

## Editorial

## Glyphosate, neurological diseases – and the scientific method

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We must be careful not to rush to label glyphosate as excessively toxic to humans because when used properly and in proper quantities it is probably no more dangerous and toxic than other effective herbicides on the market. Unfortunately, most effective herbicides and insecticides could be classified as neurotoxic and carcinogenic because in high enough concentrations they can be toxic to biological systems. In their lengthy treatise, “Glyphosate, pathways to modern diseases III: Manganese (Mn), neurological diseases, and associated pathologies” recently published in *Surgical Neurology International*, Drs. Samsel and Seneff blame the widely used herbicide glyphosate for a number of ecological as well as medical disorders via Mn metabolism and a myriad of other pathophysiological mechanisms.<sup>[9]</sup> The linking of this effective herbicide to the alphabet soup list of conditions enumerated by the authors seems to be “shotgun science” — namely, multiple associations based on population-based statistics, disconnected correlations, and manipulation of numbers and conditions that create an epidemiological recipe for errors and nonvalid associations. The authors link every kind of disorder imaginable to a widely used chemical that has not been specifically linked clinically to any of those disorders.<sup>[9]</sup>

The massive weight of unconnected data presented by Drs. Samsel and Seneff in this paper fails to establish a definite association with glyphosate usage or Mn metabolism to autism or any of the other conditions implicated.<sup>[9]</sup> At best the link to autism is weak but not completely excluded as a co-factor with as yet unidentified other causes. Before we condemn glyphosate

and its alleged mechanism of biological disruption in humans, in both alleged accumulation and depletion (both mechanisms are described by the authors), more data needs to be collected by actual fieldwork, testing, and experimentation. This hypothesis needs to be tested by other investigators under more direct and rigorous conditions for the variety of disorders listed by Drs. Samsel and Seneff.

Investigators must be wary of the various traps that befall epidemiological, population-based studies. First, for example, is the *post-hoc, ergo propter hoc* (“after this, therefore because of it”) fallacy. In other words, does a high level of a toxic substance cause a disease, or does it merely accumulate as the result of the disease or some other process? Was the high use of glyphosate noted to precede the increase in the number of cases of autism, Parkinson’s disease (PD), cholestasis, and Alzheimer’s disease (AD), etc., really responsible for those conditions? I think not, by the evidence provided by the authors. True, the authors have done a phenomenal amount of work and collected an impressive bibliography, but this of itself does not prove a cause and effect relationship.

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The assertion, “(glyphosate) usage has increased steadily. In step with the rise in autism rates,”<sup>[9]</sup> proves nothing, but suggests the intrusion of a second related epidemiological error — e.g., the *correlation-causation fallacy*, a common error in logic stating that correlation does not establish causation. We can make statements for a variety of other substances and conditions, but in the end correlation does not establish causation. Similarly, along with the markedly increased use of glyphosate, there has been increases in the use of a number of chemicals, including other pesticides and herbicides (many of them already blamed for some of the same illnesses cited by the authors); there has been a protracted increase in medical uses of prescription drugs as well as the recreational consumption of illegal drugs; administration of large number of vaccines given to children possibly overtaxing the immune system and implicated in the rise of autism (particularly measles, mumps, and rubella [MMR], and vaccines that used the preservative thimerosal), etc. By similarly shaped graphs, we could cursorily implicate not only vaccines, but also the escalation of single parenthood and poverty, increased federal spending in welfare programs, even the growth of the organic food industry, not to mention the tremendous world population growth and overcrowding — as culprits for the increase in the variety of degenerative conditions and cancers cited by the authors during a similar period of time [Figures 1-5]. And yet, the authors have singled out glyphosate as the causative agent, not just for autism, but also for an alphabet soup list of conditions. And as we will see later, one of the authors (Seneff) asserts that we need to “act drastically,” implying, I suppose, imposing a ban on glyphosate. But even if the authors were on the right track, extreme caution should be exercised for reasons that will become obvious as we proceed further with this critique.

Drs. Samsel and Seneff state: “Many diseases and conditions are currently on the rise in step with glyphosate usage in agriculture, particularly on genetically-modified (GM) crops of corn and soy. These include autism, AD, PD, anxiety disorder, osteoporosis,

inflammatory bowel disease, renal lithiasis, osteomalacia, cholestasis, thyroid dysfunction, and infertility.”<sup>[9]</sup> But as we have seen with Figures 1-5, the fact is that a myriad other pathologic and dysfunctional conditions have risen in society in step with glyphosate use — e.g., illegitimacy, broken homes, functional illiteracy, obesity, senility (and death from senility), as well as a number of neurological and degenerative conditions associated with our markedly aging population of Baby Boomers and the Gompertzian effect, whereby people are living longer and subject to diseases that they did not live long enough to suffer in the past. I discussed this paper with my friend Dr. Russell L. Blaylock, an authority in this area. He agrees with many of my criticisms in this critique but disagrees with a few points. For example, he discounts the Gompertzian effect stating, “the increase in many of the diseases is in a younger population and, in fact, the greatest increase of any malignancy is with lymphomas in those under age 30. We are also seeing neurodegenerative diseases that are occurring in younger people at an alarming rate.” Dr. Blaylock also cited anecdotal evidence for an increase in amyotrophic lateral sclerosis, which was rare at the time of our surgical residencies but seems more common today. And he adds, “the link between pesticide, herbicide, and fungicide exposure, and PD is a case in point, and there is good evidence of a link to AD.” But I remain skeptical. True, there is a lot of data out there, linking a variety of chemicals to a variety

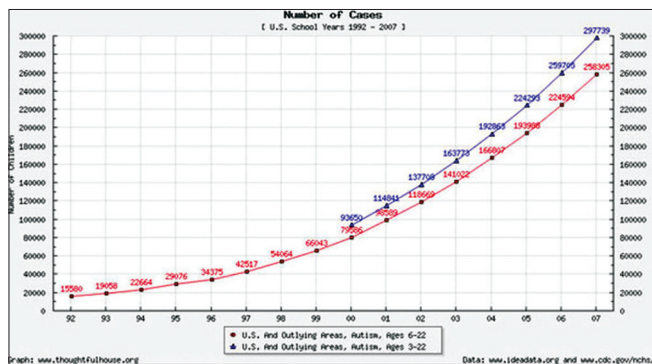


Figure 1: Vaccines and cases of autism. Courtesy Thoughtfulhouse.org, CDC data (2009)

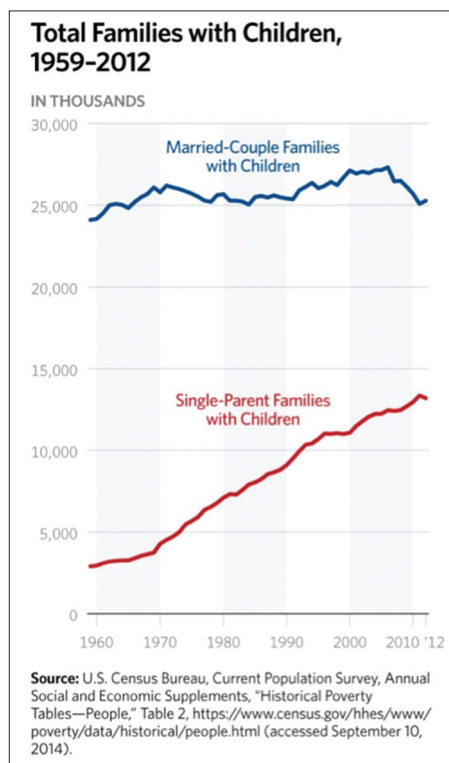


Figure 2: Single parenthood and poverty (which could implicate rightly or wrongly malnutrition, increased violence, decreased access to health care, etc.). Courtesy U.S. Census Bureau (2014)

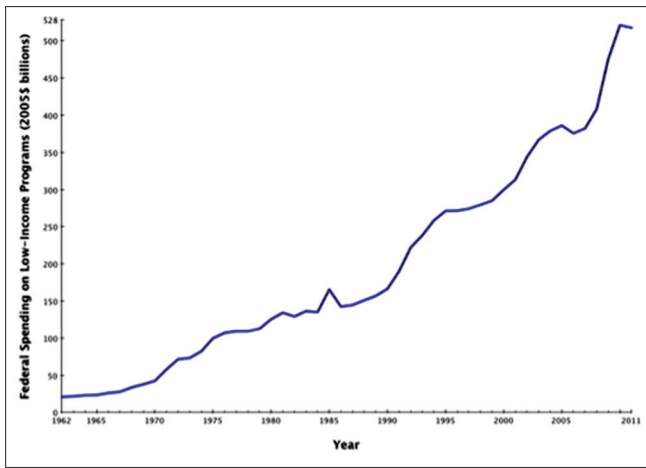


Figure 3: Federal spending on low-income programs. Courtesy Washington Post (2014)

