

British Royal Society must end its Partisan, Unscientific support for GM Crops and Food

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The Royal Society is committed to providing unbiased information on scientific issues, writes Steven Druker. But its new guide on GMOs is grossly misleading – glossing over the many dangers inherent to the technology with bland, unsupported re-assurances. The Society must end its partisan promotion of GMOs or risk its reputation as Britain’s premier scientific body.

The authority of science is being persistently challenged in regard to climate change and other major issues, and when a flagship scientific institution sullies its integrity in one area, it weakens the stature of science across the board.

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When it comes to genetically modified crops, the behaviour of the Royal Society has been routinely unroyal.

For more than fifteen years, this august institution has striven to defend the image of these novel products and to denigrate those who have raised concerns; and it has done so with lax regard for evidence or ethics.

Moreover, it has refused to acknowledge the misrepresentations it made or to redress the wrongs it inflicted. I sent the past president of the Society a well-publicized [open letter](#) in March 2015 that documented its most significant derelictions and requested that the false statements be corrected.

It also requested that apologies be issued to the scientists whose reputations had been unjustly besmirched. Even though he personally sent me an email acknowledging he received it, no remedial action was taken.

Regrettably, the Society has persisted in its irresponsible behaviour, as an examination of its recently released [guide](#) to GM crops makes eminently clear.

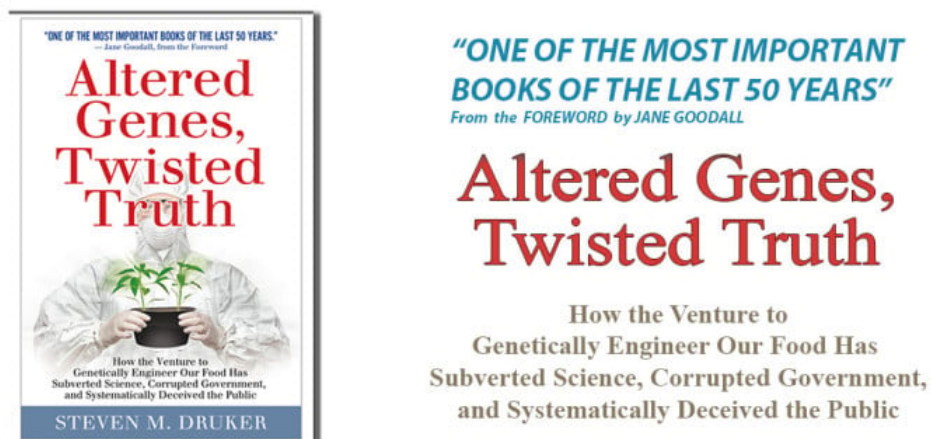
That document laments the fact that half the UK’s population feel poorly informed about GM crops, and it purports to address that lack by providing “reliable” and “unbiased” answers to peoples’ most pressing questions – information that’s supposed to enable “rational debate”.

However, despite its lofty pretensions, not only is its presentation consistently biased, a substantial amount of the information it dispenses is actually *misinformation*.

Obfuscating the unnatural nature of the GM process and ignoring its unsettling features

The bias is evident from the outset, and the authors don't even provide an honest answer to the initial question: *"What is genetic modification (GM) of crops and how is it done?"* Their response is substantially misleading because they omit the most unnatural and unsettling features while downplaying the unnaturalness of those they do mention.

In one of the biggest obfuscations, they avoid mentioning that biotechnicians have been inserting foreign DNA into plant genomes in a haphazard manner – and that the insertions not only disrupt the region of DNA into which they wedge but cause disruptions throughout the DNA strand, a phenomenon some scientists call '[genome scrambling](#)'. [i]



The authors are equally evasive regarding how the foreign genes are induced to actually function, and they fail to disclose a crucial fact: that inserting a new gene does not in itself endow the plant with the desired new trait. That's because it's essential to get the information encoded within the gene expressed into a protein, and in almost every case, that won't happen without artificial alteration of the inserted genetic material.

