Angles on knowledge

David Miller

The Limits of Science.

By Nicholas Rescher.

University of California Press: 1985.

Pp.225. \$34.50, £31.50.

THE question of whether there are any limits to empirical science is one that, since Kant anyway, has never been far from the centre of the theory of human knowledge. Logical positivists persuaded themselves (and others) that meaningful investigation is restricted to the results of observation, experiment and induction. Less extreme sufferers from scientism have held that there is no knowledge but scientific knowledge. On the other side it has been suggested that the traditionally conceived method of science as one of "rational triangulation from the empirical data" (as Rescher describes it on p.198) sets more of an external limit to science than an internal one.

In this work, much of which is collated from his innumerable previous books, Rescher approaches the issue from a number of angles: whether there are topics wholly beyond the mandate of science ("no" in Chapter 7, "yes" in Chapter 12); whether science could be perfected, even in principle ("no" in Chapter 9); whether there are problems within its domain that science is in principle unable to answer ("no" in Chapters 4 and 8); whether there are significant questions that for practical (technological) reasons science cannot handle ("yes" in Chapter 10); whether science progresses steadily towards theoretical perfection ("no" in Chapter 5); whether it progresses at an instrumental level ("yes" in Chapter 6); whether extra-terrestrial science might be scientifically more advanced than ours (question dismissed in Chapter 11).

The discussion throughout is thoroughly unsatisfactory: superficial, confused, philosophically unsophisticated, repetitive, neologistic, above all deeply antipathetic to theoretical speculation. For example, in the account in Chapter 11 of how our science and alien science might be related, a discussion whose only real conclusion is that there is nothing of interest to say, we read:

A tiny creature living its brief life span within a maple leaf could never recognize that such leaves are deciduous.... Science is limited to the confines of discernibility: as Kant maintained, the limits of our experience set limits to our science [p.197].

So much for the power of ideas. Yet in Chapter 8 Rescher seems properly to appreciate that science is not confined to what we can experience but a method of going

wildly beyond it. In a similarly glum mood Rescher seems to suppose that because other planets might be physically very different from ours, scientists there might use mathematics... very unlike ours.... their 'geometry' could be something rather strange, largely topological, say, and geared to flexible structures rather than fixed sizes or shapes [p.177].

Just like some of our mathematics by the sound of it.

Can current science tell us anything about future science, about extraterrestrial science, about possible limits to scientific inquiry? The answer seems obviously that it might be able to, but that what it tells us might be wrong. Rescher persistently muddies this issue, gliding from the platitude that "no adequate justification can be found for the view that science has barriers" (p.130) to the assertion that it has no barriers. He seems not to have appreciated that if "present science cannot speak for future science..., [if] there can be no basis for claims of inherent unanswerability" (p.129), then present science cannot speak for present science either, and there can be no basis for its assertions about the natural world. Yet Rescher is unwavering in his belief that the results of science can be justified. We are told that the advance of science amounts to obtaining "a firmer warrant for our claims", not "more of the truth"; and we are warned of the "fallacy... that moves from a picture-of-

nature's being a *better-warranted picture* to its being a *better picture*" (pp.73-74). Only someone who confuses justification with truth, and thinks that all moves have to be justified, could see this move as a fallacy rather than as an attempt to discover the truth.

The question of the existence of insolubilia is itself eventually resolved in Chapter 8 as follows:

How could we possibly establish that a question *Q* will continue to be *raisable and unanswerable* in every future state of science...? ... [If we] argue that the answer to *Q* lies 'in principle' beyond the reach of science, ... it is difficult to see how we could maintain it to be an authentic scientific question [p.128].

In other words, science has no limits except where it has limits.

Most of the topics treated in this book are treated more than once, as though the different chapters had originated from different authors. The writing is always verbose, and horrible hyphenated words ("issue-killer" on p.17, "question-disallowing" on p.22, "hole-internal" on p.131, for example) abound. On p.52 the same 130-word quotation appears twice: in the text and in a footnote appended to it. The word-processor has a good deal to answer for. In most other respects the book is well produced. □

David Miller is Senior Lecturer in Philosophy at the University of Warwick.

Word and number meta-magic

David E.H. Jones

Metamagical Themas: Questing for the Essence of Mind and Pattern.

