Health risk: just a guessing game?

T. A. Connors

Ethylene Dichloride: A Potential Health Risk? 5th Banbury Report. Edited by B. Ames, P. Infante and R. Reitz. Pp.350. (Cold Spring Harbor Laboratory: 1980.) $45, $54 outside USA.

"WELL, *is* ethylene dichloride a health risk?" is the question that comes to mind after reading this book. The comment does not imply any specific criticism of the report but rather sums up our present knowledge of the toxicology of a wide variety of chemicals to which human beings are exposed. We suspect from animal and other laboratory tests that many chemicals may be a risk to human health as carcinogens, teratogens, mutagens and so on, but we do not have reliable methods to determine whether there is an actual risk in any situation or what the degree of that risk may be.

Ethylene dichloride is a very important chemical indeed, the US production in 1977 amounting to 11,000 million pounds in weight. It is used mainly as an intermediate, so most high-level exposure is in the chemical industry, but significant amounts are also used in the textile and food industries and in agriculture, for example. The possibility that ethylene dichloride might be carcinogenic was first suggested when it was shown to be mutagenic in bacteria. In a large international study, tests of this type have been shown — at least for certain classes of chemical — to correlate reasonably well with animal carcinogenicity tests which in turn have given positive results for most human carcinogens identified by epidemiological or case control studies. This Banbury Report summarizes what is known of the toxicology of ethylene dichloride and one learns that it can be metabolized *in vivo* to an alkylating agent which can react with DNA and initiate the events that many people think can lead to cancer. One also learns that other short-term tests, using *Drosophila* and yeast, for example, have given positive results and that the chemical, like many of its congeners, is carcinogenic in rats and mice. However not all of the data are unequivocal. In a well-controlled study, Maltoni and his colleagues could find no evidence for the carcinogenicity of ethylene dichloride in rats and they question the validity of earlier studies from a number of aspects including "the professionality of the team carrying on treatment, control of animals and autopsies". Furthermore, no teratogenicity or major reproductive toxicity was found either in animals or in exposed workers, nor was there any evidence of an increased incidence of cancer in workers exposed to ethylene dichloride for 20 years or more.

All in all the book is a wonderful miniature of the multidisciplinary field of toxicology and the problems that arise in interpreting data from different types of test, in choosing between conflicting results and in attempting to assess the risk to human beings. Although scientists, as in this report, are to be commended for attempting to measure carcinogenic potency and to quantify risk, the equation contains so many unknowns that the assessed level of risk must be seen to be based on a working hypothesis with many assumptions rather than as the result of an extrapolation based on scientifically reliable methods. It follows then that in making the decision to restrict a chemical, to replace it with "safer" alternatives or to ban it altogether, economic and social argument must be considered as well as the scientific aspects. There is concern that a number of chemicals which have been used for many years and considered to be safe because there was no acute toxicity associated with exposure, may nevertheless be highly dangerous in the long term. The Banbury Report, with contributions from industrialists, government scientists and university researchers, shows how widespread this concern is, but until animal experiments can be related to human situations the debate on the dangers of chemicals will continue.

However, there has already been one welcome outcome. Workers are nowadays exposed to less dirty, dusty and smelly conditions than even a few years ago, while urban environments are certainly more wholesome than they once were. Whatever the effects may be on the cancer incidence only time will tell; but for those people who believe that quality of life is at least as important as quantity of life then there is already a vast improvement. □

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Catastrophes for starters

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An Introduction to Catastrophe Theory. By P.T. Saunders. Pp.144. (Cambridge University Press: 1980.) Hbk £9.50, $27.50; pbk £3.25, $8.95.

ALL previous introductions to catastrophe theory have been either popularizations, devoid of any serious mathematics and often riddled with falsehoods, or works of considerable mathematical sophistication. This book succeeds in filling the gap between these extremes. It divides naturally into two parts. The first is an exposition of the theory, which deals with the singularities of smooth real valued functions, using only a limited mathematical vocabulary yet not glossing over anything of importance: structural stability, equivalence, the splitting lemma, determinism and universal unfoldings are all explained as clearly as one could wish. The second half of the book gives the flavour of applications of the theory by way of a selection of examples from the physical, social and biological sciences, all of which are to be found discussed in much greater detail elsewhere in the literature. The author is careful not to exaggerate the status of catastrophe theoretic models in the social and biological sciences, and concludes with a lucid discussion of the explanatory powers of the theory and some cautionary words on appropriate standards of judgement of applications in different disciplines.

My enthusiasm is not unqualified, however. Central to catastrophe theory are the geometries of the catastrophes themselves, so it is inexcusable that their illustration in this book leaves something to be desired. Most of the relevant figures are slavishly and uncritically copied, with due acknowledgement, from the book by Bröcker and Lander (*Differentiable Germs and Catastrophes*; Cambridge University Press, 1975); some include labelling in a nomenclature incompatible with that used in Saunders's text, others include construction lines which are here irrelevant and unexplained, or fail to display the nature of the singularity at the origin of control space. Where the drawings are original, similar lack of care is evident. At the hyperbolic umbilic singularity, the rib (cusped edge) and the fold touch parabolically, yet here they are depicted as intersecting straight lines; the sketch of the lips event is quite dreadful.

The text does not suffer from any such sloppiness, but there are some omissions which are surprising in such a recent publication. Most notable is the absence of any reference to the work of the Russian mathematician V.I. Arnol'd, who is responsible for the enormous extension of Thom's classification to catastrophes of codimension > 4, and for a rational system of symbols to label the catastrophes, which Saunders eschews — the Thomist "pet names" are fine if one is only considering a few low-dimensional catastrophes, but things get out of hand as the dimensionality and number of catastrophes in the list