The subsequent role of heuristically guided processes of search and inference performed on internally stored world-models has been central to AI. So too has the development of special forms of computer language in which to express what the machine knows about its world. It is therefore illuminating to read John McCarthy, saying at this same formative Dartmouth Conference that it was desirable "to attempt to construct an artificial language which a computer can be programmed to use on problems requiring conjecture and self-reference . . .".

Occasional flashes of this kind give welcome relief from the human-interest magazine style. But the latter also has its moments, not least when McCorduck permits herself to write directly from her own resources of wit and perception. On intellectual fashion:

> No sooner do hemlines go down with enormous fanfare than they go up again, the provinces growing dizzy with trying to keep pace . . . MIT thinks itself stylish, but outsiders have been known to call it faddish. Carnegie-Mellon, on the contrary, represents old-world craftsmanship, attending to detail and using the finest materials . . . . But classic can be stodgy: if Queen Elizabeth of England bought artificial intelligence, she'd surely buy at Carnegie-Mellon.

For those not already members of the AI subculture, the parade of personalities, their doings and sayings, is liable to pall. Chapter after chapter is devoted to attacks by American polemicists of whom the general scientific world has never heard, aimed at targets whose names are scarcely better known, concerning philosophical issues about which few readers will excite themselves one way or the other. Yet during the same period a world-renowned British physical scientist published a concretely phrased indictment of robotics-oriented AI activity in Britain, and this led to its almost total dismantling and dispersal. McCorduck passes over the consequential event with a brief mention: hardly excusable in a serious history.

But McCorduck's book is not offered as a serious history, any more than Aubrey's *Brief Lives* is a serious history of Oxford, or David Niven's *Bring on the Empty Horses* is a serious history of Hollywood. The reader should not come to Pamela McCorduck's whimsically titled book for instruction, or for any deep insight. But by stretching his limbs for a while in her brightly peopled landscape he can assuredly acquire, along with much enjoyment, a feel for the adventures, and the adventurers, of a scientific story at its beginning. □

Donald Michie is Professor of Machine Intelligence at the University of Edinburgh, UK.

Natural illustrations

R.D. Meikle

Nature into Art. By H. Buchanan. Pp.220. (Weidenfeld and Nicolson: London, UK, 1979.) £15.

THE title neatly indicates the scope and object of this handsome volume. It is a concise survey of natural history books with fine, coloured illustrations, for the most part published between 1700 and the middle of the succeeding century. The accompanying text is concerned not so much with the scientific importance of the publications or the scientific exactitude of the plates as with their artistic merit and technical excellence.

To deal with such a vast subject within the compass of 220 pages means, of course, that even the finest illustrators are represented by only a very few examples of their work, while many of the less distinguished must be passed by, sometimes without as much as honourable mention. Selections seldom please everyone, but few are better qualified than Handasyde Buchanan, with forty years' experience of such splendid literature, to judge what must be included, and to decide — a more invidious task — what may be omitted. His choice is well balanced, without being too detached, just as his text is concise without becoming a bare catalogue of facts. The notes on printing techniques will be particularly welcome to those who have puzzled over *del.*, *dir.*, *sculp.* *imp.* and *pinx.*, or who have failed to grasp the distinctions between copper and stipple engravings, mezzotints and aquatints. An appendix of book prices