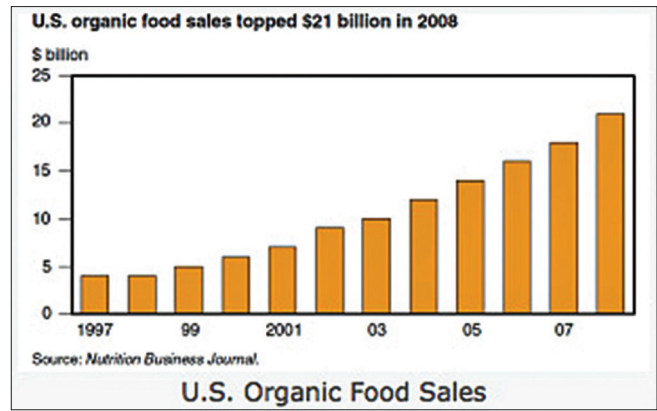


Figure 4: US Organic food sales. Courtesy Nutrition Business Journal (2008)

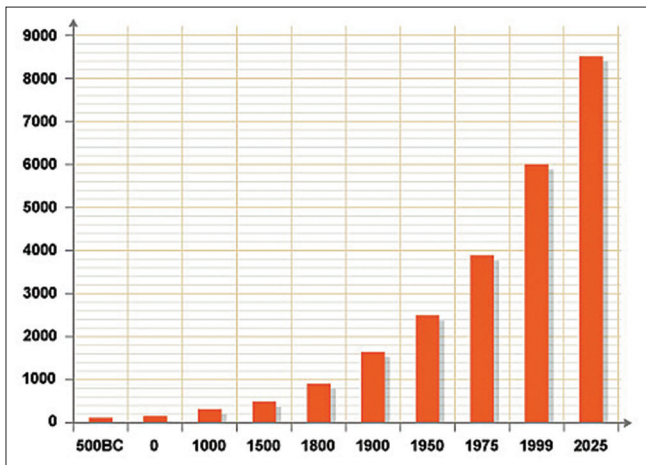


Figure 5: World population growth and projected data. Courtesy BBCoUK (2012)

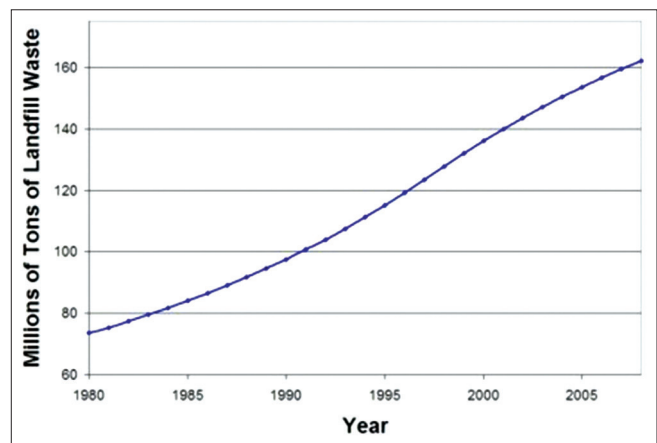


Figure 6: Graph landfills. Courtesy Jeremy M. Gernand | Progressiprocity

of conditions, but no convincing clinical evidence of causation relationship.

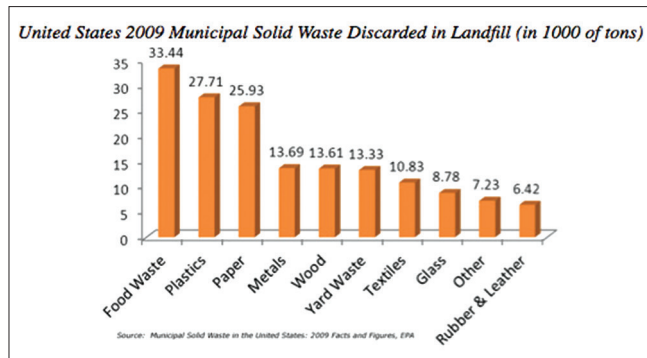
Any association between glyphosate and most of the conditions listed by Drs. Samsel and Seneff are doubtful with the evidence provided, and yet there is a statistical correlation in that they are all increasing, but this again does not establish a cause and effect relationship. We should wait for the science. How do we decide what is the true culprit when a myriad of other malefactors can be equally implicated? Consider the environmental challenges illustrated in Figures 6-10. Numerous other scientists have raised alarms and implicated those and other causes for ecological and public health challenges perceived as being, or proved to be, on the rise. How do we deal with all these conditions and activities, short of banning the human race from the planet?

As to autism specifically, a problem of the young, Dr. Seneff has already predicted that by the year 2025, half of the

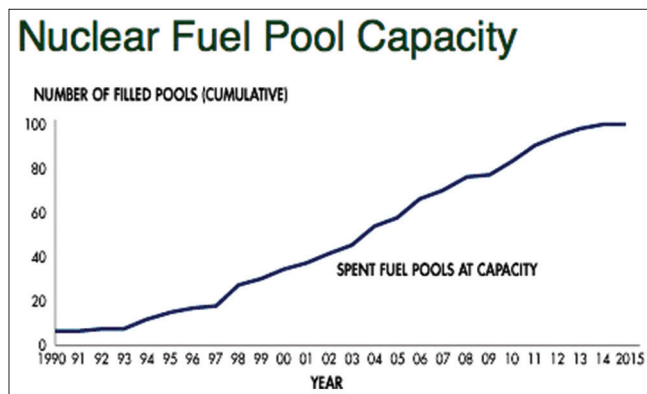
children will be afflicted with autism from glyphosate poisoning.<sup>[5]</sup> However, a newly released study in the *Journal of the American Medical Association* links autism, not to glyphosate, but to maternal diabetes.<sup>[13]</sup> Why should we then “do something drastic,” as Dr. Seneff advocates, singling out glyphosate and banning it, while ignoring the diverse list of other potential culprits such as harmful chemicals, environmental activities, and human conditions, including maternal diabetes, afflicting the human race?

As to phobias, anxiety, and panic attacks — these psychoneuroses have increased along with a variety of the psychological stresses associated with a fast-paced, materialistic, and secular society, not to mention social, environmental, and economic conditions, as illustrated in the previous graphs. These anxiety disorders, like the other illnesses, need to be separated and individually tested.

The methodology employed by the authors is repeatedly assailed by the second previously cited epidemiological error, the *correlation-causation fallacy* — that is, correlation does not establish causation. Dr. Blaylock



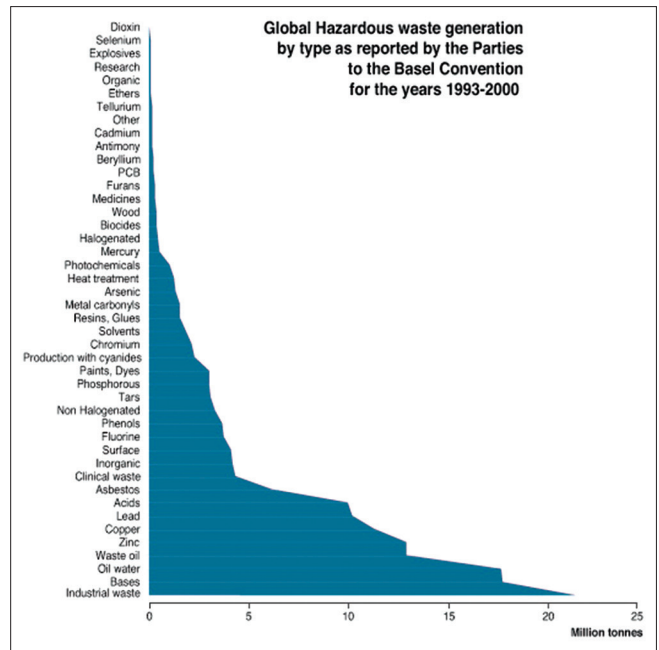
**Figure 7: Composition of landfills, United States 2009 Municipal Solid Waste Discarded in Landfill (in 1000 of tons).** Food wastes, plastics, and papers lead the pack. Many municipalities and counties are up in arms about these landfills in their communities. But who is producing the waste materials? Our own increases in population and consumption. Courtesy Environmental Protection Agency



**Figure 9: Nuclear fuel pool capacity.** How much of this spent fuel may be leaking or reflect the amount of radiation that may be affecting the environment can only be speculated. And again studies have been done hypothesizing radiation as causing damage to the environment, the fauna, and public health. Courtesy Energy Resources International and U.S. Department of Energy

agrees with this and adds that this is “the weakest aspect of their paper,” but he qualifies the statement suspecting “stronger links with cancer and neurodegeneration.” Glyphosate usage has increased, and so has autism as well as the other conditions. Therefore, on this basis of association, the one supposedly causes the other. The epidemiological hypothesis is identified, but it is far from adequately tested, much less proven, by the data provided and the myriad of pathophysiological processes described by the authors.

