aromatics, PAHs, anaerobic degradation of non-halogenated aromatics (such as BTEX, phenol and cresols) and the capabilities of lignolytic fungi. Part three moves on to bioremediation applications including: biotreatment of process water and bioremediation of chlorinated organics, coal tar and petroleum hydrocarbons. The book concludes with a final section on future trends. Included here are: the use of molecular biology tools to monitor the process of bioremediation, genetically engineered microorganisms and risk assessment.

The book contains a lot of useful information, but suffers from a significant amount of duplication of material between the authors. This stems from the structure of the book, but could have been avoided by tighter editing. There are many instances where the basic microbiology and biochemistry covered in part two are repeated in the applications section (part three). This is most evident in the chapters entitled "Cleanup of petroleum hydrocarbon contamination in soil" and "In situ processes for bioremediation of BTEX and petroleum fuel products". Both chapters are very good in their own right, but the repetition is irritating.

Chapter two "Chemical contamination of the environment: sources, types and fate of synthetic organic chemicals" is the most disappointing chapter. It is mainly a catalogue of chemicals which have been detected in the environment and contains several mistakes (eg. methyl tertbutyl ether is incorrectly classified as an aromatic hydrocarbon). There is a very small section (four pages) on contaminant fate. It would hake been far more useful to cover contaminant behaviour in the environment and how this affects biodegradation.

The inclusion of a chapter on risk assessment in a book of this type is to be applauded. All too often, it is assumed that a site should be cleaned-up (e.g., bioremediated), simply because it is contaminated, without any reference to the risk posed by that contamination to human health and the environment. The chapter concentrates on how toxicity and carcinogenicity of chemicals are assessed, but unfortunately fails to address the source–pathway–receptor concept which is key to assessing risk.

This book is one of many on the topic of bioremediation of organic contaminants in the environment that have been published in the last couple of years. Despite the reservations discussed above, it would be a useful addition to the library of those working in the field.

G. Lethbridge

Financial Evaluation of Environmental Investments, by Tuula Moilanen and Christopher Martin, published by IChemE, 1998,177 pages, ISBN 0-85295 365-B

The authors state that their book "seeks to help managers to answer the key question about an environmental investment - what is impact on the bottom-line of the company". This is a formidable challenge to undertake, and perhaps it is understandable that, after reading the book, I am still far from confident that I could carry out an evaluation with the rigour that their methodology implies.

The work which lies behind this book was carried out by the authors under a project commissioned by the Ministry of International Trade and Industry in Japan under the title of 'Clean Manufacturing in the Process Industries'. The consortium involved included major organisations such as ICI, DuPont, Teijin and the Finnish Forest Industry Federation.

The book falls into three parts: the first third describes the model itself and the required inputs, assumptions and definitions. The second section is devoted to two real-life case studies. The last part contains a 'user Guide' and some check-lists. A training package entitled Environmental Investment Appraisal is also available from IChemE — this was not reviewed.

Existing models for investment appraisal are reviewed: their limitations are listed as • present models only cover a limited range of relevant parameters • they do not provide a 'holistic' conceptual model • 'difficult' Issues are left out • most models have a societal (rather than company) perspective • they do not allow for the effects of uncertainty

The proposed new methodology is simple enough in concept. The model seeks to evaluate the areas where an environmental investment can have an impact — these include R and D, product design, production, marketing and company image. The costs of a particular project (which may not necessarily be aimed at environmental improvement) are analysed under each heading. In a similar way the returns (financial benefits) are estimated. Risks (likelihoods) are associated with both the desired and undesired effects — for example, the introduction of a new, environmentally improved process might carry with it the increased risk of an accident. Once the risk elements have been allowed for, the costs and returns are labelled as Expected Monetary Values (EMVs).

It is interesting to note that the authors recommend that events which are 'so large that they would threaten the survival of the company' are not included in the analysis!

Each of these costs and returns is then discounted back to current values, using conventional techniques. The point is made that some of the estimates of cost and return will be very difficult to make, and the further into the future these effects are, the more intangible they will be because of the rapid rates of change in factors such as legislation pressure group action and public perception. Fortunately, of course, the effect of discounting greatly reduces the need for accuracy In far-off events.

Once the current net value of the proposed investment has been calculated, decision can be made according to the normal financial criteria which the company uses.

The authors acknowledge that putting all this information together in a sufficiently complete and accurate form on which to base a realistic decision is likely to be a formidable job! They sensibly emphasise that this is not a job to be undertaken by specialist in one particular department whether that be in R and D or in finance: it is something which must be tackled by a multi-functional team covering all aspects of the company's business. Considerable stress is laid on the importance of having high-quality Life Cycle Analyses for each aspect of the project.

The point is also made that all the necessary skills and resources which include, for example, quite sophisticated computer-based risk modelling and probability analysis techniques, may not be available within even quite large companies.

Two cases studies occupy the central portion of the book. The first outlines the appraisal process which Kymmene Corporation of Finland went through in deciding

whether to invest in a pilot plant for the non-chlorine bleaching of wood-pulp. An important factor was the pressure brought on the market by Greenpeace activities against halogen compounds in aqueous effluent streams. The second case study also concerns the treatment of waste chlorine compounds — this time from an ICI process. By working through each study in some detail, the methodology is clearly demonstrated (avoiding the knotty problem of assembling the input data!)

The detailed check-lists which take up the last third of the book appear to be very useful guides to anyone using the method —and could well be very valuable in other methods of project appraisal.

Overall, this book should prove very useful in providing one step along the road towards more structured methods for analysing projects aimed at environmental improvement. Similar thinking could well be applied to safety related projects —indeed both aspects must be considered together if we are to avoid some of the pitfalls we have seen in the past!

However, the book will not in itself make it easy to carry cut this sort of analysis. The identification and assessment of realistic data will continue to be a significant barrier, especially in the area of risk estimation.

D.J. Willats