consider the status of know how under the Trade Practices Act have failed to develop a consistent approach. Consequently, while much of the detailed exposition in the text is relevant mainly to those with a specific interest in EEC law, the discussion of underlying principles, the comparison between EEC and US laws and the general conclusions of the authors should stimulate thinking in other parts of the world. The text does, however, assume some familiarity with EEC law and is therefore more likely to appeal to the specialist. Even for those with a legal background in intellectual property and competition law, the inclusion of the full text of Article 85 of the Treaty and of Regulation 556/89 would have added to the value of the analysis and avoided the necessity of referring to other sources. This is, nonetheless, a minor quibble. The text is volume 12 in a series of IIC studies devoted to the analysis of particular aspects of industrial property and copyright law. It is a valuable addition to the series; more so because it deals with a complex and uncertain area of the law.

NOTES

1. For a discussion of the general issue on the relationship between intellectual property rights and competition law in Australia see: Trade Practices Commission, Background Paper, "Application of the Trade Practices Act to Intellectual Property" (July 1991); Margaret Ryan, "Copyright and Competition Policy — Conflict or Peaceful Co-existence", (1991)2(4) *Intellectual Property Journal* 206. The American material on the topic is voluminous and includes the following: Note, "Clarifying the Copyright Misuse Defence: the Role of Antitrust Standards and First Amendment Values" (1991) 104 *Harvard Law Review* 1289; L. Kaplow, "The Patent-Antitrust Intersection: A Reappraisal" (1984) 97 *Harvard Law Review* 1813; and Note, "Standard Antitrust Analysis and the Doctrine of Patent Misuse: A Unification Under the Rule of Reason" (1984) 46 *University of Pittsburgh Law Review* 209.
2. *Kewanee Oil Company v Bicron Corporation* (1974) 416 U.S. 470.

David Lindsay
CIRCIT

Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance *by Donald MacKenzie* (MIT Press, Cambridge MA., 1990) pp. xiii + 464, $US29.95, ISBN 0-262-13258-3.

How about this for an opening statement in a book?

> Look out the window of the room in which you are now sitting. Focus on a tree or a building about a hundred yards or metres away. Imagine a circle with your room at its center and that object on its edge.
>
> That circle defines the accuracy of the most modern U.S. strategic missiles. Fired from a silo or submarine on the other side of the earth, then arching up through space, an MX or Trident II missile is designed to deposit its nuclear warheads within little more than that circle. *All this is to be achieved without human intervention beyond the order to fire* (p.1. Italics added).

Does that capture your imagination and draw you into what is a fascinating, illuminating and, at times a pretty scary, narrative?

In this book, Donald MacKenzie (a Reader in the Science Studies Unit at the University of Edinburgh) does three things. Firstly, he provides a thoroughly absorbing history of a technology that has been developed largely behind a veil of secrecy. Secondly, he opens the 'black box' of technology practice to provide an account of the social construction of one component of ballistic missiles, the 'black box' technology of inertial guidance systems. Thirdly, in the realm of action, his analysis provides a basis for challenging the continued existence and further development of nuclear weapons. Let us examine in more detail each of these dimensions of the narrative.

The history of ballistic missile guidance systems is a first, for until *Inventing Accuracy* no single detailed account had been published. The account begins with early considerations (in the 19th century) of the idea of inertial navigation, i.e. a self-contained system that does not require any input from external sources but which internally senses acceleration and the changes of direction of a moving body. It describes Leon Foucault's experiments with the spinning top-derived device he named, the gyroscope, and traces the international gyro culture that developed around this technology in the early 20th century, to initially produce the gyrocompass. The story traverses the development in the Third Reich of guided missiles with gyroscopic control systems which acted to ensure that flight would follow a pre-planned trajectory: the 'gravity's rainbow' of the notorious V-2 rockets. This development was picked up after World War II in the USA, to establish the "credibility of the promise" of inertial guidance systems, and led through a "missile revolution" of the early-1960's to the inter-continental ballistic missile (the various versions of the Atlas, Titan, Minuteman and MX) as a key component in that country's strategic nuclear arsenal. The account does not stop here, but goes on to analyse how the nuclear ballistic missiles in the USA were made increasingly accurate, and then compares the US programs with parallel — but subtly different — developments in the Soviet Union.

Central to MacKenzie's historical account are the political processes through which the developers of 'black box' navigation technology struggled to enlist and mobilise the support of the nation-state. In the post-war USA, a key actor performing this heroic role was Charles Stark Draper, who is widely seen as the inventor of inertial navigation. Draper was an MIT Professor in Aeronautics and the instrumental force in building the Instrumentation Laboratory (later named after him) at MIT into a major state-supported player in the development of inertial guidance systems.