In fact, there is no unifying pathophysiological hypothesis but a number of disconnected mechanisms that the authors attribute in one way or another to Mn, accumulation or depletion, with cellular damage.<sup>[9]</sup> At this juncture, Dr. Blaylock notes, “Mn is a powerful activator of microglia and can accumulate in certain brain areas — also, because there are multiple environmental sources, we should not add another one (from glyphosate metabolism if that turns out to be the case).” Independent



**Figure 8: Global hazardous waste generation by type.** What about lead, zinc, waste oil, bases, not to mention industrial waste, which by far leads the pack in this report. Numerous studies speculate how all of these waste chemicals have caused damage to the environment, flora, fauna, and public health. Courtesy Basel Convention 1993–2000



**Figure 10: Stormwater runoff pollution.** When it rains, trash, oil, sediment, chemicals, and other pollutants run off from “our rooftops, roads, parking lots, and driveways.” All of these pollutants and trash of all kinds end up in our lakes and streams. Studies also blame these chemical pollutants for environmental problems and harmful to human and animal life. Courtesy Maryland Department of the Environment

confirmation by other investigators will be needed to establish the purported link between Mn and the various, and quite unrelated, clinical conditions cited. The sheer number of unrelated conditions cause the authors’ hypothesis to almost sink of its own weight, becoming too unwieldy for testing directly by the scientific method.<sup>[3,4,7]</sup>

Blaming glyphosate on the environmental problems and the myriad of medical conditions listed by the



authors — that is, as “star wasting syndrome,” “collapse of coral reefs” via “ecological pervasiveness,” “liver damage,” “celiac disease,” “PD,” “anxiety syndromes,” “Salmonella poisoning,” “mitochondrial damage,” “poor sperm motility,” “poor bone development,” “phobias,” “osteoporosis,” “autism,” “AD,” “inflammatory bowel disease,” “renal lithiasis,” “osteomalacia,” “cholestasis,” “thyroid dysfunction,” “Lyme’s disease,” “panic disorders,” “infertility,” etc., — is unwarranted given the evidence, the variety of proposed mechanisms, and logic provided by the authors.<sup>[9]</sup> Dr. Blaylock and I agree that they should have concentrated on just a minimal number of diseases, where the evidence is more than circumstantial.

According to Drs. Samsel and Seneff, all of the above conditions are associated with Mn metabolism in the laboratory, but the evidence is not convincing that Mn disruption in so many different ways is caused by glyphosate utilization in the body, particularly *in vivo*, in man or animal. Nor do I believe the evidence is there to warrant the statement: “We further reason that, under conditions of adequate Mn in the diet, glyphosate, through its disruption of bile acid homeostasis, ironically promotes toxic accumulation of Mn in the brainstem, leading to conditions such as PD and prion diseases”<sup>[9]</sup> — except, perhaps, in huge doses given directly to laboratory animals, irrelevant to true environmental and existing conditions.

Furthermore, in this same context, the authors write: “The only study we are aware of that was a realistic assessment of the long-term effects of GM Roundup®-Ready crops and soy feed on mammals was the study by Séralini *et al.* that examined the effects on rats fed these foods for their entire lifespan. This study showed increased risk to mammary tumors in females, as well as kidney and liver damage in the males, and a shortened lifespan in both females and males. These effects occurred both in response to Roundup and to the GM food alone. These effects only began to be apparent after 4 months.”<sup>[9]</sup>

Thus, they also add carcinogenesis to the pot of pathologic conditions. While long-term follow-up is definitely important, the third erroneous concept that now enters the discussion must be considered. I refer to the phenomenon of *hormesis* — that is, the fundamental precept of pharmacology that “the dose makes the poison.” While some substances such as lead and cyanide are toxic at infinitesimal doses — and this is also true for a number of compounds, perhaps even pesticides, herbicides, and fungicides — most chemicals and natural substances become harmful only in higher, proportional pharmacological doses and quantities. In short, it is the huge doses, fed and ingested by these animals, that cause the carcinogenicity, not natural and normal feeding in their present environments. The doses made the poison!

We must also keep in mind a fourth factor that may have entered this study to cause further consternation, and that is, that the physiology and biochemical pathways of many laboratory animals are different from those in man, and therefore *some animals make poor models* for studying carcinogenicity and other pathological conditions in humans. The assumption that animal models can be used and always extrapolated to human conditions, generally referred to as *ordinary induction*, cannot generally be taken for granted. This does not mean that animal experiments are not of benefit. In most cases in fact they are and provide excellent models for human pathophysiology, but this fact must be ascertained and confirmed.

Nevertheless, although many chemicals and viruses that produce cancer in mice and rats often produce cancer in humans and vice versa, one cannot necessarily assume that the pathophysiology is identical and that all animal experiments can be uncritically extrapolated to humans. In the case of glyphosate, it supposedly affects the metabolic shikimate pathway, preventing the synthesis of aromatic amino acids. Since this pathway is reportedly used by plants only, it’s an effective herbicide. So at least by this pathway theoretically it should not affect animals or man. However, it could affect animal life by other pathways, if so, Drs. Samsel and Seneff, do not provide a convincing unifying hypothesis for this alternative pathway.<sup>[9]</sup> In our conversation, Dr. Blaylock objects at this point, stating that the toxicity of some pesticides/herbicides in humans may occur by other pathways, as with nicotinic poisons. I agree with him on this point. But again this fact must be ascertained. Dr. Blaylock also surmises that “the glyphosate molecule may not be the most toxic component of Roundup, but rather it lies with the adjuvant added to the glyphosate.” But if that is true, then we are blaming glyphosate for the company he keeps and not because of intrinsic toxicity. And this reminds us of the need for better, and more strict, scientific methodology to isolate the true culprit(s).

A fifth factor of concern is that Drs. Samsel and Seneff take excessive license in *making loose connections and associations* between diseases and linking them firmly and erroneously to pathological conditions, when in fact the connections are tenuous or nonexistent. Examples abound in their long paper, but consider the association of panic attacks to PD and autism, not to mention the collapse of coral reefs. Because of this, their logic frequently does not follow and purported connections become tenuous or nonexistent. The separate number of conditions and pathophysiologic processes invoked and plied together attest to this observation. The authors have implicated glyphosate as a powerful neurotoxic, and indeed as an aminophosphonic analog of glycine and possessing a chemical structure similar to glutamate analogs,<sup>[9]</sup>

glyphosate greatly enhances N-methyl-D-aspartate receptor sensitivity. Dr. Blaylock points out that this activity is sufficient to link it to neurological disorders and the risk of neurotoxicity. Yet, it must be noted that glyphosate lacks the neurotoxic *modus operandi* of organophosphate neurotoxins, which is via acetylcholinesterase inhibition and overstimulation of cholinergic receptors.

Drs. Samsel and Seneff write, “government regulators appear nonchalant about steadily increasing residue limits, and that the levels in food and water are rarely monitored by government agencies, presumably due to lack of concern.”<sup>[9]</sup> The fact is that since 1958 in the United States, businesses have been subject to the Delaney Clause by congressional legislation (i.e. Food Additive Amendment of 1958). The clause reads that the Food and Drug Administration (FDA) “shall not approve for use in food any chemical additive found to induce cancer in man, or, after tests, found to induce cancer in animals.”<sup>[6]</sup> That meant that the finding or addition of any amount of an alleged “carcinogen” at any dose, miniscule as it may be, is subject to the restriction. It was found after nearly 40 years of testing and experience that the strict requirement was not valid and not supported by science or clinical experience. In fact, we have had our share of needless alarmist food scares in relation to pesticides, herbicides, and food additives (e.g., cranberry scare of 1959, saccharin scare in 1981, alar scare in 1989, etc.).<sup>[6,10,11]</sup>

DDT is a more serious case in point. Not only did its banning result in the deaths of millions of people in Asia and Africa from malaria and other mosquito-borne diseases, but it resulted in the need for the development of pesticides with higher toxicity. Dr. Blaylock and I agree on this point; he admits, “In truth the banning of DDT was a gross mistake as it led to the mass production and use of agents infinitely worse, such as the organophosphate, organochlorines, and carbamates. The toxicity of DDT is in no way comparable to these newer agents.” In fact, one of my fears is that we could end up banning glyphosate on insufficient data, and then with the expected continued growth in the world population and less available land for cultivation, we could be saddled in the end with more toxic agents needed to replace it.

With the increasing necessity for the use of pesticides in agriculture, the Food Quality Protection Act of 1996 finally removed pesticides (found in processed foods) from being subject to the Delaney Clause’s absolute requirement. Nevertheless, there are stringent requirements still in place, reportedly “to be considered reduced risk, pesticides must have a proven low-impact on human health, have low toxicity to non-target organisms, and have a low potential to contaminate groundwater.”<sup>[10]</sup> These requirements affect herbicides

as well and are still valid, but we certainly do not need to go back to the outdated 1958 absolute standards for herbicides or pesticides.