Here's why.

The default condition of most genes is to be inactive and blocked from expressing – which conserves the organism's energy and prevents proteins from being produced when and where they're not needed. [ii]

A gene transitions from its closed-down default mode to its active mode through the operation of a regulatory element called a 'promoter', a segment of DNA adjoined to the gene that serves as its on/off switch. This switch is finely attuned to specific biochemical signals so that the gene expresses in harmony with the organism's needs.

Consequently, when a gene is taken from one species and transferred to an unrelated one, the promoter will rarely (if ever) receive signals to which it's sensitive, and the gene will remain inactive. Hence, before making such transfers, biotechnicians must remove the native promoter and replace it with one that will reliably function in the foreign milieu.

Moreover, to deliver the desired results, the promoter must in most cases not only induce the gene to express, but to boost its expression (and consequent protein production) to an extraordinary level.

For virtually every GM crop on the market, the potent promoter that's been used to achieve such unusual results comes from a plant virus. Not only does it impel the inserted genes to

produce proteins at an abnormally elevated level, it drives the production continuously, regardless of the organism's needs and completely outside the intricate regulatory system through which its other genes are controlled. This can create serious problems by inducing metabolic imbalances or upsetting complex biochemical feedback loops.

Therefore, given the crucial role played by viral promoters, and the degree to which their employment is unnatural, it's reasonable to expect that any purportedly balanced account of the GM process would mention them – and to deplore the Society's utter failure to do so.

Obscuring the disruptiveness of the process that transforms the modified cells into whole plants

The authors are likewise elusive in explaining how an isolated plant cell that has incorporated new genes is subsequently turned into a mature plant.

They say this is possible *“because individual plant cells have an impressive capacity to generate entire plants”*, but they neglect to disclose that this capacity can only be actualized through a distinctly artificial process – in contrast to natural seeds, which grow into plants spontaneously.

That process is called 'tissue culture', and although the authors note that it's employed, they say nothing more about it – which obscures the fact that through its procedures, the cell is *“forced to undergo abnormal developmental changes.”* [iii] They also becloud the fact that besides being highly unnatural, tissue culture is highly disruptive – and imparts what's referred to as a 'genomic shock' that causes numerous mutations throughout the plant's DNA.

Thus, the authors' account of the GM process is notable, not for what it says, but for what it fails to say; and their systematic avoidance of disquieting facts not only causes it to be significantly distorted, but, as will be seen, leads to the distortion of other key parts of their presentation.

Denying the significant differences between GM crops and those bred conventionally

Because the authors acknowledge only the most obvious differences between GM and conventional breeding, while ignoring the lesser-known but more important ones, they're emboldened to claim that GM is no more likely to entail *“unforeseen effects”*. But this is flat-out false, and experts who *have* taken the key differences into account have decisively reached the opposite conclusion. [iv]

For instance, a major [report](#) by the Royal Society of Canada concluded that GM is far more likely to induce unforeseen effects, and even a [report](#) by the US National Academy of Sciences, which, like the Royal Society, has consistently endeavoured to promote GM crops, has nevertheless clearly acknowledged this greater likelihood too. [v]

The authors attempt to support their spurious claim by arguing that *“all”* plant genomes *“frequently”* receive insertions of new DNA through viral and bacterial infections and through the activity of 'jumping genes' – and that these insertions are *“similar”* to those made via GM, which entails that conventional breeding is just as likely to have unforeseen consequences.

This argument is seriously flawed and significantly misleading. For one thing, every gene

that's inserted into the DNA of an isolated plant cell via GM also becomes integrated within the DNA of every cell of the plant that's developed from that single cell (and so is integrated into the plant's entire genome). On the other hand, and contrary to the authors' assertion, the integration of a gene from a virus or a bacterium into the entire genome of a plant is a rare event.