By Douglas R. Hofstadter.

Basic Books: 1985. Pp.852. \$24.95. To be published in Britain later this year by Viking.

DOUGLAS Hofstadter is widely and justly celebrated for his book *Gödel, Escher, Bach*, and for his co-production with Daniel Dennett of *The Mind's I*. Between June 1981 and September 1983 he succeeded Martin Gardner in running *Scientific American's* "Mathematical Games" department. He gave his contributions the anagrammatical title of "Metamagical Themas". All 26 of these essays are reprinted in this book. Each now has a postscript of subsequent reflections and developments; in addition there are seven new, specially-written "Themas".

Hofstadter claims that his Themas form a scatter of random dots around his intellectual "home territory", which is concerned largely with thinking, thinking about thinking, and thinking about language. There are Themas on self-referring and self-replicating sentences, and

ones on the search for consistent patterns and styles in music and in geometrical art-forms. Hofstadter's own research into artificial-intelligence programming is reflected in several Themas, such as those on the pattern-recognition of sameness underlying difference, in particular the recognizable sameness of letters of the alphabet throughout unimaginably many variations of form and fount.

Other Themas continue the tradition of "Mathematical Games", dealing with such topics as Rubik's cube, the mathematics of chaos, computer languages, psychological games with numbers, and logical dilemmas and paradoxes. A rather special cluster of Themas locates a societal region in Hofstadter's territory: his concern over mass gullibility, innumeracy and some political issues. Each Thema is complete in its own right, but most are buttressed and extended by others elsewhere in the book. It's a format ideal for browsing; rather like his previous books, in fact. There is an excellent bibliography, with short notes on the works cited.

To illustrate Hofstadter's style and matter, I'll outline one Thema in greater detail, No.23 "On the Seeming Paradox of Mechanizing Creativity". Could a computer be creative in the human sense? Or must it always be, in effect, a huge fast-scanned dictionary of clichés? After considering the background to this question, Hofstadter introduces an example of

● P.B. Medawar's *The Limits of Science*, first published in the United States by Harper & Row, and recently in Britain by Oxford University Press, was reviewed in *Nature* 312, 203 (1984).

extreme uncreativity — the blind repetitiveness of instinctive behaviour shown by the wasp *Sphex*. Typically, he gives this behaviour a name: sphexishness. Its opposite, mental flexibility, he calls anti-sphexishness; and to illustrate the notion he positions various machine, animal and human behaviours along a continuum connecting these extremes. The essence of anti-sphexishness, says Hofstadter, is the ability to break out of loops and ruts of all

Hofstadter — love of word-play.

kinds. He has a word for this, too: "joot-sing" (jumping out of the system). It depends, he argues, on watching what you're doing, so as to break up any routine which is getting repetitive. This leads into his favourite topic of self-watching and self-referencing systems, recursive theorems and computer-routines, and the use of recursiveness in "creative" computer programs. He ultimately concludes that some sort of Gödel theorem forbids any exhaustive formalization of creative ability. Any conceivable creative genius or artificially intelligent program must ultimately remain a prisoner of its own style — just like the humble *Sphex*.

In the postscript to this Thema, Hofstadter throws out some intriguing remarks about the subtleties of "style" (What makes a tune catchy? Why do trade-names such as "Day-glo" and "Turbo-matic" now seem vaguely dated?), and comments on a new rival artificial-intelligence strategy inspired not by recursion but by the ideas of statistical mechanics. The reader is directed to related discussions in other Themas.

Hofstadter is no mere armchair theorist. He constantly supports his ideas by appeals to practical experience or to intriguing psychological experiments. Expounding the Turing test for computer intelligence (can you distinguish the computer from a human being by its responses to questions?), he presents a transcript of an actual Turing test, with a delightful surprise ending. His discussion of the "Prisoner's Dilemma" paradox, a sort of mathematical microcosm of the tension between competition and cooperation, is enlivened by accounts of several experimental studies. Two of them were tests carried out by Hofstadter himself on human subjects, the other two were tournaments between computer pro-

grams. The tournaments marvellously illuminate the biological concept of the "evolutionarily stable strategy" — the optimum behavioural strategy towards which a group of competing organisms will evolve over the generations. This is used to suggest how socially cooperative creatures could have evolved from a primitive population of warring egotists.