The Delaney Clause prohibition remains in place in other sections of the Food, Drug, and Cosmetic Act of 1938, amended in 1958<sup>[9]</sup> and 1996,<sup>[10]</sup> as it pertains to food additives, drugs in meat and poultry, and color additives. It is more politics than science that has kept some of the other tight regulations in place. The FDA Food Safety Modernization Act of 2010 even tightened preventive standards of food safety.<sup>[11]</sup>

Consider the fact sassafras, peanuts, sweet basil, etc., and many other fruits and vegetables, contain natural substances which are considered “carcinogenic” at pharmacologic doses injected into animals, but in the quantities found naturally in those beneficial plants are harmless. Still, no amount of safrole (found naturally in sassafras, nutmeg, cinnamon, etc.), for example, can no longer be added to root beer or other products in the United States, because of the remaining restrictions. Saccharin was retained as an artificial sweetener in the US only because of the widespread public outcry against its ban.

It has been countered that the support for the relaxation of the Delaney Clause was based on studies funded by the chemical manufacturers themselves. And this is true in some instances but not in others. And in this argument, I would like to play the devil’s advocate: Why are these investigators working for the chemical companies necessarily less reliable than their environmental counterparts, whose ecological zeal at times is profound, and no less prejudicial, than the purported financial considerations of their opponents? I have found in many instances that ideology and zealotry for some crusading causes are more intense and no less biased than financial incentives.

Finally, as it relates to glyphosate, I venture to say that by increasing the yield of agricultural produce around the world, glyphosate herbicide has provided a bounty of benefits to the global economy via crop yields and in ameliorating world hunger. It has been hypothesized that some of the surplus food we send to Third World nations is less nutritious than what we are allowed to consume in the West by regulatory agencies, and that in some cases this food aid reduces fertility in undeveloped nations and is, therefore, a form of population control. First, for those afflicted with famine and at the point of starvation, any edible food is a blessing. Any decrease in fertility is probably more related to endemic diseases, hunger, and chronic malnutrition than to any chemical by-products contained in the life-saving food supplied by Western nations. Overpopulation in Africa and Asia has been a manifest and insoluble problem, a serious

problem that India, for example, has tackled but not solved satisfactorily. It would be a great tragedy to the ever-increasing world population needing to be fed, if we were to begin a premature or erroneous campaign of vilification against pesticides and herbicides that have undoubtedly ameliorated world hunger to a degree, which although difficult to exactly quantitate, has been certainly incalculable.

More studies employing scientific methodologies<sup>[3,4,7]</sup> with long-term follow-ups are needed and caution utilized in the use of glyphosate, and all the other herbicides and pesticides, that we continue to spill into the environment.

I'm in no way completely exonerating glyphosate and supporting its astronomical use as a harmless substance. It is not, and further studies need to be done, as mentioned. I also deplore two of Monsanto's alleged business practices. One of them, as I have been told, is that of "their technological efforts with plants as to make them GM Roundup®-Ready, meaning the GM crops would require increasing concentrations of Roundup." This has resulted in the increased amounts of glyphosate having to be used to obtain the same agricultural yield at increasing costs to farmers. Another is the terrible practice of "sterile seed technology," or "terminator seeds," whereby seeds are sterilized, genetically engineered, not to produce crops. This practice, I have been told, has destroyed the livelihood of many farmers, especially in Latin America and India, where crop yield is essential to subsistence farming and human life. Monsanto must have recognized the problem and has ceased producing these "terminator seeds," stating on its website: "Monsanto made a commitment in 1999 not to commercialize sterile seed technology in food crops. We stand firmly by this commitment, with no plans or research that would violate this commitment."<sup>[8]</sup> The publication of these articles and communications, perhaps, will also help eliminate and keep these deplorable practices in check.

We must be careful that in attacking corporations, for real or suspected evil practices, we do not lose the proper perspective and harm the very people we want to protect, the consumers, and increase the burden on the middle class, who ultimately pay the bills with more expensive products and litigation costs. I can speak as a consumer as well as a physician. I grow vegetables in my little garden and tend fruit trees, e.g., pears, peaches, apples, plums. Without a minimal use of fungicides and insecticides, I could not keep my fruit trees. Fungal diseases have, and would again, after a few days of rain, overwhelm my trees. Japanese beetles, tree borers, Asian moths, caterpillars, etc., have wiped out and would again destroy my little garden and vineyard! My wife and I have tried organic farming, it was impossible. Japanese beetle traps have been our only organic farming technique resulting in a clear victory. Two of my hunting friends, who are small farmers

and keep cattle, agree with my assessment even more strongly. Their agricultural and cattle farm yields would perish, they assure me, without pesticides or herbicides. I suspect many businesses claiming to sell organic foods may be fraudulent. One should visit those farms to be reassured! Vegetables in smaller farms are possible with intense labor, but fruit trees are much more difficult to maintain. Costs also become prohibitive as well.

The freedom of choice that fortunately still exists in the marketplace of the Western world frequently responds to the legitimate medical information sooner, and not requiring the authoritarian streak of compulsion inherent to governmental regulatory agencies. At other times, the free market, and even the regulatory agencies, unfortunately respond to prematurely released medical information that turns out to be faulty. As a result, consumers frequently cannot be sure of the scientific validity of the medical information presented by the media, but the free enterprise system, using experience and trial and error, is able to separate the wheat from the chaff. Thus, good products survive; bad and sham items are ultimately discarded.

Consumers today can make the choice between buying cheaper GM Organism (GMO) products or more expensive non-GMO products. GMO stands for "GM Organism," which refers to food and products derived from GM plants or animals. A whole industry of non-GMO products, from foods to textiles, has arisen as a result of the free enterprise system without the need of government compulsion.<sup>[12]</sup> Likewise, in the related industry of organic farming, more labor intensive and therefore more expensive produce — e.g., with government limits on the amount of pesticides, fungicides, and herbicides, including glyphosate — can be bought and consumed by those who value the alleged purity of organically grown products. Again the free market operates as best it can, voluntarily and without the need of government compulsory edicts. Government regulation has had its beneficial side, but we are probably regulating more than is needed.

Dr. Seneff calls for "drastic action," but the fact is that unanimity as to the culprit(s) does not exist, and scientists have been arguing for years about the validity of the studies, both blaming and exonerating glyphosate and other chemicals for the lion's share of culpability.<sup>[14]</sup> The jury is still out. How can we pass the sentence of banishment and prohibition without a guilty scientific verdict?

I categorically disagree with Dr. Seneff's concluding remarks, "In my view, the situation is almost beyond repair. We need to do something drastic."<sup>[5]</sup> We do not need to go and ban glyphosate with the evidence provided. We do not need to act urgently and incite lawsuits that consumers

will end up paying for in higher food bills; farmers ending up with insufficient crops; and the poor and most vulnerable in societies worldwide, starving. What we need to do is to increase education and awareness in what we do know, and in concert with the findings and concerns of these authors, support the fact that more studies are needed, particularly pathological inspection of tissues with verifiable accumulation or deficiency of Mn and other toxic elements. Toxic damage of tissues in association with glyphosate usage must be documented.

More field and clinical, not just laboratory, work must be conducted. Foods that “presumably” contain excessive glyphosate amounts need to be tested to confirm if that is truly the case and demonstrate tissue and physiologic damage. And if glyphosate is found in processed corn and soy foods, then it must be ascertained if beneficial intestinal bacteria are affected causing nutritional deficiencies and other problems. Studies should make valid comparisons and show statistically significant associations, as well as verifiable data associated with specific glyphosate-related human conditions.

In the end, Dr. Blaylock stated in our conversation, “like you, I have great trepidations about this paper because it went too far, focused on too many pathological conditions, and as you demonstrate with great clarity, statements are made that cannot be supported by scientific methodology and the rules of logic.” I also agree with the informative commentary of Drs. Robin Mesnage and Michael Antoniou at the end of the paper indicating that several areas of glyphosate neurological interactions are in critical need of investigation,<sup>[9]</sup> but I disagree that the research efforts are *urgently needed*, if by that it’s meant we need to obtain data quickly and rush to publish conclusions. One of the regrettable trends in the contemporary rush for dissemination of scientific knowledge constitutes a sixth factor of error — namely, *the rush to publish and the premature disclosure of scientific findings* that frequently are misquoted by the popular press or the research findings themselves turn out to be invalid — needless to say, these occasions prove to be highly discomposing to the public and discreditable to scientific research.<sup>[1-4,7]</sup>

In short, we must establish factual cause and effect relationships, rather than promote fear mongering, food scares, and lawsuits. I do appreciate the authors’ incredible review of the literature and long bibliography, but compilation, again, does not prove a cause and effect relationship. The scientific method, and when applicable, the simple fulfillment of Koch’s Postulates of Pathogenicity do. In conclusion, I cite the words of a great British epidemiologist, Bruce G. Charlton, M.D., from the University of Newcastle upon Tyne, who in 1996 in the *Journal of the Royal College of Physicians in London*, summed up the state of population-based epidemiology:

*There is a worrying trend in academic medicine which equates statistics with science, and sophistication in quantitative procedure with research excellence. The corollary of this trend is a tendency to look for answers to medical problems from people with expertise in mathematical manipulation and information technology, rather than from people with an understanding of disease and its causes.*

*Epidemiology [is a] main culprit, because statistical malpractice typically occurs when complex analytical techniques are combined with large data sets. The mystique of mathematics blended with the bewildering intricacies of big numbers makes a potent cocktail...*

*Indeed, the better the science, the less the need for complex analysis, and big databases are a sign not of rigor but of poor control. Basic scientists often quip that if statistics are needed, you should go back and do a better experiment.<sup>[7]</sup>*

**Disclosures:** I have received no monetary remuneration or any kind of benefits, perks, or employment from pharmaceutical, chemical or any type of company, including Monsanto, and have no conflict of interest, except as a consumer who has used this product for many years in my yard and would not like to see it banned unless glyphosate is found guilty as charged, judged by the scientific process and not by “reasoning” or data from frequently unreliable epidemiological-based studies.

