

Editorials

A Conflict Between Science and Social Concerns: Agent Orange

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This past November I had the great pleasure of presenting a Colloquium Lecture to the faculty and students of the Institute for Environmental Sciences at the Landau Campus of the University of Koblenz, Landau, Germany. My host, Dr. Carsten Bruehl, asked me to lecture on my experiences of working with Agent Orange and its associated dioxin (2,3,7,8-TCDD). Thus, I chose as my subject 'Agent Orange: A Conflict Between Science and Social Concerns.' My goal was not to defend or damn Agent Orange or TCDD, but rather to illustrate to the students what is meant when we say 'A conflict between science and social concerns.' In my opinion it means that the significance of the science is 'filtered' by the perceptions of the society.

All too frequently, environmental activists, the media, and policy-makers form the public perceptions of the risks of toxic chemicals in our environment, with little or no regard for the actual scientific findings. The public does not distinguish between 'exposure' and 'dose'. While 'exposure' is the opportunity to receive a dose, it is not the actual dose, but rather 'dose' is the amount of a substance actually entering the body, not the amount of a substance located nearby. In 1996, the National Academy of Sciences' Institute of Medicine in the United States tried to clarify these concepts with regard to Agent Orange: "*Accurate estimation of any risk associated with exposure depends on the ability to identify those who are 'exposed' and those who are not. When the concern is with low-level possible intermittent exposure to a chemical such as a herbicide, it becomes important to not only assess the presence or absence of exposure, but also to characterize the degree of exposure – its intensity and duration*" [1]. With the development of sophisticated methods for biomonitoring of low levels of chemicals in human tissue, we are now able to assess the actual received doses in persons exposed to environmental chemicals. The investigation of the dioxin contaminant in Agent Orange is one of the many excellent examples where the potential exposures of various populations, previously uncertain, were clarified by biomonitoring of actual levels in human tissues [2].

For many years I have argued that the Agent Orange Controversy is really an issue that strikes at the fundamental concept of 'quality of life'; and hence, science alone cannot resolve the controversy. Many veterans of the War returned

from Vietnam with apprehensions that were manifested by fear of the unknown about how they were going to re-adjust back into a society that was rapidly changing in its social and economic values. One historian concluded that these apprehensions may have had nothing to do with Agent Orange in scientific fact, but was grounded in other problems affecting the Vietnam veteran population. However, anecdotal stories about the horror of Agent Orange have been launched into notoriety by a self-perpetuating series of press and television stories [3].

I suggested to the students at Landau University that public discussion and governmental actions have proceeded largely on an assumption, rather than a determination, of widespread substantial exposure to Agent Orange by veterans of the Vietnam War [4]. Much attention has been focused on work supported by the National Academy's Institute of Medicine on publications concluding that dioxin and herbicide exposure in Vietnam were much greater than reported by all previous investigators, based on computer modeling and assumptions underlying a calculated exposure opportunity index *that were unsupported by actual measurements of serum dioxin levels* [4]. However, the extensive medical and scientific (including environmental fate) studies of Agent Orange and its associated dioxin over the last thirty-five years have provided ample evidence that most veterans (and Vietnamese) were not exposed [5,6]. They also show that even those veterans with measurable serum 2,3,7,8-TCDD have not suffered significant ill effects as a result [2,4,7]. The historical records from the Vietnam War also supported the conclusion that spraying of troops and civilians with Agent Orange was highly unlikely [8] (see also [9], this issue). Nevertheless, the actions by the United States Congress via the Agent Orange Act of 1991 (Public Law 102-4) provides presumptive compensation **in the absence of exposure and causation**, an expression by the political system that was intended to acknowledge the sacrifices of the Vietnam veteran [10]. Unfortunately, it has not met its objective. Few veterans have been compensated, and litigation has once again become the 'hallmark' of today's action on Agent Orange and dioxin.

Vietnam and Agent Orange are public policy issues as much as medical and scientific issues – perhaps more so. There are strong public policies favoring our veterans, and rightly so. But our scientific principles ought not favor or disfavor anyone. As scientists, we cannot ignore the policy context, because in our world the policies shape the research agenda, and if we are not careful, may affect even the research results.

As Editor-in-Chief, I have seen many articles published in *ESPR* that have attempted to provide important scientific data and logical reasoning necessary to resolve such controversial topics as radiation exposure [11], alternative energy sources [12], climate changes [13], genetically modified organisms [14], and a multitude of chemical pollutants [15]. However, the reality is that these issues cannot be resolved by science alone. If we are to ensure that policy makers are aware of the quality science that we are engaged in, we have an obligation to become involved in the public dialogue on these controversial issues. This is the challenge that we must meet if we want to attract the brightest and most enthusiastic young people to become the next generation of outstanding environmental scientists and engineers. The Institute for Environmental Sciences at Landau University is certainly on the right track.

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Coalbed Methane: A New Source of Energy and Environmental Challenges

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Coalbed methane (CBM) is a naturally occurring gas bound by water pressure in underground coal seams. It is the same as natural gas. Water wells are drilled into the coal deposits. As the water is released through the well, water pressure is decreased, which releases the natural gas. The natural gas flows to the surface within the well bore where it is captured, minimally compressed, and piped to a larger compression station. The water is drawn from the coal seam through a water line and piped into newly constructed retaining ponds or reservoirs. The well bore is equipped with oxygen sensors that will shut the pipelines if any oxygen is detected. This prevents any underground spontaneous ignition of coal. Approximately 60% of the wells are drilled to a depth of less than 335 meters, with the remaining wells greater than that depth. Typically a new CBM well will discharge about 45 liters per minute of water. After about a year of production, the water discharge is reduced to about 30 liters per minute.

The typical half-life of a CBM well is 13 years. During that period a typical CBM well will produce 11.3 million cubic meters of methane gas.

The Powder River Basin, which is located in Northern Wyoming and Southeastern Montana, is known to hold at least half of the 1.5 trillion cubic meters of undiscovered natural gas resources. Currently, there are more than 32,000 operating CBM wells in the Basin. The projection is that there will be more than 100,000 operating CBM wells in the near future. In many areas of the basin, wells are being placed and drilled on every 32-ha plots. It is anticipated that there will be more than 400,000 operating CBM wells in the five-state area by 2010. Although both state and Federal regulatory agencies have require that BLM and coalbed methane companies have approved Environmental Impact Statements (a process requiring public input), the development of such an enormous program nevertheless has many adverse environmental impacts.