It seems to have come as a surprise to many scientists when, citing the increased ease of use of synthetic biology techniques like CRISPR, the top intelligence official in the US added gene editing to a list of potential weapons of mass destruction.

The intelligence report states, “Given the broad distribution, low cost, and accelerated pace of development of this dual-use technology, its deliberate or unintentional misuse might lead to far-reaching economic and national security implications.”¹⁰

Nature writes that most “serious science commentators” consider it hyperbolic to call SB a potential weapon of mass destruction.¹¹ The broad distribution of SB is certainly real, as *Nature* mentions

⁵ *Gene intelligence: The risks and rewards of genome editing resonate beyond the clinic.* (10 March, 2016). *Nature*. Retrieved from <http://www.nature.com/news/gene-intelligence-1.19515>

⁶ *Gene-Drive Modified Organisms Are Not Ready to Be Released Into Environment; New Report Calls for More Research and Robust Assessment.* (2016, June 8). Retrieved from <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=23405>

⁷ Regalado, Anthony. (2016, June 6). *Meet the Moralistic Policing Gene Drives, a Technology That Messes with Evolution.* MIT Technology Review. Retrieved from <https://www.technologyreview.com/s/601634/meet-the-moralist-policing-gene-drives-a-technology-that-messes-with-evolution/>

⁸ Some of these comments are written up in the double-sided handout *Quakers and Synthetic Biology* available at <http://quakerservice.ca/QuakersSB>

⁹ E.g. Cobb, Matthew. (9 February, 2016). *Gene drives need global policing.* The Guardian. Retrieved from <https://www.theguardian.com/science/2016/feb/09/gene-drives-need-global-policing>

¹⁰ Regalado, Antonio. (2016 February 9). *Top U.S. Intelligence Official Calls Gene Editing a WMD Threat.* MIT Technology Review. Retrieved from <https://www.technologyreview.com/s/600774/top-us-intelligence-official-calls-gene-editing-a-wmd-threat/>

¹¹ Editorial. (10 March, 2016). *Gene intelligence: The risks and rewards of genome editing resonate beyond the clinic.* *Nature*. Retrieved from <http://www.nature.com/news/gene-intelligence-1.19515>

elsewhere that a single supplier, Addgene, sells well over 20,000 do-it-yourself CRISPR kits per year.¹² However, researchers at King's College have examined discussion of the weaponization of SB and argue that, although not beyond the realm of possibility, biosecurity risks are consistently exaggerated.¹³

150 scientists and potential funders held a “secret meeting” at Harvard in May and shortly afterward made a major announcement - they plan to synthesize a full human genome. To date nothing more complex than the bacterium *Mycoplasma mycoides* has been synthesized from scratch, so it is estimated that the incredibly challenging project to synthesize the human genome will take a decade.¹⁴

Perhaps the most surprising part of the story so far has been that prominent SB enthusiast Drew Endy not only came out in opposition to the lack of ethical debate before announcing this project, but did so in a letter making reference to religion. This is one of the very few instances we've seen where both ethical and faith aspects of SB are highlighted.

Less surprisingly, Endy and others have expressed dismay that such a controversial project as synthesizing the human genome (opening up possibilities like a human with no parents) may cause a public backlash leading to increased regulation of all applications of SB.¹⁵

A study released at the end of 2015 discusses growing partnership between SB companies and the fossil fuel industry. The study notes various applications of SB techniques in support of fossil fuel extraction, refinement, carbon capture, and more.

For example, since an estimated 40 to 60% of the world's proven gas reserves are remote or stranded, the fossil fuel industry is turning to SB, seeking to extract oil and gas from ever more difficult to reach reserves through the deployment of synthetic organisms. The authors note that this, “combines the biosafety risks of synthetic biology with the climate risks of fossil fuel extraction.”¹⁶

Microsoft has announced plans to store data in DNA rather than on computer disks or tapes. While disks need to be replaced every 10 years, the company claims DNA data storage can last centuries.¹⁷

Corn and mushrooms created using CRISPR have now been approved in the US for commercial sale.¹⁸ Apparently the US Food and Drug Administration feels that the SB technique used to edit these foods is

¹² Corbyn, Z. (2015, December 3). *Research: Biology's big hit*. Nature, 528(7580), S4-S5. Retrieved from http://www.nature.com/nature/journal/v528/n7580_supp/full/528S4a.html

¹³ Jefferson, Catherine, Filippa Lentzos and Claire Marris. (2014, August 21). *Synthetic biology and biosecurity: challenging the “myths”*. Frontiers in Public Health.