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## Commentaries

We have stated clearly in the paper that we are only providing compelling correlation data backed up by research studies that support a link between glyphosate and manganese (Mn) dysbiosis on the one hand, and Mn dysbiosis and multiple modern diseases linked to glyphosate through correlation data on the other hand. It is through Mn deprivation that glyphosate disrupts the Mn-dependent enzyme in the shikimate pathway, and one can assume that it would also disrupt other Mn-dependent enzymes in a similar fashion, explaining many pathologies associated with autism. We hope that our paper will inspire researchers to conduct studies to verify Mn deficiency in association with autism and other diseases currently on the rise, as we feel confident that they will find it if they look.

While correlation does not necessarily imply causation, when the Pearson correlation coefficients are this significant, it behooves us as scientists to stop and take a closer look, and we have. It cannot be denied that many chronic diseases like autism, PD, anxiety disorder, and inflammatory bowel disease, are rising at an alarming rate, and that this time trend matches with the dramatic increase in the use of glyphosate on core crops over the same time period. No other pesticide matches the data nearly as well as glyphosate does, so it is obviously the best candidate to focus on as a plausible factor in these diseases.

There are many places in this editorial response that are not factually accurate. The commentator wrote: "Similarly, along with the markedly increased use of glyphosate, there has been increase in the use of a number of chemicals, including other pesticides and herbicides (many of them already blamed for some of the

same illnesses cited by the authors)." We wholeheartedly agree that other herbicides, insecticides, and fungicides are also damaging our health. This to us just increases the urgency of the goal of finding a way to grow food sustainably and without the use of these toxic chemicals. However, the use trends on none of these other pesticides align so perfectly with the disease trends as does glyphosate. In fact, the use of many other herbicides has actually declined as glyphosate has taken over as a popular replacement for them, in parallel with the adoption of glyphosate-resistant crops.

The commentator wrote: "More data needs to be collected by actual fieldwork, testing, and experimentation." Such studies have already been done by Monsanto. As my co-author, Anthony Samsel, elaborates on in his reply, Monsanto knew in 1981 that there were problems with glyphosate, and they distorted and hid the evidence, denying the release of their studies to this day. Instead of making their discoveries known to the public, which would have led to a refusal to allow glyphosate to be used as a pervasive chemical poison, and would have protected a huge number of people from harm, they used a secretive strategy to contrive an approval process that has had devastating consequences, not only to humanity but also to many other life forms on earth.

Mn impairment is a plausible mechanism by which glyphosate may cause many of the observed symptoms of autism, and we hope that our paper will inspire others to investigate this idea more fully. We anticipate that parents of autistic children will want to get their children's blood and urine tested for Mn levels. Deficient Mn levels in autistic children have already been found in multiple studies in hair samples,<sup>[2-4]</sup> in urine samples<sup>[2]</sup>

and in teeth.<sup>[1]</sup> Anecdotally, a mother of an autistic child showed me her child's blood tests, which showed Mn levels far below the minimum of the expected range, just as was seen in cows across eight different dairy farms in Denmark.<sup>[6]</sup>

It is interesting that you bring up MMR vaccine as potentially overtaxing the immune system in relation to autism. MMR contains glutamate in the gelatin that the virus is grown on, and as we discussed in the paper, glyphosate prevents the detoxification of glutamate by glutamine synthase, a Mn-dependent enzyme. Furthermore, as we stated in the paper, glutamate serum levels are high in association with autism, along with low glutamine. In fact, statistical analysis of word frequencies in MMR vaccinations in Vaccine Adverse Event Reporting System adverse reaction reports before and after 2002 show that symptoms related to monosodium glutamate sensitivity, such as seizures, hyperventilation, anaphylactic shock, shortness of breath, headache, and hives, are significantly more common in the later reports compared to the early reports. We hypothesize that this can be explained by synergistic toxicity due to glyphosate, which is far more likely to be a factor in the later data.

If trends continue as they have for the past 30 years, we can expect that half the children born in 2032 will be diagnosed on the autism spectrum, 80% of the boys. Since I believe that there is under-reporting occurring today (due to the newly introduced "pervasive developmental delay not otherwise specified" category), and I also believe that the causative agents have accelerated even more rapidly over the past decade, I think it is not beyond one's imagination that we will reach the one-in-two mark even earlier than the mathematically projected 2032 time point.

I disagree with you strongly in your claim that "the dose makes the poison." Glyphosate is an endocrine disruptor, and endocrine disruptors as a class have the interesting property that very low doses are far more toxic to our health than higher doses. Most of the toxicology studies expose the animals to doses that are much too high to evoke an endocrine response. However, *in vitro* studies on glyphosate exposure to breast cancer cells have shown that glyphosate at parts per trillion induces cell proliferation by acting as an estrogen mimetic.<sup>[8]</sup> Of course, it is noteworthy that the World Health Organization (WHO) has just come out with a position that glyphosate is a level 2 "probable carcinogen".<sup>[5]</sup>

While you claim that, despite often being classed as an "organophosphate," glyphosate does not inhibit acetylcholinesterase, in fact, at least one study has shown that it does.<sup>[7]</sup> Glyphosate is not technically an "organophosphate": It is correctly referred to as an "organophosphonate." Much-needed future research can clarify whether organophosphonates behave similarly to organophosphates in inhibition of acetylcholinesterase.

The United States Department of Agriculture (USDA) regularly tests for every pesticide, fungicide and herbicide in the food supply except the major herbicides glyphosate and glufosinate, used on core crops found in 90% of the western diet. This must change. We should be testing for these herbicides in our food, water, air, human breast milk, blood, and urine. And then, corrective measures need to be taken to eliminate them. The US government has failed us dismally in this regard, and immediate action needs to be taken to safeguard the public from a looming disaster. Other countries are playing a leadership role in banning glyphosate. And grass roots efforts are underway at the city and county level in the US. I applaud these efforts, and I hope that the US government will heed our call for action and be more proactive on this issue in the near future.

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There is one biosphere to which everything is connected, what affects one, affects all. Our microbiome, a symbiont microcosm which comprises some 70% of our immune system, may determine our destiny from birth to grave. The disruption of homeostasis of the microbiome and greater biosphere by exogenous chemical materials is the common thread that runs through our current work.

Monsanto's Roundup glyphosate-based herbicide is foundational for weed control in industrial agriculture. The patented system of seed, producing herbicide tolerant (HT) and insect-killing proteins contained in every plant cell would seem to be the product of genius, but in fact, it is the product of short sighted developers who did not consider the consequences of these products on our biology and that of the entire biosphere.

Herbicides, including glyphosate, affect multiple biochemical pathways, not just the shikimate pathway. The Glyphosate Pathways to Modern Diseases series of papers focus on the most pervasive antibiotic in the western diet, and can serve as a template for the review of the effects of other agricultural chemicals on biological systems. Glyphosate residues are found in all major core crops used in processed food, which include HT GM crops of corn, soybean, canola, beet sugar, and cotton seed. In addition, its residues can be found in 160 non-HT GM food categories, which include wheat, cane sugar, peas, beans and more, as well as some non-HT GM crops.

Glyphosate is patented as an antibiotic, and the effects of its chemical residues found in our food supply can devastate our microbiome. Those who eat the western diet are exposed to a continual daily supply of herbicides and agrochemicals, particularly the antibiotic glyphosate. The USDA pesticide data program for the calendar year 2011 reported glyphosate in over 90% of the soy tested, with residues as high as 18.5 mg/kg. Monsanto<sup>[2,6]</sup> found residues as low as 3 mg/kg to induce tumorigenic growth in male and female rats in a long-term study. Both adenomas and carcinomas were found in multiple glands and organs. Further details appear later in this response.

Glyphosate residues have been shown to disrupt bacterial homeostasis even in dairy animals.<sup>[1]</sup> Make no mistake about it, there should not be any antibiotics, e.g., herbicides in our food supply. Whether it's glyphosate, glufosinate, atrazine, 2,4-D or whatever, residues of herbicides and their surfactants do not belong in food; they disrupt bacterial homeostasis and lead to immunological disorder, dysfunction, immunosuppression, and/or immunodeficiency.

