One of the major trends within expert systems today is the move for close integration with existing work environments and computer systems. Although the book provides a good catalogue of these types of integration, it describes expert systems as a stand-alone technology. It would help many managers to make it clearer throughout how best expert systems can be integrated with existing practices.

As a final complaint, the author seems to dismiss expert system shells on ordinary PCs as inadequate. Although it is wise to use the most powerful development environment possible, many companies have been very successful with small PC-based applications.

In summary, this book is highly recommended for every manager involved with expert systems, or hoping to bring expert systems into their company. It provides an excellent overview, not only of the technology of expert systems, but the management related issues.

Artificial experts: social knowledge and intelligent machines by HM Collins, MIT Press, Cambridge, MA, 1990, pp 258, £17.95.

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The field of artificial intelligence and expert systems has achieved a certain maturity in that following the waves of enthusiastic introductory texts, promising a great technological future but able to deliver little of practical value, we can now find a growing international literature which takes a more reflective and civilized approach. The tools of intelligent computing have fallen into the hands of non-computing specialists, who have found the experience provocative and productive. As the sociologist HM Collins notes in this book:

> "When one tries to put knowledge into a computer, the questions present themselves in an acute and well-defined form. That is why artificial intelligence research is a natural . . . laboratory for the science of knowledge."

This new generation of intelligent computer users brings refreshingly different perspectives and emphasis. Just as the French archaeologist Jean-Claude Gardin (1988) derives valuable insights for his discipline from the use of simple expert systems tools such as SNARK, a large part of Collins' book is devoted to an account of the use of APES to build a system to teach people to grow specialized semiconductor crystals. A similar level of technology stimulated Richard Susskind (1987) into investigations of expert systems in the area of jurisprudence. In each case the domain specialist has been motivated to take on the role of knowledge engineer, building demonstration systems that have to meet the criteria of the specialist domain rather than carrying forward the leading edge of research on advanced workstations.

In recent years a number of books (e.g. Graubard, 1988) have sought to challenge the concept of "strong AI", the building of intelligent systems that could replicate an ever-increasing range of human intellectual functions. The arguments have often focused on new developments, such as neural computing, which have challenged conventional, and for some discredited, simple principles of artificial intelligence. Where, as in the work of Searle (1984) Dreyfus (1987) and Leith (1990, 1991), the basis of the argument has been philosophical, the combative style has often served to antagonize the research community, who have felt forced on to the defensive, in some cases perceiving threats to ongoing funding. With the work of Goranzon and colleagues (1988, 1990) at the Swedish Centre for Working Life, where artificial intelligence has been considered in the context of culture, language and work, the unfamiliar style of the resulting literature has made it possible for the emerging case for human-centred systems to be ignored as marginal. Those who have sought to develop practical and socially useful demonstrations of alternative directions for the technology, such as the Artificial Intelligence For Society Club, founded at the BCS Expert Systems Conference in 1987 (Gill, 1988; Ennals, 1991) have found the task harder than anticipated, and some have found it easier to withdraw from such experimental, and unfunded, efforts.

Harry Collins has made a notable contribution to the debate in this book, which should strengthen the chances of dialogue and mutual understanding between social scientists and

artificial intelligence researchers. He assumes no specialist technical background, and gives a lucid presentation of both philosophical arguments and practical scientific experience, crystallized in the work on his CRYSTAL system with colleagues at the University of Bath. The book is accessible, affordable, and an essential acquisition for all institutions of higher education.

Collins writes from the perspective of knowledge science, which he defines as the study of what communities know and the ways in which they know it, concerned with how knowledge is made, maintained, disputed, transformed and transferred. In this review, the locus of knowledge is not the individual, but the social group. This poses a crucial question for, as he notes: "the existence of any intelligent machine seems to contradict a basic premise of knowledge science because a machine is not a community or a member of society;"

In a stimulating re-working of the Turing Test, whereby an observer had to distinguish between imitations of a woman by a man and a machine, Collins explores the case of automated intelligent agents who could pass muster as residents of Semipalatinsk, and raises critical issues of culture and tacit knowledge. Turing (1923) had predicted that by the end of the century "one will be able to speak of machines thinking without expecting to be contradicted". Such an outcome would be the result of changes in ourselves as well as in technology, and not necessarily for the better. Collins concludes:

> "Intelligent machines are among the most useful and interesting tools that we have developed. But if we use them with too much uncritical charity, or if we start to think of ourselves as machines, or model our behaviour on their behaviour, not only will we lose sight of what we are, the tools we make will not be good ones."

Collins' case study on growing semiconductor crystals casts useful light on the status of tools. Artificial intelligence researchers frequently produce tools, but all too often have little concern for their subsequent mode of use in the application domain. Collins, like Gardin, sees expert systems as tools for experts. They both draw attention to the difference between abstracting rules of practice for use in a text or an expert system, and learning the practice of the same craft, an issue pursued by Goranzon and his colleagues. Collins takes up some of the criticisms voiced by Dreyfus of the conventional model of expertise, saying:

> "Expert systems are machines that use what experts can say about their knowledge as the basis of their programs", but does not see this as a fatal weakness in an appropriate context of use: "The fundamental inexplicability of knowledge only causes insoluble problems if it is expected that the system will be used by non-experts."

Such a conclusion would, of course, pose problems for commercial developers of expert systems.

References

Dreyfus, H, 1979, *What Computers Can't Do*, New York: Harper & Row.

Ennals, R, 1991, *Artificial Intelligence & Human Institutions* London: Springer.

Ennals, R and Gardin, J-C (Eds.), 1990, *Interpretation in the Humanities: Perspectives from Artificial Intelligence*, London: British Library.

Gardin, J-C (Ed.), 1988, *Artificial Intelligence & Expert Systems: Case Studies in the Knowledge Domain of Archeology*, Chichester: Ellis Horwood.

Gill, K (Ed.), 1986, *Artificial Intelligence for Society*, Chichester: John Wiley.

Goranzon, B and Florin, M (Eds.), 1990, *Artificial Intelligence, Culture & Language: On Education & Work*, London: Springer.

Goranzon, B and Josefson, I (Eds.), 1988, *Knowledge, Skill & Artificial Intelligence*, London: Springer.

Graubard, S (Ed.), 1988, *The Artificial Intelligence Debate*, Cambridge, MA: MIT Press.

Leith, P, 1988, *Formalism in AI & Computer Science*, Chichester: Ellis Horwood.

Leith, P, 1991, *The Computerized Lawyer*, London: Springer.

Searle, J, 1984, *Minds, Brains & Science*, London: BBC.

Susskind, R, 1987, *Expert Systems in Law*, Oxford: Oxford University Press.

Turing, AM, 1982, *Computing Machinery & Intelligence*, reprinted in Hofstadter, D and Dennet, D (Eds.), *The Minds I*, Harmondsworth: Penguin.