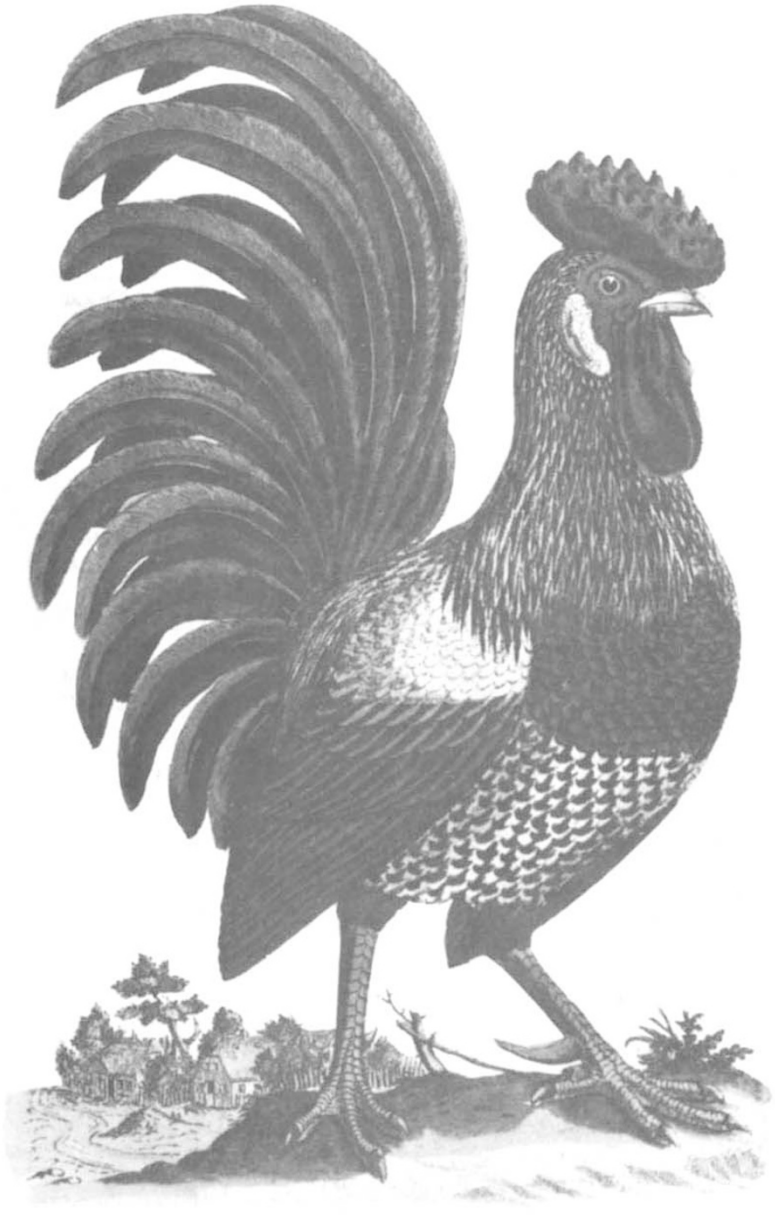

Plate from Johann Leonhard Frisch's *Vorstellung der Vögel in Teutschland*, Berlin 1733–63.

current in 1934 seems, at first sight, to be a catalogue of missed opportunities, until one recalls that, in the same year, a professional naturalist, lucky enough to find work, was considered affluent on a salary of £400 p.a.

Illustrations are essential to the botanist or zoologist, indeed it may be conceded that one good plate is worth a dozen paragraphs of descriptive text, however carefully penned. But it may be questioned if more than a very few of these "grand" works were intended for scientific study. Most were destined for the libraries of those enlightened sections of the gentry who, drawn to the study of plants and animals by the lucid codifications of Linnaeus, sought, in botany and zoology, a pastime less boisterous and bloody than the chase. With few exceptions the text which accompanies such glorious illustration is a sad let-down, even that of the monumental *Flora Graeca*, too often revealing an absence of accurate data, while the *Botanical Magazine* belied its name for a hundred years by serving up what often amounted to little more than the shadow of a commentary.

The relative immobility of plants, and their clear, definite outlines, suited the processes of engraving; indeed, in the hands of skilled engravers, the very limitations of the technique were salutary, and, with the rise of lithography, plant illustration (always excepting the work of W.H. Fitch) too often degenerated into the blurred prettiness of *The Ladies' Flower Garden*. On the other hand, lithography might almost be said to have been made for the softer world of fur and feather. Set against the splendours of Lear and Gould, many earlier illustrations of mammals (and to a lesser degree, birds) have a quaint, almost comical look, even in books like Catesby's *Natural History of Carolina*, where the plant illustrations are perfectly acceptable. Ignorance of animal movement and anatomy was, no doubt, a factor also contributing to the comparatively late development of good animal illustration: the lifeless butterflies which Ehret and his contemporaries scattered so liberally over their botanical plates are, to my mind, an unwelcome adornment, detracting from, rather than adding to, the beauty of the flowers.

