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Pesticides: benefits and risks: fantasy, fiction and fact

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I was Chairman of the Advisory Committee on Pesticides for nearly 13 years, from 1975 to 1987; during those years the main role of the Committee was to assess potential hazards for human health, wildlife and the environment from the use of pesticides. Only in the last two years was the committee required to assess efficacy formally, so that benefits could be weighed against potential risk or hazard. I shall concentrate on the problem of hazard assessment in our modern society.

In summary, I shall develop the argument that there has been a growth of intense interest in chemicals and the environment – a greening effect – and also intense media interest. Pesticides have been mainly under attack, compared to human and veterinary medicines. My main thesis is that the attack has been that of allegation, often with putative scientific data which usually has not stood up to rigorous scrutiny of evidence. An analogy with the witch-craze of the 16th and 17th centuries will also be developed, with the main similarity being the necessity to prove a negative: the accused had to demonstrate that he or she was not a witch, and similarly the manufacturer or State regulator had to demonstrate that a particular chemical was without hazard. Proof of a negative characteristic is beyond human rationality.

Though potent substances to eliminate or control pests were known before the Second World War, the development of new powerful organic chemicals began during the war with DDT. Many new substances and widespread use burgeoned during the next two decades and it is not unusual to be able to seek evidence on the effects of a substance which has been used for 40 years. However, interest in the possible harmful effects developed much later, when the world had become used to the beneficial effects of pesticides. As examples, malaria control and increase of crop yields may be quoted. The use of Agent Orange in Vietnam produced a marked acceleration of allegations of harm from herbicides, and the controversy still causes much heat today.

A second major factor in the possible harmful effects of pesticides is the public perception of risk. It is well recognised that an individual will accept potential risk of a treatment more easily when an individual decision can be made, compared to community treatment which is unavoidable by an individual. Fluoridation of water supplies is a long-standing example. In my view, the ability to make a personal decision to use or not accounts for much less public concern with human medicines or for that matter, the use of pesticides in home or garden.

Accordingly, most of my examples of unsubstantiated allegations come from agro-chemical use.

Pharmacology and toxicology have few basic principles. Easily the most important is that the effect of a chemical substance increases with the amount taken and, as a corollary, that no effect will be produced until a minimal quantity has been absorbed. The principle underlines all regulatory measures.

Another important principle is to establish a causal relationship between substance and effect. Experimentally, proof is not difficult when the effect can be demonstrated on laboratory animals. More difficult is when the alleged effect is singular to human beings. Other parameters such as reproducibility, disappearance of effect when chemical is withdrawn and an unambiguous dose response relationship will be required.

As a practising physician, I am especially acquainted with the third principle which is that of the placebo effect. Humans are easily influenced by suggestion. Many of the benefits of medicine prior to 50 years ago were due to this effect. But it is important to stress that just as an individual by suggestion can feel better, so also can he feel worse, if he believes that he has been exposed to a chemical with alleged hazards.

That there has been a growing public awareness of chemical dangers is indisputable. My illustrations attempt to demonstrate that often allegations of harm ignore the above scientifically demonstrated principles of chemical action on living things. Further, while we may accept an ignorance of such principles in the general public and media, it is less acceptable when the alleged have some professional knowledge. Most important of all is the emotion attached and emotional language used when such allegations are made. There is little doubt that commitment to a view that pesticides are bad, can lead to a prejudiced assessment of evidence. I have two illustrations of evidence that did not follow the normal dose-relationship. The first exemplifies the tangle that is very characteristic of my view that allegation is made before scrutiny of evidence can occur. Aldicarb (Temil) is a nematocide, which has been used for around 15 years. Recently evidence was reported to the United States Environmental Protection Agency that it produced suppression of the immune system in experimental animals¹. The press immediately reported and interpreted this effect as causing symptoms akin to AIDS. The evidence has not been published in a peer review journal, but it is known that an inverse dose-response effect was claimed. It is not surprising that such

evidence was not published, as such a bizarre effect is akin to the Laputians who attempted, unsuccessfully, to build houses from the roof down. The second point is that there are a limited number of ways in which mammalian organisms can respond to insults. Many diseases suppress the immune system but AIDS is a deadly and unique variety. The press interpretation was designed to produce anxiety and successfully did so.

My second example concerning lack of correlation between dose and effect is more complex. Perhaps the most efficient and selective herbicide group is the phenoxy acids. Vietnam made 245T the most infamous and an enormous amount of scientific effort has been devoted to their alleged harmful effects on the past 15 years. Swedish workers produced evidence about 10 years ago, suggesting that a rare cancer, soft tissue sarcoma, has a sixfold increased risk of developing when there had been exposure to phenoxy acids of more than one day^{2,3}. However, the dose-response correlation was not significant. Such a lack should have evinced surprise, especially as it was possible to interpret their results as indicating more effect from exposure under six months duration, than for durations greater than six months. Both in Sweden and many other countries studies have been done to confirm or deny this risk of cancer in other ways^{4,5}. All such studies have failed to confirm such a high selective risk and it seems likely that an extraneous factor had invalidated the initial studies. Almost certainly the long-lasting campaign against these herbicides in Sweden including very extensive press allegations was a factor not given due weight. Case-control studies, of which these were examples, measure individual recall in a controlled fashion. But if an individual knows he has cancer and has been subjected to press allegations, he or his relatives may recall a biased exposure.