As discussed by Morgun *et al.*,<sup>[7]</sup> there are three basic effects of antibiotics in disruption of microbial homeostasis, which leads to disease. These factors have

been delineated and confirmed through experimentation and include:

- Antibiotics (like glyphosate) have direct effects both on the symbiont or host's tissues and the antibiotic-resistant microbes which are not destroyed by the antibiotic
  - Disruption of microbial homeostasis leads mostly to the down-regulation of many parameters controlling immunity
  - In context, Glyphosate has been shown to up-regulate and down-regulate some 1040 genes in *Escherichia coli* bacteria alone. We have some 100 trillion bacteria representing approximately 1000 species which perform important functions in our biology.
- Antibiotics inhibit mitochondrial gene expression and the number of active mitochondria, which increases epithelial cell death
- Toxic effects of antibiotics, such as glyphosate, are also mediated by virulence/quorum sensing of the resistant microbial species.

Concerning the commenter's editorial, it is far from a critique of the Samsel and Seneff research. Judging by the overall content and tone, it is more of a pro-chemical industry commentary. The thoughts of its author are tired and old, and they do not reflect current understanding of glyphosate herbicide, its toxicology and relation to disease. Rather, the letter is a diatribe which touts and solicits the position and views of Monsanto and other corporate affiliates who promote industrial, chemical-based agriculture. Such companies are in the business of making money by marketing biocidal chemicals intended to destroy life. These chemicals can also have deleterious effects on our biology. Our commenter's view is directly antithetical to the role of medical professionals to do no harm. To condone such chemicals in our food supply is reprehensible.

The commenter refers to hormesis and states: "Most chemicals and natural substances become harmful only in higher, proportional pharmacological doses and quantities. In short, it is the huge doses, fed and ingested by these animals, that cause the carcinogenicity, not natural and normal feeding in their present environments. The doses made the poison!" This statement is blatantly false and old school. Glyphosate displays an inverse dose-response relationship: There is nothing linear about this chemical. Glyphosate works at the molecular level and destroys biology.

Monsanto studies conducted by Biodynamics Inc., from 1978 to the early 1980s, in both rats and mice<sup>[2,5,6]</sup> clearly showed that glyphosate induced tumorigenic growth even at the lowest dose levels (3 mg/kg) in contrast to the studies at mid and high dose levels of 30 mg/kg and even higher in the rats and mice of two additional studies.

These findings baffled investigators who repeatedly wanted to dismiss results as “a mystery or not compound related,” because they did not see an increasing dose-response linear relationship as in, the dose makes the poison.

Today we know that low dose chemical exposures are often more remarkable than high doses with certain chemicals, especially amphiphilic zwitterions like glyphosate, whose bond-dissociation energy characteristics are highly pH dependent. Glyphosate is an endocrine disruptor. Thongprakaisang *et al.*<sup>[9]</sup> induced breast cancer cell proliferation by glyphosate at an even lower dose ranges, in the parts per trillion.

Corporations have always vigorously defended their products, to protect the status quo and bottom line profits regardless of safety to human health and the environment. They often use outside resources that include credentialed professionals, consumers, and/or bloggers to create doubt in research that might threaten cash flow and investment dividends paid to shareholders.

The commenter’s penniless libretto indicates personal upset with the thought that glyphosate could be removed from the market, and attempts to remain distanced from ties to Monsanto and big pharma by stating: “I have received no monetary remuneration or any kind of benefits, perks, or employment from pharmaceutical, chemical or any type of company, including Monsanto.” However, throughout the letter, the author demonstrates allegiance to the chemical industry, even stating that getting rid of DDT was a bad idea, and he tries to justify the thought with distorted reasoning. Such thoughts Rachel Carson would decry as foolish, even from her grave. The commenter’s point-by-point rehash of industry propaganda can be found throughout his comments which bear striking similarities to those found in the blogosphere, all of which continue to promote the safety of chemical-based technology on false assumptions.

The commenter further tries to scare the reader with industry related verbiage, that such action as getting rid of glyphosate would: “Increase the burden on the middle class.” Similar references to burdening the middle class have been used by cheesy politicians and the grocery manufacturers’ association for a plethora of issues. In my honest opinion, removing all antibiotics, which include the most ubiquitous herbicides, from the food supply would reduce healthcare costs and save the country billions of dollars annually.

The commenter argues that organic farming is not possible: “I could not keep my fruit trees. Fungal diseases have, and would again, after a few days of rain, overwhelm my trees. Japanese beetles, tree borers, Asian moths, caterpillars, etc., have wiped out and would again destroy my little garden and vineyard! My wife and I have tried organic farming, it was impossible.” Actually,

there are millions of successful organic farmers around the globe, and an increased demand for organic food in the USA and other countries. For over 40 years, I have grown my own fruits and vegetables without the use of chemicals. My wife and I freeze, can, dry and root cellar successfully. Cultivators on the back of the tractor have been used for generations for weed control, long before the advent of chemical herbicides, along with a hoe.

The fact is, farmers have fed the world for centuries without the use of industrial chemical agriculture. Farmers feed the world, not profit-motivated corporations bent on creating a monopoly, or profiting from every morsel of food, or even before the seed is planted. The move by biotech companies to use gene silencing technology to prevent farmers from saving seed is a dangerous and selfish technology, which creates corporate dependence and control of the food supply. The safety of this technology has never been fully assessed, but rather fast-tracked by government agencies for industry.

The commenter makes a disturbing reference to the overpopulation of Africa and Asia as an insoluble problem. The reality is that the US Department of State uses taxpayer dollars to promote corporate owned biotechnology and chemical-based agriculture around the planet. Former Secretary of State Henry Kissinger said: “Control oil and you control nations; control food and you control the people.” The principles and ideas set forth in the National Security Study Memorandum 200, December 10, 1974 *aka* “The Kissinger Report” included population control for US and overseas interests; its intent has never changed.

I personally witnessed the implementation of that program in 1974, in Cambridge, Massachusetts, and had discussions with African attendees. The program brought leaders from African nations to the USA to be trained in management for the conduct of business in line with US interests in exchange for US aid and easy access to oil, gas, and mineral wealth. It also included a population control agenda, the programs of which continue even to this day. Getting countries hooked on US biotechnology and chemical dependence may be job security for some, but it is not sustainable. It causes great harm to people and to the planet, and it is downright immoral. As a research scientist and global consultant, I discourage all nations from buying into the model of industrial chemical addiction.

Monsanto and the Environmental Protection Agency (EPA) knew in 1981 that glyphosate induced tumorigenic growth of both adenomas and carcinomas. Their own long-term studies<sup>[2,5,6,8]</sup> conducted in rats and mice show glyphosate’s ability to induce tumorigenic growth of glands and major organs [Tables 1-3]. The studies were submitted to the US EPA during the original registration and review process for glyphosate. It took 4 months and



a US Senator to finally gain access and obtain these studies for our continuing research. I was required to sign an agreement with the government not to give them to foreign nationals under penalty of law.

During the original review process, Monsanto requested the EPA to seal and mark many study documents as a trade secret. What is interesting is that, in the many thousands of pages, there are no secret formulas or recipes; only the study reports, data, and letters of communication for multiple glyphosate studies using mice, rats, rabbits, and dogs. Why would Monsanto ask the EPA to render all of these documents as a trade secret and eliminate them from access by scientists and the public? After reading them, it is my opinion that they did not want anyone to ever revisit or question the data. The letter from Monsanto to EPA was quite explicit and the study documents “in the opinion of Monsanto, constitutes trade secret, and/or confidential or proprietary information, we request that your agency treat this information accordingly.”<sup>[2]</sup>

A 26 months long-term study in rats conducted by biodynamics reveals multitudes of tumors<sup>[6]</sup> in glands and organs. They are shown from highest to lowest incidence:

- Pituitary
- Thyroid
- Thymus
- Mammary
- Testicular
- Kidney
- Pancreas
- Liver
- Lungs.

Pituitary, thyroid, and thymus glands control body and immune function, and disruption can induce disease, including cancer. These glands produce many necessary hormones which control numerous biologic processes. Tumorigenic growth also disrupts the functionality of the glands and major organs. A Monsanto trade secret document<sup>[6]</sup> reveals that there were statistically significant lymphocytic hyperplasias of the thymus, pancreatic Islet cell tumors, as well as C-cell thyroid tumors [Tables 4-6]. Thymus lymphoid hyperplasia occurs in Graves’ disease, and thymus hyperplasia is commonly observed with computed tomography scans of thyroid cancer patients and also associated with autoimmune disorders such as myasthenia gravis, lupus erythematosus, scleroderma, and rheumatoid arthritis.

It should be noted that the significant incidence of tumors was found during these investigations. However, to create doubt and cancel statistical significance of inconvenient findings, which may have prevented product registration, Monsanto used experimental noise from 3, 5, 7, and even 11 unrelated study controls to nix results, as needed. In some instances, the experiments’ own

control showed 0% incidence of tumors, while all of the glyphosate-treated groups were statistically significant, but through the dishonest magic of comparing the findings to data from unrelated historical controls, they were explained away as a mystery and not related to administration of the glyphosate.