So many aspects of *Nature into Art* are pleasing that it seems almost ungrateful to end on a sour note, but I doubt if anyone will commend the extraordinary system whereby groups of legends are referred backwards or forwards to invisible page numbers, a scheme which might have been designed to ensure maximum exasperation and minimum accuracy. Less irritating, because it may have been unavoidable, is the frequent spread of animal plates across facing pages, with a hinge down the middle, breaking the poor creature's spine, and sadly detracting from the artistic effect. These are, however, small criticisms of a book which will delight all those who value a tradition (fortunately still very much alive) which reconciles, in the happiest possible way, the several objectives of art and science. □

R.D. Meikle is a Principal Scientific Officer on the staff of the Herbarium, Royal Botanical Gardens, Kew, Richmond, UK.

Objectives for technology

Steven L. Del Sesto

The History and Philosophy of Technology. Edited by G. Bugliarello and D.B. Doner. Pp. 384. (University of Illinois Press: Urbana, Chicago and London, UK, 1979.) £12.25.

THIS book attempts to locate the problems of contemporary technology within the mainstream of philosophical and historical inquiry. It is the belated publication of a collection of papers first given at the International Symposium on the History and Philosophy of Technology, May 14-16, 1973, at the University of Illinois, Chicago Circle. The event was sponsored jointly by the Colleges of Engineering and Liberal Arts, attesting to the interdisciplinary character of the book and its principal subject matter. The book therefore reflects the essential beliefs of the members of the symposium: that technology plays an increasingly centralized role in our societies and our lives, and that we might study it systematically by way of the substantive and methodological approaches offered by history and philosophy.

To achieve this task, the book consists of some two dozen essays, structured around three sub-headings. The first, the history of technology, contains a number of useful papers clarifying the connections between history, society and technology. Among the papers in this section is an original piece by A.L. Donovan concerning the relationships between science and technological innovation, described by way of an account of the close personal association between Joseph Black and James Watt in the invention of the separate condenser. There is also an insightful paper by N. Rosenberg discussing the complex interactions between technology, society, economy and values; he argues that we cannot predict the consequences of technological change without understanding the values of a society. And finally, some methodological suggestions for studying the relationships between science and technology are advanced by D.S.L. Cardwell and C.S. Smith. Smith posits that the ultimate understanding of invention and discovery depends more on the study of material objects than on the written records which historians generally use, while Cardwell argues that much of physical science as we know it was shaped by man's early industrial experiences, and not simply the other way around as many people believe.

The papers in the second section are grouped under the heading, the philosophy of technology. D. Wojick, for example, shows the utility of a Kuhnian model of scientific change to describe what he calls "technological revolutions" (nuclear power, food additives, and water resources management in the United States are his examples); while M. Bunge gets down to the serious job of characterizing the relationships between technology and the various branches of philosophy: epistemology, metaphysics, axiology, ethics and legal philosophy. In addition, there are papers concerning the relation between modern technology and political theory, as well as essays which trace the history of the philosophy of technology to its early origins. Many papers in this section contribute detailed bibliographical materials that will be quite useful to specialists and philosophers, but are probably less interesting to the general reader.

The book concludes with a section on the future of technology which I found too brief and largely disappointing, perhaps because of the many new developments since the symposium was first held more than six years ago. I would like to have seen the important relationships between technology and social change explored more directly, and there could have been additional material regarding the anticipated affects of contemporary technological enterprises such as electronic message transfer, new biological techniques, computers, and so on. Furthermore, little attention was afforded either to the important issue of technology assessment, or to the areas of alternative technology and technology transfer. What we get are eloquently written but largely familiar statements like "technology subverts human values and impinges upon individual freedom", "we must understand technology to help provide for the continued existence of the human race", and the like. No-one denies the importance of such issues, but serious scholars of technology are apt to find the section on the future of technology less useful than the preceding ones; it is at best incomplete.

Beyond the content and organization of the individual essays, the book as a whole stresses at least two general themes, which seem to have been the central messages of the symposium. First, it is clear that the phenomenon of technology deserves continued, if not more systematic, study by scholars. Comprehensive studies and