¹⁴ Achenbach, Joel. (2016, June 2). *After secret Harvard meeting, scientists announce plans for synthetic human genomes*. The Washington Post. Retrieved from <https://www.washingtonpost.com/news/science/wp/2016/06/02/after-secret-harvard-meeting-scientists-publish-proposal-to-create-synthetic-human-genomes/>

¹⁵ Endy, Drew and Laurie Zoloth. (2016, May 12). *Should we synthesize a human genome?* Cosmos Magazine. Retrieved from <https://cosmosmagazine.com/society/should-we-synthesize-a-human-genome>

¹⁶ ETC Group and Heinrich Böll Stiftung. (2015, November 24). *Extreme biotech meets extreme energy*. Retrieved from <http://www.etcgroup.org/content/extreme-biotech-meets-extreme-energy>

¹⁷ Markoff, John. (2015 December 3). *Data Storage on DNA Can Keep It Safe for Centuries*. The New York Times. Retrieved from <http://www.nytimes.com/2015/12/04/science/data-storage-on-dna-can-keep-it-safe-for-centuries.html>

not covered by existing regulatory requirements because the foods produced don't contain “foreign DNA.” SB techniques like TALENs and CRISPR did not exist when laws regulating genetically modified organisms were originally developed.¹⁹

APPENDIX:

Canadian Yearly Meeting of the Religious Society of Friends (Quakers) recommends that Friends work on this concern in the following ways:

1. That CYM affirm the seven principles identified in [Principles for the Oversight of Synthetic Biology](#), a document that makes many important recommendations, and continue to work with the [Biotechnology Reference Group of the Canadian Council of Churches \(BRG\)](#) on discerning ways to implement the seven principles:
 - i. Employ the Precautionary Principle;
 - ii. Require mandatory synthetic biology-specific regulations;
 - iii. Protect public health and worker safety;
 - iv. Protect the environment;
 - v. Guarantee the right-to-know and democratic participation;
 - vi. Require corporate accountability and manufacturer liability; and
 - vii. Protect economic and environmental justice.
2. That CYM request that Canadian Friends Service Committee (CFSC), with the help of concerned groups such as the [ETC Group](#) and the [BRG](#), provide Canadian Quakers with an annual, easily understandable update on synthetic biology;
3. That CYM request CFSC, and encourage Monthly Meetings, to find opportunities to link with other faith and community groups, and with Indigenous peoples, to share insights and discernment about synthetic biology; and
4. That CYM encourage CFSC and Quaker Meetings in Canada to engage with other faith groups and interested parties, including organizations involved in research and/or manufacture in synthetic biology, to hold and/or participate in conferences that address ethical, spiritual, social, and economic aspects of synthetic biology.



Find out more about synthetic biology, including background of how this concern of Friends has developed and what Meetings from across Canada have said:

<http://www.quakerservice.ca/syntheticbiology>

Questions? Comments? Contact us
416-920-5213 or matt@quakerservice.ca

¹⁸ McKie, Robin. (2016 April 24). *US moves to sell gene-edited mushrooms fuel doubts over British ban on GM imports*. The Guardian. Retrieved from <http://www.theguardian.com/environment/2016/apr/24/crispr-gene-edited-food-us-decision-mushrooms-corn>

¹⁹ Waltz, Emily. (2016 April 14). *Gene-edited CRISPR mushroom escapes US regulation*. Nature. Retrieved from <http://www.nature.com/news/gene-edited-crispr-mushroom-escapes-us-regulation-1.19754>