Although viruses frequently infect plant cells, their genes are seldom inserted into the DNA of the gametes (the sex cells), a necessary step for transferring to the plant's progeny and becoming established in the genome. Thus, the vast majority of the viral DNA sequences within plant genomes have been there for an extremely long time; and during that time, the plant's defense mechanisms have inactivated them.

Further, scientists know of only two bacterial species that are capable of inserting their genes into the DNA of plants, and those genes are hardly ever incorporated into an entire genome. There are only three plant species in which such integrations have been observed, and just one is a food crop (sweet potato). Moreover, the bacterial genes in the potatoes have no discernible effect, are being transcribed at low levels, and either may not be producing any proteins at all or are producing very little.

In contrast, the new genes that are added to a plant's genome via GM not only produce proteins, they *hyper-produce* them, which could cause hazardous imbalances. And that hyper-production is driven by a powerful viral promoter. Whereas that promoter is not affixed to any of the active genes within the genomes of conventionally bred crops, it's affixed to one or more active genes within the genome of virtually every commercialized GM crop. [vi]

So not only are insertions of bacterial and viral DNA into plant genomes exceptionally rare, and not only are they *dissimilar* from the insertions wrought by GM, it is through the GM process *alone* that new viral DNA has recently and widely entered plant genomes – and this incursion has introduced new risks.

Ignoring biological realities to reach a patently false conclusion

The actual facts about 'jumping genes' are likewise at odds with the authors' claims. In reality, those segments of DNA, technically termed 'transposons', rarely mobilize in the absence of extraordinary stress; so most of their current locations have been stable since an ancient era. [vii]

In fact, a GM plant is much *more* likely to harbour new transposon-induced perturbations than its parent because the GM process tends to activate transposons and get them jumping. [viii] Conversely, pollen-based breeding rarely causes transposons to move. [ix]

The authors' other allegations about hazards of conventional breeding are equally erroneous. Contrary to their claims, that process hardly ever moves genes into "*new unknown places*" or introduces new genes that have never been in the food chain. Only GM regularly produces such novel results. [x]

Thus, not only do the authors fail to acknowledge the abundant evidence that documents the disruptive effects of the GM process, they significantly misrepresent important biological realities that they do discuss. Only in this way can they conclude that GM is no more likely to entail unforeseen consequences than is conventional breeding.

In glaring contrast, the expert panel that produced the report of the Royal Society of Canada, who took account of the facts the guide's authors ignored or distorted, concluded that while pollen-based breeding rarely involves worrisome unintended outcomes, the "*default prediction*" for every GM crop should be that it entails unintended effects that are hard to predict, could be difficult to detect, and might be harmful to human health.

Which leads to the question of whether GM crops are safe, another issue that the authors of the guide have grievously mishandled.

Declaring the safety of GM crops by dishonouring the standards of science

"Is it safe to eat GM crops?" Of all the questions the guide addresses, this is the most crucial. And it answers with a resounding "Yes." But this simple answer is simply unjustified.

For one thing, the unequivocal declaration that all GM crops are safe flies in the face of the World Health Organization's [assertion](#) that "*it is not possible to make general statements on the safety of all GM foods*". As the WHO noted, because "*different GM organisms include different genes inserted in different ways*" it's necessary to assess them "*on a case-by-case basis*."

Even the Royal Society's president emphasized the need for case-by-case assessment in comments he released in conjunction with the guide's publication.

So how do the authors attempt to support their all-inclusive claim? They declare: "*All reliable evidence produced to date shows that currently available GM food is at least as safe to eat as non-GM food*." And they assert that "*there has been no evidence of ill effects linked to the consumption of any approved GM crop*."

But there has indeed been such evidence, and many studies published in peer-reviewed journals have detected ill effects to the animals that consumed a GM crop. For instance, [a systematic review](#) of the toxicological studies on GM foods that was published in 2009 concluded that the results of "*most*" of them indicate that the products "*may cause hepatic, pancreatic, renal, and reproductive effects and may alter hematological, biochemical, and immunologic parameters the significance of which remains unknown*."