Using these deviations got rid of the inconvenient results and thus allowed the product to be brought to market. Had they not engaged in this deception, glyphosate would never have been registered for use. EPA documents show that unanimity of opinion for product registration was not reached. Not all members of the EPA glyphosate Review Committee approved the registration of glyphosate. There were those who dissented and signed do not concur.

The practice of introducing experimental noise by using data from unrelated historical controls is still in use today, but it should be banned from science, as it is really bad laboratory practice. The European Union Good Laboratory Practice (GLP) Working Group approved a guidance document for GLP inspectors and test facilities in 2005 and is available at the European Commission’s (EC) GLP internet site. The document discusses the responsibilities of the study director and principles of identifying miss-dosing and corrective measures.

The EC GLP document<sup>[3]</sup> notes: Miss-dosing and/or cross-contamination of the test item is always a risk in animal studies. These problems are usually detected by the presence of the test item and/or its metabolites in plasma or other biological samples from control animals. It is recognized that dietary and topical studies might lead to a higher level and incidence of contamination of test item in control animals. However, contamination of biological samples from control animals has also been observed in studies using other routes of administration, e.g., gavage, intravenous, intraperitoneal, subcutaneous, or inhalation. Exposure of the control animals to the test item may compromise or invalidate the study from a scientific point of view.”

The use and introduction of spurious experimental noise to cancel out inconvenient data, that could prevent the registration of a chemical for marketing is dishonest, to say the least. The unrelated historical controls that Monsanto used 3, 5, 7, and even 11 times for all intensive

**Table 1: 1981 biodynamics Interstitial cell tumors of the testes**

| Interstitial cell tumors of the testes in Sprague-Dawley Rats |      |      |      |       |
|---|------|------|------|-------|
| Glyphosate dose (mg/kg/day)                                   | 0    | 3    | 10   | 30    |
| Terminal sacrifice  | 0/15 | 2/26 | 1/16 | 4/26  |
| Percentage  | 0    | 7.69 | 6.25 | 15.38 |
| All animals   | 0/50 | 3/50 | 1/50 | 6/50  |
| Percentage  | 0    | 6    | 2    | 12    |

**Table 2: 1981 bio/dynamics Incidence of FTD and FTN**

| Incidence of kidney FTD and FTN in Sprague-Dawley Rats |      |      |      |      |
|--|------|------|------|------|
| Glyphosate dose (mg/kg/day)                            | 0    | 3    | 10   | 30   |
| FTD unilateral   | 2/10 | 3/10 | 2/9  | 7/10 |
| Percentage   | 20   | 30   | 22   | 70   |
| FTD bilateral  | 0/10 | 2/10 | 1/9  | 1/10 |
| Percentage   | 0    | 20   | 11   | 10   |
| FTN unilateral   | 1/10 | 2/10 | 1/9  | 0/10 |
| Percentage   | 10   | 20   | 11   | 0    |
| FTN bilateral  | 0/10 | 0/10 | 0/10 | 1/10 |
| Percentage   | 0    | 0    | 0    | 0    |

FTD: Focal tubular dilatation; FTN: Focal tubular nephrosis

**Table 3: 1981 bio/dynamics Incidence of pancreatic islet cell tumors**

| Incidence of pancreatic islet cell tumors in male Sprague-Dawley Rats |      |      |      |      |
|---|------|------|------|------|
| Glyphosate dose (mg/kg/day)   | 0    | 3    | 10   | 30   |
| Adenomas  | 0/50 | 5/49 | 2/50 | 2/50 |
| Percentage  | 0    | 10   | 4    | 4    |
| Carcinomas  | 0/50 | 0/49 | 0/50 | 1/50 |
| Percentage  | 0    | 0    | 0    | 2    |
| Adenomas/carcinomas   | 0/50 | 5/49 | 2/50 | 3/50 |
| Percentage  | 0    | 10   | 4    | 6    |
| Hyperplasias  | 3/50 | 2/49 | 1/50 | 0/50 |
| Percentage  | 6    | 4    | 2    | 0    |

**Table 4: 1990 Stout and Rueker Incidence of pancreatic Islet cell tumors**

| Incidence of pancreatic islet cell tumors in male Sprague-Dawley Rats |       |       |       |        |
|---|-------|-------|-------|--------|
| Glyphosate dose(ppm)  | 0     | 2000  | 8000  | 20,000 |
| Adenomas  | 1/43  | 8/45  | 5/49  | 7/48   |
| Percentage  | 2     | 18    | 10    | 15     |
| <i>P</i>  | 0.170 | 0.018 | 0.135 | 0.042  |
| Carcinomas  | 1/43  | 0/45  | 0/49  | 0/48   |
| Percentage  | 2     | 0     | 0     | 0      |
| <i>P</i>  | 0.159 | 0.409 | 0.467 | 0.472  |
| Adenomas/carcinomas   | 2/43  | 8/45  | 5/49  | 7/48   |
| Percentage  | 5     | 18    | 10    | 15     |
| <i>P</i>  | 0.241 | 0.052 | 0.275 | 0.108  |
| Hyperplasia   | 2/43  | 0/45  | 3/49  | 2/48   |
| Percentage  | 5     | 0     | 6     | 4      |
| <i>P</i>  | 0.323 | 0.236 | 0.526 | 0.649  |

purposes were actually corrupted studies, whether by technician error, contaminated water and or feed or other mistakes. Taking potentially good experimental data and corrupting it for an ulterior motive that of product registration, must be stopped. Why else would Monsanto

**Table 5: 1990 Stout and Rueker Incidence of thyroid c-cell tumors in male SDR**

| Incidence of thyroid C-cell tumors in male Sprague-Dawley Rats |       |       |       |        |
|--|-------|-------|-------|--------|
| Glyphosate dose (ppm)  | 0     | 2000  | 8000  | 20,000 |
| Adenomas   | 2/54  | 4/55  | 8/58  | 7/58   |
| Percentage   | 4     | 7     | 14    | 12     |
| <i>P</i>   | 0.069 | 0.348 | 0.060 | 0.099  |
| Carcinomas   | 0/54  | 2/55  | 0/58  | 1/58   |
| Percentage   | 0     | 4     | 0     | 2      |
| <i>P</i>   | 0.452 | 0.252 | 1.000 | 0.518  |
| Adenomas/carcinomas  | 2/54  | 6/55  | 8/58  | 8/58   |
| Percentage   | 4     | 11    | 14    | 141    |
| <i>P</i>   | 0.077 | 0.141 | 0.060 | 0.060  |
| Hyperplasia  | 4/54  | 1/55  | 5/58  | 4/58   |
| Percentage   | 7     | 2     | 9     | 7      |
| <i>P</i>   | 0.312 | 0.176 | 0.546 | 0.601  |

**Table 6: 1990 Stout and Rueker Incidence of thyroid c-cell tumors in female SDR**

| Incidence of thyroid C-cell tumors in female Sprague-Dawley Rats |       |       |       |        |
|--|-------|-------|-------|--------|
| Glyphosate dose (ppm)  | 0     | 2000  | 8000  | 20,000 |
| Adenomas   | 2/57  | 2/60  | 6/59  | 6/55   |
| Percentage   | 4     | 3     | 10    | 11     |
| <i>P</i>   | 0.031 | 0.671 | 0.147 | 0.124  |
| Carcinomas   | 0/57  | 0/60  | 1/59  | 0/55   |
| Percentage   | 0     | 0     | 2     | 0      |
| <i>P</i>   | 0.445 | 1.000 | 0.509 | 1.000  |
| Adenomas/carcinomas  | 2/57  | 2/60  | 7/59  | 6/55   |
| Percentage   | 4     | 3     | 12    | 11     |
| <i>P</i>   | 0.033 | 0.671 | 0.090 | 0.124  |
| Hyperplasia  | 10/57 | 5/60  | 7/59  | 4/55   |
| Percentage   | 18    | 8     | 12    | 7      |
| <i>P</i>   | 0.113 | 0.112 | 0.274 | 0.086  |

then collude with the EPA and hide the data from purview?

Data tables are now presented without the use of experimental noise from historical controls. Only the data results of the experiment are shown.

One final consideration is that glyphosate technical powder, used to manufacture all Roundup formulations and competitive products, is contaminated with N-nitroso-glyphosate (NNG) a carcinogenic compound which occurs as a contaminate during synthesis. NNG is particularly dangerous due to glyphosate's known chemistry as an amphiphilic zwitterion. The EPA has reported glyphosate to contain levels approximating 100 ppb. Hardell and Eriksson noted increases in non-Hodgkins lymphoma with an increased risk of hairy cell leukemia for people exposed to glyphosate and other

herbicides. As previously stated, glyphosate has been shown to induce cancer in the parts per trillion range.<sup>[4,9]</sup>

When we look at the experimental data without the addition of experimental noise introduced by use of unrelated historical controls, a different picture of the herbicide glyphosate emerges, one that has been demonstrated through experimentation to induce tumorigenic growth of many glands and organs.<sup>[2,5,6]</sup> Monsanto and the EPA knew about its effects as early as 1981 and suppressed the data, even hiding it under the guise of trade secret information. It is my honest opinion, that in so doing they lied.