Inventing Accuracy is not merely a historical account; it also provides a sociological analysis which draws on and contributes to the contemporary surge of research in the sociology of technology. The main tenets of this field of study are now well established. One early strand was the critique of technological determinism posed by the social shaping of technology perspective (to which MacKenzie made a significant contribution through the joint introduction to and editorship of a landmark collection of readings[1]). According to this perspective, technologies do not develop autonomously, according to some inner logic, but are essentially social products, the results of complex sets of social, technical, economic and political factors. Another strand has been the application of methods and concepts from the sociology of scientific knowledge to the study of technology, and the opening up of what had most often been treated as a 'black box' in order to examine technology *from the inside* as a

body of knowledge and a culture of practice. More recently, constructivist analyses have gone further and have confronted the complex and messy interrelationships among society and technology. In so doing they have dispensed with mechanistic accounts, based on dichotomous categories demarcated by rigid boundaries (e.g. science and technology, the technical and the social, technology content and social context, etc.), and instead have sought to portray the sociotechnical processes of technological development and implementation in terms of 'seamless webs'.

MacKenzie's account is part of this developing tradition, as two of his constructs illustrate. The first is that the developers of technology are "heterogeneous engineers", who in their work simultaneously engineer or shape the social and the physical. For example, Charles Draper and his Instrument Laboratory not only had to create physical artefacts (the process we would conventionally call engineering), they also had to engineer both the internal social world of the laboratory, so that its staff could effectively carry out this task, and the external social world in order to mobilise material support. The second illustrative construct is stated boldly early in th text: "Technological knowledge is social through and through" (p.11). This viewpoint leads us into the interpretation of technical facts as fundamentally social constructions. But surely, the puzzled reader will ask, there is some aspect of technical fact that is independent of the social world of "... politics and the clash of organisational interests"? After all, technologies are realised in concrete form as physical artefacts (missiles) and these do work (hit their designated targets). MacKenzie's sceptical and rigorous analysis of the knowledge claims and controversies around the testing of missiles shows that matters are not so simple. The "facts" resulting from tests "... are facts only within a wider web of assumptions and procedures" (p.341), and so "... testing should not be expected to close issues of controversy to the satisfaction of all concerned" (p.380). His challenging conclusion is that:

> the more deeply one looks inside the black box, the more one realises that the 'technical' is no clear-cut and simple world of facts insulated from politics (p.381).

Inventing Accuracy explicitly contributes to the realms of theory and praxis. Through demystification it provides an antidote to the passivity and paralysis that derive from deterministic views of the world. The main targets here are the "big determinisms": technological determinism (nuclear weapons development and proliferation is a "... juggernaut out of control, following its own course independent of human needs and wishes", p.383) and political determinism (nuclear weapons development is the result of deliberate decisions by state actors pursuing power or the national interest). Both targets are hit with considerable accuracy by the force of detail in MacKenzie's account. The main manuscript of the book was completed in mid-1989 and the bulk of the account refers to developments that took place in the often hysterical political climate of the Cold War. However, much has happened in the world political scene since 1989 and it would be interesting to project MacKenzie's analysis of the technology into the emerging geopolitical milieu to explore the question: can we return the nuclear weapons genie back into the bottle? In an epilogue (written in mid-1990), with the inspiring title "Uninventing the Bomb", MacKenzie does indeed consider this prospect.

This is an important book, and for me it is one of the must-be-read texts in the social studies of science and technology. For those of us who want to break out of the state of (to use Langdon Winner's term[2]) "technological somnambulism", *Inventing Accuracy* provides a rich source of empirical detail and theoretical insight to be mined and critically reflected upon. It is a darned good read to boot!

REFERENCES

1. Donald MacKenzie and Judy Wajeman (eds), *The Social Shaping of Technology,* Open University Press, 1985.
2. Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology,* The University of Chicago Press, 1986.

Paul K. Couchman
Union Research Centre on Office Technology

Telecommunications Law — Australian Perspective *edited by Mark Armstrong* (Media Arm, Melbourne, 1990), pp. xxviii + 435, $78.00, ISBN 0-731-6-9555-0.

It was H.G. Wells who once remarked that developments in telecommunications represent the greatest single achievement of mankind in 50 centuries. Today telecommunications provides the essential infrastructure for communication and wealth generation in a modern state. The commodity that it conveys is information — the raw material of the modern information economy. More than a century ago in Australia the regulation of 'post and telegraphic services' began. Supported by the constitution this legislation saw Australia through to the point at which information technology revolutionised the capability of the network and when other countries in the international community were embarking on a privatisation programme for network and services provision.

This text contains 22 contributions examining the impact of the changes introduced by the 1989 Act. The preface indicates that the aim is not simply to catalogue the changes but to provide a range of views on the legal developments from which the reader can gain a perspective on what has taken place. Accordingly we have both a descriptive and a discursive text that encompasses the major changes in Australian telecommunication regulation through a series of essays on specific topics. Given the complexity of orchestrating such a large number of contributors, the editor notes that contributions are not written to exactly the same date. However in most cases material was current to late 1989 or early 1990. So how can the non-expert get into this book and what would his/her purpose be? I think at one level the book does provide good specific coverage of the legislative changes that have taken place but it also purports to go beyond that, explaining the consequences of these changes in economic and social policy terms. The editor also remarks that the book can be used as a ready reference where the reader requires information on a specific point.

The preface indicates that the chapters are arranged thematically but the theme involved that determines this is not explained. Broadly speaking, however, the first half of the contributions concern the background and context to the reforms