It also noted that further studies were clearly needed. [Another review](#) that encompassed the additional studies that had been published up until August 2010 also provided cause for caution. It concluded that there was an "*equilibrium*" between the research groups "*suggesting*" that GM crops are as safe as their non-GM counterparts and "*those raising still serious concerns*."

Between 2008 and 2014 there have been eight such reviews published in standard journals, and as a whole, they provide no grounds for unequivocally proclaiming safety. As Sheldon Krimsky, a professor at Tufts University, [observed](#) in a comprehensive examination that was also published in a peer-reviewed journal: "*One cannot read these systematic reviews and conclude that the science on health effects of GMOs has been resolved within the scientific community*." [xi]

Yet the authors of the guide purport that it has been resolved conclusively – and that safety is a certitude.

The answer? Dismiss all the research that has detected harm

But to do so, they resort to trickery. They claim that only “a few” studies have stated that a GM food caused harm when in fact there have been many. They then summarily dismiss all these studies as ‘unreliable’. And to justify this wholesale rejection, they argue that each of the studies has been “*challenged*” regarding its statistical analysis and methodology.

But based on that criterion, most of the studies that underlie their claim of safety are also unreliable, because they too have been challenged. Moreover, while the latter critiques have been reasonable and fair, most of those on which the authors rely have not. [xii]

The unfairness is strikingly exemplified by the attacks that were mounted against a long-term study that yielded disturbing results. In it, a team of university researchers led by Giles-Eric Séralini demonstrated that a GM crop approved by regulators based on a medium-term, 90-day toxicological feeding study caused significant damage to the rats’ livers, kidneys, pituitary glands, and mammary tissues when tested over the long-term (two years). [xiii]

Those results cast doubt on the entire GM food venture because no regulators require tests greater than 90 days, and several GM crops have entered the market without any toxicological testing at all.

So when the study was published in a respected journal in 2012, proponents of GM crops bitterly attacked it and demanded its retraction. But because it was a sound toxicological study, they had to assail it on different grounds. So they focused on the part that reported an increased rate of tumour development in the GM-fed rats, and they argued that too few animals had been used to meet the standards for a carcinogenicity study.

However they disregarded the facts

1. that the research was not designed to meet those standards,
2. that it *did* fulfill the standards for a toxicological study,
3. that tumours are supposed to be reported if they’re detected during such a study, and
4. that the troubling toxicology results *were* reliable.

Nonetheless, despite the weakness of their claims, they continued to pressure the journal until, more than a year after publication – and after the addition of a former Monsanto scientist to the editorial board – the study was finally retracted.

But not only did the chief editor acknowledge the adequacy of the toxicological findings, the lone reason he proffered for rejecting the tumour-related findings was that they were “*inconclusive*”, which is not a valid reason for retraction. Moreover, according to standard guidelines, even if there had been good grounds for retracting that part, the rest of the study should not have been pulled.

That retracted paper is the only study the guide’s authors cite to back their claim that all the ones which reported harm are unreliable. And though they emphasize its retraction, they don’t mention any of the above-noted facts, imparting the impression that none of its findings were sound.

Worse, they also fail to mention one other key fact: that due to the study’s solidity, it was subsequently *republished* in another peer-reviewed journal. Because that happened almost a year before their guide was released, such an omission is inexcusable – and downright deceptive.

Falsely asserting that no study has cast doubt on the GM method itself

Furthermore, besides unfairly rejecting the studies that reported problems, the authors don't even describe them fairly. For instance, they assert that none has indicated that "*the GM method itself*" caused any harm and that all the problems have been attributed either to the specific gene introduced or to particular agricultural practices. But this claim is doubly bogus.

First, in almost all the cases, the researchers couldn't determine which specific factor or factors caused the harm, so they didn't pin the blame on a particular gene or herbicide – and the GM process was never absolved.

Moreover, the only study on an herbicide-tolerant GM crop designed to separately assess the roles of the herbicide and the plant found that *each* caused harm – and that the plant was harmful even when *unsprayed*. [xiv] And because the exact source of the plant-induced harm could not be ascertained, the GM process may well have been at fault.

