World Ice Doctrine. He began a search for conclusive evidence in the SS "Research Institute" ("Ahnenerbe", or "Ancestral Heritage"), with a view to elevating the doctrine to official Nazi ideology.

It is true that Himmler was not deflected from his faith in the World Ice Doctrine by the vehement opposition of the academic establishment, the "journeymen of science", for whom he harboured a deep loathing. This is certainly to be inferred from his harsh treatment of opponents of the Hörbiger ideology in his own ambit. But he was compelled to give the impression of distancing himself from the World Ice Doctrine, and even the journals under his control were deterred from running advertisements for new books about the theory. The research groups in the Ancestral Heritage were renamed and were able to pursue their researches only covertly.

This fiasco resulted primarily from the activities of the physicist and Nobel laureate — and ardent admirer of Hitler — Philipp Lenard, who vigorously fought the World Ice Doctrine as "Volksverdummung" — dulling of the people's mind. One may then hazard the interpretation that Himmler sought to protect Werner Heisenberg — who had been libellously dubbed "the Ossietzky of physics" by Johannes Stark, Lenard's spiritual patron, in the *Schwarze Korps*, the journal of the SS — as a means of striking at his arch-enemy in the propagation of the World Ice Doctrine, Lenard, whom he did not dare to challenge in matters of science.

Bowen is seemingly unacquainted with the state of knowledge in this area, for he finally goes so far as to say that "Hörbiger might well have become a scientific overlord in Nazi Germany probably more important than was Trofim D. Lysenko in Stalin's Soviet Union". In fact, even if Hörbiger had been alive, the World Ice Doctrine would never have achieved the standing of an official Nazi ideology. Such an outcome was not even attained by Lenard's "Aryan physics". In the course of the war the pragmatic professionals gained the upper hand over the pure Nazi ideologues in all important matters relating to military technology, and thus furthered the implementation of Hitler's destructive mania. And Hitler's paranoid hatred of the Jews did not stem from the World Ice Doctrine, but rather from the racial theories thrown up by social Darwinism at the turn of the century. □

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■ *Nature* thanks Walter Gratzer for translating this review from the German.

Invisible Johnny

Ray Monk

John von Neumann. By Norman Macrae. *Pantheon: 1992. Pp. 405. $25.*

DURING his all-too-brief life (he was 53 when he died), John von Neumann was regarded by many, including both prominent politicians and Nobel-prizewinning scientists, as the most intelligent person in the world. That he is not better known among the general public is probably due to the fact that, unlike say Einstein or Freud, his name is not associated with a single revolutionary breakthrough in any one discipline. His fame is, rather, diffused throughout the astonishingly varied fields of his interests. Mathematical logicians know him as the man who, in the 1920s, provided one of the first systems of axioms for set theory; in theoretical physics he is known as the mathematician who gave precise form, in a well-known book of 1932, to the so-called 'Copenhagen interpretation' of quantum mechanics; social scientists will have come across his name as one of the joint authors, together with Oskar Morgenstern, of the classic work of game theory; historians of the Cold War will know him as the technical expert responsible for advising first Truman and then Eisenhower on the strategy of 'maximum retaliation'; while computer scientists — and, increasingly, the general public — will recognize his name in connection with the 'von Neumann architecture' that lies at the heart of all modern computers.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

John von Neumann with his wife, Klara, and pet dog Inverse (1954).

Like that of those other great mathematical logicians, Kurt Gödel and Alan Turing, von Neumann's role in shaping the development of the twentieth century was, until recently, known to only a few. Public awareness of the other two, however, has been massively increased by the publication of two widely read books: Douglas Hofstadter's astonishing bestseller *Gödel, Escher, Bach* (Basic Books/Penguin, 1980) and Andrew Hodges's superb biography *Alan Turing: The Enigma of Intelligence* (Simon and Schuster/Hutchinson, 1984). The success of these two books, both of them rich in scholarship and exciting to read, should have paved the way for a study of von Neumann that was lively enough to excite, and well-informed enough to satisfy, the curiosity of a wide audience about the nature and the importance of his achievements. Sadly, this is not that study.

Norman Macrae is a former editor of *The Economist*. He writes in a style that, while accessible, is perhaps too breezy for his subject matter. Von Neumann is called "Johnny" throughout the book, which is bad enough, but worse is Macrae's habit of putting an adjective in front of this familiarized form of his subject's name and referring to him as, for example, "cherubic Johnny", "inexperienced Johnny," "Computer Johnny", "logical Johnny" and, towards the end of von Neumann's life, "overweight Johnny" (although, thank God, he spares us "cancerous Johnny"). Breezy Norm, one feels, does not read his work aloud. How else can one explain his letting go unrevised a phrase like: "the appearance of Johnnies is the cheapest way of increasing man's material prosperity very fast"?

Even worse than these stylistic infelicities, however, is the fact that Macrae does not seem very interested in mathematical logic. His work is therefore uncertain and unreliable at precisely the point when it should be laying an intelligible and enlightening foundation for what is to follow. For, as with Alan Turing, von Neumann's later multifarious activities were all in some way grounded in his early work in logic.

Indeed, one feels throughout the early sections of the book that Macrae is just dying to get on to what he is really interested in: von Neumann's work on economics, computers and nuclear deterrence during and immediately after

the Second World War. His chapter on the Budapest in which von Neumann grew up, for example — potentially a fascinating and lively study of a pre-First World War culture as intriguing as its Habsburg counterpart, Vienna — leans far too heavily on statistics ("By 1910 Jews made up around 60% of Budapest's doctors and lawyers") and makes little attempt to breathe life into these facts or to use them to conjure up in the reader's imagination a world that, though now largely forgotten, produced, in addition to von Neumann, Theodore von Kármán, Michael Polayani, Eugene Wigner, Edward Teller and Leo Szilard.

