Environmental Release of Genetically-Engineered Mosquitoes: The Latest Episode in Frankenstein-Type Scientific Adventures

William Leiss (2 February 2012)

The subtitle for this essay is merely descriptive – not at all intentionally provocative – and is meant to be taken literally. By "Frankenstein-type" I mean, not the scientific work itself, but rather the arrogant and thoughtless act of a scientist in releasing a novel entity into the environment without adequate notice or prior discussion with the public, whether accidentally (as in the case of Mary Shelley's story) or deliberately. Should this practice continue, as I suspect it will, almost certainly there will eventually be a very bad ending – for science itself. Only remedial action by other scientists themselves can head it off, and so far such action is noteworthy by its absence. They will regret this omission.

Yesterday's story in *Spiegel International Online* by Rafaela von Bredow, "The controversial release of suicide mosquitoes" (http://spon.de/adztv), prompted me to look further. And sure enough, I had missed an earlier report in the publication I most rely on for such matters, *The New York Times,* in the edition dated 31 October 2011, written by Andrew Pollack: "Concerns raised over genetically engineered mosquitoes" (http://tinyurl.com/7remh3q). Other sources for this issue can easily be found by putting "genetically engineered mosquitoes" into your preferred Internet search engine.

The *Aedes aegypti* mosquito carries the dengue virus, which causes the most important insect-borne viral disease (dengue fever) in the world. Worldwide there are an estimated 50-100 million cases and at least 20,000 fatalities (mostly children) annually, and there is no vaccine or adequate therapy. It is a serious public health burden in many countries. Papers in the scientific literature about the possibility of attacking the problem by modifying or genetically engineering the mosquito itself have appeared over the past fifteen years. The dominant approach of this type is to release sterilized male mosquitoes into the environment which upon mating with females will produce no young. This approach has shown limited success.

The recent publicity has to do with a new approach in which laboratory-bred male mosquitoes are genetically engineered to express a protein that causes the larvae to die. The gene was developed by a biotechnology company in Oxford, England. The controversy involves the decision made by the company to seek approval for the environmental release of the GE mosquitoes in confidence – without public release of relevant information – from governments in various countries. This began in 2009 in the Cayman Islands; later releases took place in Malaysia and Brazil, and future releases are scheduled in Panama, India, Singapore, Thailand, Vietnam, and Florida.

Here's an extract from Andrew Pollack's story:

> In particular, critics say that Oxitec, the British biotechnology company that developed the dengue-fighting mosquito, has rushed into field testing without sufficient review and public consultation, sometimes in countries with weak regulations.

> "Even if the harms don't materialize, this will undermine the credibility and legitimacy of the research enterprise," said Lawrence O. Gostin, professor of international health law at Georgetown University.
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> Luke Alphey, the chief scientist at Oxitec, said the company had left the review and community outreach to authorities in the host countries.
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> "They know much better how to communicate with people in those communities than we do coming in from the U.K." he said.

Rafaela von Bredow's recent and useful follow-up report in *Spiegel Online* also includes comments from other scientists, in particular two who are working on competing projects. The first reference below is to Guy Reeves of the Max Planck Institute for Evolutionary Biology in Plön, Germany:

> The geneticist [Reeves] doesn't think Oxitec's techniques are "particularly risky" either. He simply wants more transparency. "Companies shouldn't keep scientifically important facts secret where human health and environmental safety are concerned," he says.
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> Reeves himself is working on even riskier techniques, ones that could permanently change the genetic makeup of entire insect populations. That's why he so vehemently opposes Oxitec's rash field trials: He believes they could trigger a public backlash against this relatively promising new approach, thereby halting research into genetic modification of pests before it really gets off the ground.
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> He's not alone in his concerns. "If the end result is that this technology isn't accepted, then I've spent the last 20 years conducting research for nothing," says Ernst Wimmer, a developmental biologist at Germany's Göttingen University and one of the pioneers in this field. Nevertheless he says he understands Oxitec's secrecy: "We know about the opponents to genetic engineering, who have destroyed entire experimental crops after they were announced. That, of course, doesn't help us make progress either."

Commentary.

H. G. Wells published his novel, *The Island of Doctor Moreau*, in 1896: See the Wikipedia entry, http://en.wikipedia.org/wiki/The_Island_of_Doctor_Moreau; the entire book is online at: http://www.bartleby.com/1001/. His story deals with a medical scientist living on a remote island who creates half-human/half-animal creatures. In more recent times we have become aware of experiments in genetic engineering, such as cloning, that have been done in some countries, notably South Korea, and have raised serious issues in scientific ethics. (See the *New York Times* editorial of December 2005 [http://tinyurl.com/7xmdlgt] and follow the links, or just search for "cloning South Korea.") Later publicity concerned the cloning of human embryos in China: See the *New Scientist* article (http://tinyurl.com/7sguhgq) from March 2002. Significant differences among countries in terms of government regulatory regimes and scientific research ethics programs remind us of the Wells' scenario.

Other modified insects using the earlier technology (males sterilized with radiation), notably the pink bollworm, have been released to control plant pests. The GE mosquitoes from Oxitec are the first to use the new technology for a human health problem. They could very well represent an enormous human benefit with insignificant or even no offsetting risks –

although it would be very nice to have a credible and publicly-available risk assessment certifying the same (perhaps we will get one from the U. S. Department of Agriculture, which has to approve the field trial in Florida). It is quite possible that very few people living in countries affected by dengue fever would have any objections to the use of GE mosquitoes.

But the biggest risk involved in the use of unpublicized field trials (environmental release) for GE mosquitoes is to scientists and scientific research itself. Readers of my recent blog, (http://leiss.ca/wp-content/uploads/2011/12/Nature-is-the-biggest-bioterrorist.pdf), on the genetic engineering of the H5N1 avian flu virus, will recall the interesting issues in scientific ethics raised in that case which are different from, but related to, those in the current one.

Both of these sets of issues encompass the ability and willingness of the scientific community to "police" research practices with the long-term public interest in mind. To do so they would have to create deliberative structures both international in scope and sufficiently robust to enforce their strictures on unwilling members of their community – for example, by an enforceable policy of denial of research grant funding and publication in journals. (The suggestion here avoids any necessary involvement by government authorities.) This is a tall order, to be sure, but there are a few precedents, notably the 1975 Asilomar Conference (http://en.wikipedia.org/wiki/Asilomar_Conference_on_Recombinant_DNA).[1]

In the case of GE mosquitoes, the offhand comment by the lead scientist, Luke Alphey, quoted above from Andrew Pollack's article, with its crude justification for ignoring *his own* clear responsibility for initiating public disclosure and deliberation, is telling. The other scientists who were quoted in the two articles referenced above were obviously unhappy with him, but they did not suggest what remedies might be imposed for such irresponsible acts. This despite their recognition that it is the genetic engineering of plants and animals that has been already a source of both intense public curiosity and equally great concern, a phenomenon that will inevitably grow in importance with each further advance in scientific discovery and application in this field. For scientists to ignore the risks to their own activities in this domain is foolish and short-sighted indeed.

[1]The first famous example was the debate among some scientists over the use of the first atomic bomb in 1945: See the discussion in the Back Section of my 2008 book, *The Priesthood of Science* (http://www.press.uottawa.ca/book/the-priesthood-of-science).