Second, at least one major study *did* specifically link the GM process with harm. And the Royal Society is well aware of that study because it led the sordid attempt to discredit it.

Misrepresenting and maligning Pusztai's important research

That study was conducted at the Rowett Institute under the leadership of a renowned authority on food safety testing, Arpad Pusztai.

It revealed that GM potatoes producing a foreign protein that's safe for mammals to eat caused a problematic effect in the rats that consumed them compared to rats that ate the non-GM counterparts, even though the latter had been spiked with the same level of foreign protein within the modified spuds. Accordingly, the researchers concluded that some aspect of the GM process was significantly responsible for the result.

Because this research cast doubt on the process, the technology's defenders ardently assailed it, with the Royal Society at the forefront. Even before it was published, nineteen of the Society's fellows disparaged it in an open letter without having seen all the data; and the Society then conducted a biased and unwarrantedly critical review even though the research was still unpublished and the reviewers had not seen all the data either.

So irregular and unfair was the Society's review that the editor of the prestigious journal, *The Lancet*, rebuked the organization for its "*breathhtaking impertinence*" and its "*reckless*" abandonment of the principle of due process. [xv] The Society subsequently put "*intense pressure*" on the *Lancet* to deter it from publishing the research, [xvi] and even after that journal published it, [xvii] the Society continued to unjustly malign it. [xviii]

So, having been unable to honestly refute the research, and having also failed to block its publication in a premier journal, the Society now blatantly misrepresents its express findings, falsely asserting they have no bearing on the safety of the GM process itself.

And to aggravate the injustice, it claims that the mere fact it attacked the study robs it of reliability – while ignoring the fact that the attack was demonstrably unfair. [xix]

The Society must choose dedication to science over unprincipled promotion of GM crops

Thus, it's clear that when dealing with GM crops, the Royal Society has behaved more like propaganda unit than an objective scientific institution.

It's also obvious there's an urgent need for thorough reform – especially because the authority of science is being persistently challenged in regard to climate change and other major issues, and when a flagship scientific institution sullies its integrity in one area, it weakens the stature of science across the board.

It's almost certain that most of the Society's fellows, including the new president, Professor Venki Ramakrishnan, are unaware of its multiple misdeeds; and if even a few learn the startling truth, they could impel positive change.

On that note, I offer to meet with Professor Ramakrishnan, accompanied by a few knowledgeable scientists, for a cordial conversation to clarify the facts and consider the best way forward. I extended this offer to his predecessor, and had it been accepted, the Society's subsequent statements about GM crops might well have been worthy of respect.

Hopefully, under Dr. Ramakrishnan's leadership, the institution will restore its status as an exemplar of science and address the GM issue in an honest and accurate manner.

Steven M. Druker is an American public interest attorney who, as executive director of the [Alliance for Bio-Integrity](#), initiated a lawsuit that exposed how US governmental fraud had enabled the commercialization of GM foods.

Books: Steven Druker is the author of [Altered Genes, Twisted Truth: How the Venture to Genetically Engineer Our Food Has Subverted Science, Corrupted Government, and Systematically Deceived the Public](#), which was released in March 2015 with high praise from many experts and a [foreword by Jane Goodall](#) hailing it as “without doubt one of the most important books of the last 50 years.”

Notes

i The Royal Society's guide employs the terms 'genetic modification' and 'GM process' to exclusively refer to the methods that have been used to create almost all of the genetically engineered crops currently on the market, and those methods are the focus of its discussion. It does not deal with newer techniques such as 'genome editing.' Accordingly, this article discusses the GM process on which the guide is focused.

ii A small percentage of an organism's genes are always in an expressive mode because it's essential that the proteins they produce be constantly available.