In connection with this, one should also point out that the general standard of scholarship throughout the book is not very high. In places, Macrae makes heavy use of work that has already been published, and although in his notes he makes clear which particular books he is dependent on, he very rarely gives the exact source of his quotations or of his information. This is a pity, because where I am in a position to check his information, the number of mistakes he makes does little to inspire confidence in the rest. He has three or four pages on Bertrand Russell, for example, in which almost every paragraph contains an egregious error. Russell's grandfather, Lord John Russell, for instance — a radical Foxite Whig for whom anti-Toryism was practically a religion — is described by Macrae as "a right wing former British prime minister" and a "promising young conservative politician at the time of Waterloo".

There must, then, be doubts about how far we can trust Macrae for an assessment of von Neumann's work, especially in the field of politics. His prejudice in favour of a hawkish, right-wing opposition to communism is plain for all to see, as is his willingness to distort the views of his opponents. Nevertheless, in part because of Macrae's personal commitment, the sections of the book dealing with von Neumann's work on the 'Fat Man' bomb that was dropped on Nagasaki and his role in first developing the hydrogen bomb and then advising Eisenhower's government on the deployment of thermonuclear weapons are unfailingly fascinating. In dealing with the politics and personalities of committees, Macrae shows the confidence and the sure touch that was missing in his earlier accounts of mathematical logic.

What made Hodges's book on Turing such a stunning success was the author's ability to move around between three apparently unrelated subjects: the persecution of homosexuals in British society, the cracking of the 'Enigma' code and the development of computer models of the mind. A successful biography of von Neumann would need to show a similar, perhaps even greater, range of interests. In this deeply flawed work, Macrae has done little more than hint at what such a book would be like. □

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■ Of related interest is *Prisoner's Dilemma: John von Neumann, Game Theory and the Puzzle of the Bomb* by William Poundstone, now published in paperback by Oxford University Press (£7.99) and Anchor/Doubleday ($12.95). For a review by Martin Shubik, see *Nature* **356**, 637 (1992).

Have book, will travel

Karl Sigmund

Reality Rules: Picturing the World in Mathematics. Volume 1: The Fundamentals. Volume 2: The Frontier. By John L. Casti. *Wiley: 1992. Pp. 388/424. $80, £42.50 (two-volume set).*

STARTING with the Necker-cube-like ambiguity of its title and going right up to a discussion of alternative interpretations of quantum reality in the final chapter, *Reality Rules* invites one continuously to shift one's position. This plea for mobility is characteristic of John Casti's book. It is essentially a sightseer's guide to the fairyland of mathematical models, and aims at enticing one to book for a tour.

Casti Tours offers the most spectacular vistas of modern applied mathematics — including (of course) chaos theory, fractals, computational complexity, NP-completeness, artificial life and cellular automata, as well as such topics as catastrophe theory and game theory that are no longer the current rage but still provide reliable, well-tested thrills. Even the more down-to-earth topics on the agenda, such as linear systems and control theory, are replete with 'souped-up' applications ranging from Searle's 'Chinese room' test for artificial intelligence to a party-goer's optimal drinking policy. With the exception of a chapter on connective structures, which seems somewhat at odds with the other chapters, the common thread running through the book is dynamical systems in one guise or another.

The book grew out of *Alternative Realities*, a widely acclaimed work published in 1989 that was awarded a best book prize by the American Association of Publishers. In the meantime the book has grown by 300 pages and split into two handsome volumes. The main changes include a substantial new chapter on computation and complexity, a wealth of exercises, problems and discussion questions, a solutions manual available on request and a wholesale updating of the text.

The book's style can best be seen by considering the author's antecedents. Casti started out as a systems scientist at the Rand Corporation, and wrote several mathematical textbooks before launching into science writing for the general public with his well-received books *Paradigms Lost* (Morrow, 1989) and *Searching for Certainty* (Morrow, 1990) — reviewed in *Nature* **385**, 293–4; 1992). *Reality Rules* occupies a niche somewhere between a textbook and a trade book. It is intended for readers with some training in undergraduate mathematics and a curiosity about the latest 'bestseller themes' in the scientific arena. Not incidentally, Casti nowadays works at the Santa Fe Institute, a hotbed of avant garde activities in dynamic systems modelling.

The two chapters bracketing the book are general discussions about the aims and limitations of mathematical modelling. Each of the eight chapters in between outlines enough material for at least a one-term graduate course. These surveys are to a large extent independent of one another (so that the same topics are sometimes approached from several perspectives), but they are not meant to be self-contained. On the contrary: in a sense, the climax of each chapter is reached with the six to ten superb pages of notes and references, which cover the relevant literature in an informal, agreeably chatty and extremely user-friendly way. I found them most helpful, both in fields I am familiar with and in those areas where I am a stranger. They offer reliable, thoroughly up-to-date advice for mathematical globe-trotting.

The text is designed to whet one's wanderlust. It is mostly a blend of simple yet instructive examples and heroic theorems. The general impact of these theorems is then analysed in a conversational style that leads up to a collection of stimulating discussion questions. Casti's formula is thus to invite the reader to take some easy steps first and then offer a breath-taking view of the heights. The notion of an algorithm, for instance, is explained by means of a detailed recipe for Caesar's salad, but just a few pages later one is up to one's ears in uncomputable numbers. In much the same vein, the exercises are a mixed bag — some straightforward classroom drill problems together with many thoroughly hard nuts that on occasion summarize entire research articles, sending one scurrying to the solutions manual. These