Glyphosate was recently reclassified as a Group 2a probable carcinogen by the International Agency for Research on Cancer (IARC) of the United Nations WHO. Monsanto's attempts to have the decision overturned have been unsuccessful - as well as the US Department of State's efforts to prevent the Columbian ban of aerial spraying of coca plants with glyphosate. The Dutch Parliament has also passed legislation which will end the sale of Roundup- and glyphosate-based products to the public, effective at the end of 2015. Other countries have considered and/or are considering also taking similar action.

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## REPLY TO COMMENTARIES

I take and accept Dr. Stephanie Seneff's critical comments on my letter in good faith in the same vein as (I think) she accepted and rejected some of my criticisms. I can only hope that her dire predictions of escalating rates of autism do not come to pass, regardless of whether glyphosate is the culprit or some other health or environmental factor is involved.

As far as Dr. Anthony Samsel's criticisms, I do have several comments. First, I should remind him that for clarification purposes, he and Seneff are the authors of the article in question. I was the letter writer in response to the article.

Second, I discussed my objections to their study on the basis of scientific methodology, the meaning of correlations as opposed to causation, the large number of conditions supposedly implicated, as well as the conclusions drawn based on the evidence and logic provided by the authors themselves. I stand by my conclusions as discussed in my letter. I do question the scientific conclusions drawn by the authors. I do question their zeal but not their integrity; nor did I question their beneficent motives, nor impute any malevolent or vengeful motivation for the authors' work or conclusions. Despite my criticisms on the science I assumed good faith on

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their part, and expected no less collegiality from them in responding to my letter.

Thus, I take offense at Samsel's insinuations that I am involved in any way with Monsanto or any faction of the chemical or pharmaceutical industry. He writes:

"Judging by the overall content and tone, it is more of a pro-chemical industry commentary. The thoughts of its author are tired and old, and they do not reflect current understanding of glyphosate herbicide, its toxicology, and relation to disease. Rather, the letter is a diatribe which touts and solicits the position and views of Monsanto and other corporate affiliates who promote industrial, chemical-based agriculture."

Not satisfied with that little assault, Samsel a few paragraphs later launches an even more vicious, overt ad hominem attack:

"The commenter's penniless libretto indicates personal upset with the thought that glyphosate could be removed from the market, and *attempts to remain distanced from ties to Monsanto and big pharma by stating* (my italics): *'I have received no monetary remuneration or any kind of benefits, perks, or employment from pharmaceutical, chemical or any type of company, including Monsanto'* (his italics). However,

throughout the letter, the author demonstrates allegiance to the chemical industry, even stating that getting rid of DDT was a bad idea, and he tries to justify the thought with distorted reasoning.”

I have and owe no allegiance to any chemical industry or pharmaceutical company. My allegiance is to scientifically established truth, professionally, and the pursuit of life, liberty, and the pursuit of happiness for my family and for me personally as a citizen — just as I intimated in my letter. If Samsel can prove otherwise, he should show proof or apologize for making unsubstantiated, malicious, and cynical insinuations.

There was no basis for those two accusatory paragraphs, except to outright dismiss my objections, as well as besmirch my reputation and integrity. Scientists can disagree on scientific points, the degree of certainty needed to establish cause and effect relationships, etc., but venal insinuations and ad hominem attacks should have no place in scientific discourse. It is ironic that he calls my letter a diatribe, which I deny; but if by any chance, I went farther than I intended, then with his own comments Samsel himself becomes the proverbial pot calling the kettle black!

The fact is those insinuations speak more about Samsel’s own professional motives than my own. As Samsel recapitulated my statement: “I have received no monetary remuneration or any kind of benefits, perks, or employment from pharmaceutical, chemical or any type of company, including Monsanto.” I stand by that statement. Yet Samsel insisted on the association implying that I was lying. For Samsel, it is inconceivable that a lonesome scholar would have the gumption to profane the sacred cow of environmentalism by pointing out that even fashionable and worthwhile medical goals must follow the rules of science in public health research.

I also hope for a pristine environment for my children and grandchildren, but reality, not fantasy, must be taken into account. Radical environmentalism has become a secular religion. The attack I have been subjected to begs the question: Are the ideological motives and zeal of some environmentalist researchers any different from those of salaried investigators working for chemical and pharmaceutical companies on the other side of the issue? These are important questions that medical ethicists should be asking themselves and investigating.

Instead of attempting to besmirch my integrity, he should have stayed with the science and fine-tuned his hypothesis. By now he is confusing exceptions to the rule with the basic axioms of science. Samsel writes, “The commenter refers to hormesis and states: ‘...Most chemicals and natural substances become harmful only in higher, proportional pharmacological doses and quantities. In short, it is the huge doses, fed, and ingested by these

animals, that cause the carcinogenicity, not natural and normal feeding in their present environments. The doses made the poison!’ (his italics). This statement is blatantly false and old school.” My statement is in fact true and remains the general rule! I wrote *most* chemicals and natural substances do follow the rule of hormesis, including water! Glyphosate may be one of many exceptions to this rule; nevertheless such severely toxic chemicals are still exceptions to the basic rule of hormesis.

Samsel writes that I exonerated glyphosate. Nonsense! I did not. I question the all-encompassing associations and calls for action that implied finality. I also condemned Monsanto’s alleged practices, such as the use of “terminator seeds.” Specifically in that regard, I wrote:

*More studies employing scientific methodologies with long-term follow-ups are needed and caution utilized in the use of glyphosate, and all the other herbicides and pesticides, that we continue to spill into the environment.*

*I’m in no way completely exonerating glyphosate and supporting its astronomical use as a harmless substance. It is not, and further studies need to be done, as mentioned. I also deplore two of Monsanto’s alleged business practices. One of them, as I have been told, is that of “their technological efforts with plants as to make them GM Roundup®-Ready, meaning the genetically-modified crops would require increasing concentrations of Roundup.” This has resulted in the increased amounts of glyphosate having to be used to obtain the same agricultural yield at increasing costs to farmers. Another is the terrible practice of “sterile seed technology,” or “terminator seeds,” whereby seeds are sterilized, genetically engineered, not to produce crops. This practice, I have been told, has destroyed the livelihood of many farmers, especially in Latin America and India, where crop yield is essential to subsistence farming and human life. Monsanto must have recognized the problem and has ceased producing these “terminator seeds...”*

But we cannot begin to ban every product suspected of “doing harm,” especially when we are dealing with an exploding world population needing to be fed. It is the purpose of science to establish cause and effect relationships. Samsel writes about his organic farming with a motorized tractor in his farm, a far cry from most independent farmers in the Third World. For most people, including myself, organic farming is labor intensive and expensive. I did not say it was an impossible task, but that it was difficult and potentially subject to fraudulent claims by unscrupulous sellers.

The fact is that organic foods are a growing luxury of mostly developed nations, particularly in Europe and North America; but in Asia, Africa, and Latin America, farmers are content with what they can grow from the soil with hard toil, in some cases barely above



subsistence farming. Farmers in places such as India, Pakistan, and Latin America are happy if they can have a profitable crop, a crop they can have a surplus (and profits) to exchange for other amenities of life that we take for granted. It is Samsel that is out of touch in his environmental utopia, riding his tractor and using his motorized equipment.

That privileged world may be real for him but not for the majority of the nearly 8 billion (projected to reach 10 billion by 2050) people of the world, particularly the growing populations of the Third World nations in Africa, Asia, and Latin America. I have in the past visited such nations as Morocco, Belize, El Salvador, Guatemala, Jamaica, Haiti, etc., and know the necessity and difficulty of these countries to feed their people. These nations do need pesticides, fertilizers, herbicides, (and many of the chemicals some of us have the luxury not to use), for their agricultural needs, if not their survival.

Samsel writes: "Farmers feed the world, not profit-motivated corporations bent on creating a monopoly, or profiting from every morsel of food, or even before the seed is planted." I agree with the first part of the statement, but corporations are the ones that furnish the equipment needed such as his tractor and motorized equipment. They also produce much needed fertilizers,

herbicides, and pesticides needed for the farmers who choose to use them to live above subsistence level and to increase profits, if that is, possible. As to profit-motivated corporations, we must recall with the collapse of the Soviet empire that free market capitalism, with all its flaws, has turned out to be the best economic system man has yet created, and profits are its engine. Monopolies do not occur unless government allows them to exist. I think Samsel should set "his hate of evil corporations" aside and continue the pursuit of science, where the path truly leads rather than where there is a preconceived objective.

I categorically stand by my letter and hope only that scientific methodology and truth triumph over environmental hysteria and fantasies of false utopias — whether or not glyphosate is responsible for the disturbing rise in many neurological diseases and other conditions. Although he spent plenty of ink and paper in his own comment, Samsel should have used the occasion to further prove his hypothesis, not by throwing more unconnected data and using insinuations attempting to impugn the motives and besmirch the integrity of a colleague with an opinion different from his.

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