

their users. Similarly, human beings — unlike existing computers (and some other living creatures) — can reflect on *how* to make a decision, and on how to make a decision amongst different methods of making a decision ... and so on. They can even elect to make an arbitrary choice that in some circumstances frees them from the constraints of rationality. Human intentionality may one day be modelled computationally, but only if theorists act like proper 'difference engines' and keep in mind the discrepancies between their theories and human mentality.

The scope of Minsky's interests is exhilarating. He has things to say about nearly all psychological topics — learning, motivation, the sense of self, vision, pleasure and pain, the meanings of words, how children develop intellectually, reasoning and problem solving, creativity and genius, consciousness, emotions, jokes, and so on and on. It is all but impossible to summarize his book because its structure, quite deliberately, mimics the structure of the theory. Each page is a self-contained 'agent' with its own title and part number. It may begin with an apposite quotation, often from an unlikely source such as Dr Johnson or Kurt Vonnegut; it elucidates some aspect of the mind making its point economically and perhaps aided by a diagram, and its moral

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may be encapsulated in an italicized principle. The pages make up 30 chapters, but the organization of a chapter is manifest solely in its title and the part numbers of its component pages. There is only a brief bibliography (attached to the items in the glossary) and there are few references — often not even to work reaching similar conclusions. The format and the imprimatur from luminaries in the world of science fiction suggest a book for the coffee-table. The contents suggest a book for the AI laboratory. The result is a unique Minskian amalgam — a coffee-table monograph, that is both readable and provocative. But is it good science?

A sceptic is likely to complain that Minsky appears neither to have checked

whether his ideas add up to a coherent theory by building computational models of them nor to have submitted them to any sort of empirical test. By his own reckoning, he has made hundreds of assumptions, and many of them may be wrong. An enthusiast will retort that Minsky is attempting to provide a coherent framework for psychology, and that until he succeeds it would be premature to try to show that his theory is better than others. Minsky's book is speculative, but, as he says, it is intended to be an adventure story for the imagination, not a scientific textbook. □

*P.N. Johnson-Laird is Assistant Director of the MRC Applied Psychology Unit, 15 Chaucer Road, Cambridge CB2 2EF, UK.*

## Social invention

*Edmund N. Todd*

**Diesel: Technology and Society in Industrial Germany.** By Donald E. Thomas, Jr. *University of Alabama Press:1987. Pp.279. \$26.95, £22.50.*

DURING the late nineteenth century, Germany underwent impressive economic and urban development, which formed an industrial state from one based on agriculture. Conservative elements were concerned with promoting the agricultural sector and damping down what they considered to be unhealthy industrial concentration. The growth of a large Marxist party representing the industrial working class also threatened traditional aristocratic and new industrial élites. As social and economic structures changed, German engineers developed their profession, modelling it on the older legal profession, which was closely tied to the conservative bureaucracy.

Although technological change threatened the old order, engineers hoped to increase their professional status by claiming a cultural mission of mediating between labour and capital and by promoting further technological change to preserve the old order. For instance, many engineers sought to develop new sources of power to revitalize artisanal production, threatened by big industry. Donald E. Thomas places Rudolf Diesel and the early history of the diesel engine in this context, and his book should appeal to those interested in understanding the relationships between science, technology, industry and society.

The history of the diesel engine provides a model of technological change through interaction between invention, development and innovation. In order to decentralize industry by providing a source of power for artisans, Rudolf Diesel translated concepts in thermo-

dynamics into an idea (invention) of a hot-air engine, based on the Carnot cycle. Trained at the Technical University (Technische Hochschule) in Munich, Diesel stressed the importance of thermal efficiency and, like leading academic experts, did not realize the difficulties of building an engine. Diesel found industrial backing but had to modify his theory of isothermal combustion using a large ratio of air to fuel in order to develop a working engine (development). Thomas analyses the invention and developmental stages and notes throughout the methods Diesel used to protect his original idea, embodied in his patent of 1892. Modifying the theory undermined the patent, which Diesel's enemies duly noted.

Successful innovation, or making the engine marketable, did not follow smoothly either. Diesel, and representatives from his industrial backers — Augsburg Engine Works and Krupp Works — prematurely announced a successful engine in 1897. Diesel suffered a breakdown and was unable to participate in overcoming the problems which became evident after diesel engines were placed in factory environments. As a result Diesel left the innovation stage to the Augsburg Engine Works, which helped form MAN in 1898. During the decade before his apparent suicide in 1913, Diesel faced financial problems and was little involved in engineering work on his engine.

Thomas accepts the widely held notion among German historians of a feudalized German middle class and combines it with the stages of invention, development and innovation used in the history of technology. Thus, he makes an important contribution to both fields by showing how engineers promoted technological change to preserve a social order threatened by that change. This is a finely crafted biography that goes beyond the usual limits of the genre. □

*Edmund N. Todd is in the Department of History, University of New Haven, 300 Orange Avenue, West Haven, Connecticut 06516, USA.*