iii A. Wilson, J. Latham, and R. Steinbrecher, “Genome Scrambling -Myth or Reality? Transformation-Induced Mutations in Transgenic Crop Plants.” Technical Report – October 2004, p. 1 <http://www.econexus.info/taxonomy/term/12>

iv There are some modes of non-GM crop development that induce a greater number of unpredictable effects than pollen-based reproduction, and many GM proponents claim that two of them (inducing mutations via radiation and via chemicals) have greater potential to do so than does GM. However, not only are there sound reasons to contest this claim (as explained in my book), because the authors of the guide employ the term 'conventional breeding' to denote only pollen-based reproduction, the soundness of their assertions must be judged by comparing the properties

of that particular mode with GM.

v The chart on page 240 of the NAS report indicates that the processes used to produce the vast majority of the GM crops that have been cultivated and consumed are many times more likely to induce unintended effects than is pollen-based breeding, even when the effects of tissue culture are not factored in.

vi Because the virus containing that promoter is not a retrovirus but a pararetrovirus, its DNA ordinarily doesn't even enter the DNA of the plant cells that it does infect, let alone the entire genome of plants. And in cases where it may have been inadvertently integrated into a genome, it would most likely have been inactivated.

vii Fedoroff, N. and Brown, N.M., *Mendel in the Kitchen: A Scientist Looks at Genetically Modified Foods* (Washington, DC: Joseph Henry Press, 2004) p. 103.

viii Transposons can be activated through the disruptions caused by the insertion process and also through those induced by tissue culture. And some scientists think they could also mobilize due to destabilizing effects of the powerful viral promoters.

ix *Mendel in the Kitchen* (cited in note 6) pp. 104-05. However, Fedoroff points out that wide crosses between "very distantly related plants" can activate transposons.

x This is especially true when the term 'conventional breeding' is applied solely to pollen-based reproduction, which is how the Royal Society's document employs it. And the relevant question is whether GM is more likely than is the natural process to induce unexpected changes in the new plant that were not present in the parent.

xi Krinsky, S., "An Illusory Consensus Behind GMO Health Assessment," *Science, Technology & Human Values*, November 2015; vol. 40, 6: pp. 883-914., first published on August 7, 2015

xii For a detailed discussion, see Chapters 6 and 10 of *Altered Genes, Twisted Truth*. Extensive documentation is also provided in [GMO Myths and Truths](#).

xiii Seralini, G.-E., et. al. 2012. "Long Term Toxicity of a Roundup Herbicide and a Roundup-tolerant Genetically Modified Maize." *Food and Chemical Toxicology* 50:4221-31 (retracted 2013). Republished in *Environmental Sciences Europe* 26:1-17 (2014).

xiv That study was Seralini's long-term test, referenced in note 13.

xv Editorial: "Health risks of genetically modified foods," *The Lancet* 353, May 29, 1999: 1811.

Horton, R., "GM Food Debate," *The Lancet* 353, issue 9191, November 13, 1999: 1729.

xvi Flynn, L. and M. Gillard, "Pro-GM food scientist 'threatened editor'," *The Guardian*, October 31, 1999. The *Lancet's* editor stated that the Royal Society exerted "intense pressure" in an attempt to "suppress publication."

xvii Ewen, S. W. B., and A. Pusztai. 1999. "Effects of Diets Containing Genetically Modified Potatoes Expressing *Galanthus nivalis* Lectin on Rat Small Intestine." *Lancet* 354 (9187): 1353-54.

xviii For instance, its Biological Secretary asserted that the *Lancet* published Pusztai's research "in

the face of objections by its statistically-competent referees.” But because five out of the six referees voted for publication, the Secretary’s implication that more than one objected is false – and the implication that no one with statistical competence voted favorably is almost surely false as well. (Bateson, P., “Mavericks are not always right,” *Science and Public Affairs*, June 2002.) The unjustness of the Society’s attack is more extensively described and documented in my 2015 open letter to the Society’s president and in Chapter 10 of my book.

xix Although the authors do not specifically mention the Pusztai study, or any studies besides the long-term one conducted by Seralini’s team, their categorical assertions logically encompass it; and those assertions misrepresent it.

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