My example to illustrate the second principle of causality could be replicated many times. It is in the nature of man that he will try to find a cause for serious natural phenomena especially in children. In 1978, an epidemiological study of Reye's syndrome was performed in the Eastern Maritime Provinces of Canada⁶. This condition is rare and only 17 instances were studied. The conclusion was reached that as the distribution was not random, an association with forest spraying programmes was postulated, despite the fact that such spraying had been performed many months before the disease was manifest. In fact, I was challenged in the major civil trial of 245T in Nova Scotia in 1982 with this hazardous effect. It is now accepted in both the U.S. and the U.K. that Reye's syndrome is related to aspirin intake. Causation is much more likely as the intake is temporally associated with the disease and most telling of all, the condition has greatly decreased with the reduction of aspirin use in children.

Suggestion is a potent force in human affairs. At the height of the 245T controversy in the U.K., the headline in the *Daily Mirror* claimed that some 300 children had

collapsed at a music festival due to a cloud of gas, probably from pesticide spraying⁷. Only one fact was given, namely that only the marching children had collapsed, whereas the spectators were exempt. Over the next few days it was revealed that no spraying had occurred, and there were no residues in air or on the ground. Mass hysteria in children is well known and this description is quite characteristic. However, it highlights the importance of the phenomenon of suggestion. All of us wish to have an explanation for natural disturbances, for example abortion and birth defects.

Let me now digress to outline the features of society finding other explanations for natural events. The Christian church in the Dark Ages recognised and ignored the superstitious fear of witchcraft. The Canon Episcopi of the 9th century put the weight of canon law against a belief in witches. During the 14th, 15th and 16th centuries, an organised belief in witchcraft and demonology arose supported and later orchestrated by both the Catholic and Protestant churches⁸. Legalised torture was accepted to extract confessions and guilt could only be dispelled by proving that you were not a witch. Unlike earlier times when only old demented women were accused, all levels of society produced witches. This was not surprising, as confession produced by torture would often include accusations against other individuals, and these were likely to be well-known citizens of the town. The craze grew to such proportions over Europe and New England that some half to one million people were burned or hanged as witches over two centuries. Perhaps the most striking feature was the inclusion within this organised and emotional craze of some of the most intellectual and thoughtful of the age. This was the age of early scientific discovery and of the Renaissance, yet Erasmus and Francis Bacon did not deny the validity of demonology and the causation of illness or harvest failure by superstitious means. Social fear, exacerbated by powerful religious differences between Catholic and Protestants, was the breeding ground for a systematised social delusion which grew enormously. Yet by the end of the 16th century the craze waned rapidly, without any change in the arguments that had sustained it. The 20th century now casually regards this craze with patronising pity, yet modern man has found in this century a social group to ostracize and then to eliminate, namely the Jews. The combination of social fear and high emotional temperature may make a community turn on any conceivable cause for its ills. Rational man may be scorned for not accepting the obvious.

Let me conclude by attempting to illustrate the emotional irrationality which still pervades our society. Perhaps the most potent condition to arouse social fear is that of cancer. It is clear that most cancers have an environmental cause. Evidence for such a view does not come from knowing specific causes such as sunlight and skin cancer, or smoking and lung cancer. It comes from the large variation of incidence on a geographical basis.

Further it is reinforced by the demonstration that emigration to another country allows the indigenous incidence to be expressed in the immigrants. But not so well known are the historical variations in cancer incidence. When corrected for ageing population, it is clear that there has been no increase in total incidence of cancer in this century and even perhaps a slight decrease⁹. The latter is even more significant when lung cancer is deducted. Yet it is only during the second half of this century that the chemical revolution came to pass. This does not deny that there may be rare cancers associated with particular chemicals. But it is reassuring in its entirety, especially in a society where much disease is caused by individual decision to smoke or take alcohol.

A cool rational scrutiny of the hazards of pesticides, when used with due precautions, endorses my view that their controlled use has not caused major human, wildlife or environmental damage. It is not denied that they are potent chemicals which can cause biological damage if misused, and there are many such examples. However, they are pilloried in the present climate of allegation, and we must strive to preserve a rational method of investigation, and not be coloured by emotional commitment.

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1990 SMITH & NEPHEW FOUNDATION SERVICE DOCTOR SCHOLARSHIP

Squadron Leader Brian Joseph O'Reilly has been awarded the 1990 Smith & Nephew Foundation Service Doctor Scholarship. The award will enable Squadron Leader O'Reilly to study with Professor Claus Walter, a world expert in head and neck reconstruction surgery, in Hieden, Switzerland.

Squadron Leader O'Reilly is a Consultant Ear, Nose and Throat Surgeon at Princess Mary's Hospital Royal Air Force Halton and an Honorary Consultant at The London Hospital. One of his special interests is in the field of osseo-integration (the unique healing response of bone to pure grade titanium) and its surgical applications, from the implantation of hearing aids to the repair of major facial defects.