Hofstadter's style of writing has its own pleasures and pleantries. He loves playing with words; puns, anagrams and literary jokes abound. This almost dangerous infatuation with word-play at times works against him. Three whole chapters are devoted to self-referencing sentences, a self-indulgence quite unjustified by the limited conclusions reached. Another chapter presents numerous examples of literary nonsense, again without any moral that I can see. Set against the commentaries by (for example) Aldous Huxley, George Orwell and John Updike on nonsense-verse considered as a penetrating subversion of the stifling world of convention, this is very thin gruel.

The most serious lapses, though, are political. Hofstadter declares himself a natural activist, easily "fired up" by various good causes. The ones he espouses here, those of nuclear disarmament and feminism, are badly served by his simplistic enthusiasm. His anti-nuclear Thema is a sadly flat and contrived parable, arguing that if enough people devote enough time to denouncing the arms-race, it will go away. Once world leaders realize the complete symmetry of the U.S./S.U. confrontation (there's that word-play again) all will surely be well. His feminist Themas point out that in normal grammatical English usage, "he" can include "she" and so on. He seeks to make this a matter for resentment among women, and guilt in men, by means of an extraordinary attempted mapping from a region of very high guilt-density, that of race relations. Orwell, in his celebrated essay "Notes on Nationalism", remarks that the political bigot's great sensitivity to specific words and phrases probably has overtones of word-magic — the belief that the world can be changed by proper incantation. Despite his fascination with words, Hofstadter is too rational a soul to be a bigot. He admits that he may be over-acting. Certainly all previous attempts to change society by word-manipulation have merely enriched the language's glittering treasure-house of euphemisms and polite evasions.

But this is to carp. Most of Hofstadter's Themas are concerned with his areas of special knowledge and insight, and sparkle with linguistic fun, provocative insights and intellectual challenges. This random walk through his intellectual "home territory" is highly recommended. □

David E.H. Jones is a guest staff member of the Physical Chemistry Department, University of Newcastle upon Tyne, and a science consultant to industry and the media.

Life with a lighter touch

Martin Gardner

"Surely You're Joking, Mr. Feynman!": Adventures of a Curious Character.

By Richard P. Feynman with Ralph Leighton.

W. W. Norton: 1985. Pp.350. \$15.95. To be published in Britain later this year by W. W. Norton.

"THE stories Feynman tells about himself would make a book", an interviewer wrote in 1963. Here, 22 years later, is that book. It is not an autobiography. You will learn nothing from it about the work on quantum mechanics that earned Richard Feynman a Nobel prize in 1965. What you will learn is a great deal about the flamboyant personality of a great theoretical physicist: his amazing range of interests, his unusual hobbies, his enthusiasms and animadversions, his dislike of pompous fools, his unpredictable behaviour and, above all, his fondness for outrageous comedy.

Feynman's famous three-volume *Lectures on Physics*, and his marvellous little book *The Character of Physical Law*, were based on taped lectures. *Surely You're Joking, Mr. Feynman!* is a taping of Feynman's uninhibited conversations over the years with his friend Ralph Leighton. "That one person could have so many wonderfully crazy things happen to him in one lifetime is sometimes hard to believe", Leighton writes in his preface.

The reason they happened is that Feynman has a knack of creating his own adventures. When, for instance, he was a young man at Los Alamos, working on the top secret bomb, he discovered a hole in the perimeter fence. Anyone else would have reported this to the authorities and that would have been the end of it, but Feynman is incapable of passing up a chance for a lark. Out of the main gate he goes, back through the hole, then out again. He keeps this up until the sergeant at the gate suddenly realizes that some strange character is always going out but never coming in.

Feynman's expert ability to pick locks followed naturally from his lifelong passion for puzzles. To demonstrate how loose security was at Los Alamos, he would secretly open the safes of top scientists, leaving little notes that said such things as "I borrowed document LA4312 — Feynman the safecracker". But such idiosyncracies were not appreciated by everyone, least of all the military. When three psychiatrists tried to test Feynman for Army service they quickly found themselves being tested. "How much do you value life?", one of them asked. "Sixty-four", Feynman answered. The Army's final verdict: mentally deficient. (The chapter on this banter, headed