Book Reviews

High Technology and Less-Developed Countries

Technological Trends and Challenges in Electronics. Dominance of the Industrialized World and Responses in the Third World. STAFFAN JACOBSSON and JON SIGURDSON, Eds. Research Policy Institute, University of Lund, Lund, Sweden, 1983. xvi, 314 pp. Paper, SEK 95.

This book considers some of the implications for less-developed countries (LDC's) of recent economic and technical trends in electronics. The work consists of nine papers, many of which reflect fieldwork in LDC's. The papers focus mainly on developments in robotics, computers, numerically controlled machine tools, and computer-aided design and manufacture (CAD/CAM).

The work starts on something of a plaintive note. Most R & D expenditure and production in electronics take place within companies that are based in the more developed countries. This pattern is sometimes supposed to harm the LDC's, by widening the international technological gap in this industry and in other, more pervasive ways. The economics of the latter, however, are not clear. R & D expenditure, per se, is a cost, not a benefit. Firms at the technological frontiers in the more developed countries undertake such expenditure if they find it to be their most profitable strategy for expansion. By contrast, companies in the LDC's are often not at the technical frontiers and have access to profitable investments that draw on the existing stock of technology. Consequently, it is not surprising that LDC's spend proportionately much less on R & D than do the economically more advanced countries. Further, there is no basis for assuming that LDC's face monopolistic conditions when they attempt to purchase advanced technology in the world market. On the contrary, even for products like integrated circuits, the present study (pp. 34–35) documents the participation of numerous firms, under conditions that generate serious rivalry and a competitive market structure.

The papers are more helpful when they focus on likely effects that the new technologies may have in specific industries. The availability of cheap numerically controlled machine tools makes it possible in many cases to substitute semiskilled operatives for highly skilled machinists. Experienced and highly trained industrial workers are often at a premium in LDC's. The new technology may permit LDC producers to relax skill constraints and hence to expand output (and employment of complementary workers) more rapidly.

The book also raises the prospect of effects that harm the LDC's. Thus developments in robotics, microelectronics, and CAD/CAM may enable firms in the more developed countries to raise their productivity dramatically and compete much more effectively in the manufacture of products that are of major interest to LDC exporters. Engineering products and garment production are discussed as two likely possibilities. In the latter case, however, it is made clear (pp. 86–92) that, quite apart from a high cost of capital, serious organizational and informational rigidities impede the adoption of the new technologies by garment producers in the more developed countries. Indeed, adoption may be easier in LDC's, which can benefit from centralized industry planning as well as a relative absence of vested interests in the older production techniques and their social relations. An important caveat is in order, however. If LDC's are to realize the full productivity gains that the new technologies permit, it is essential that the more developed countries keep their markets open to exports from developing countries.

Three papers consider the possibilities for an LDC that would like to promote domestic production of the new technologies. Case studies of India, mainland China, and Argentina are presented, with occasional observations on Brazil. (Surprisingly, the case of Israel was not studied, even though that country has had one of the more successful experiences in developing production of advanced-technology goods.) As the discussion makes evident, the presence of a large number of able scientists and engineers is not a sufficient condition for promoting a local industry in these activities. Special problems are presented by extremely rapid technological change, by short product cycles in design, and by the importance of economies of scale—and therefore large volume—in production. The case studies demonstrate that fostering domestic production behind import restrictions does not necessarily lead to a happy outcome. Because of the short product cycles that characterize many activities in electronics, unselective import substitution can have especially negative welfare effects. An LDC can easily saddle itself with protected, high-cost firms that produce obsolete products. As a result, the rest of the economy is denied access to the continuing flow of productivity increase that the electronics industry's rapid technical progress elsewhere makes possible.

As indicated, this book provides interesting and informative material on important recent and prospective developments. Another feature is also noteworthy. Almost all of the authors are associated with the same two institutions (the University of Sussex and the University of Lund), and they approximate a "school" with shared assumptions concerning the subject. Such conceptual homogeneity among researchers often helps promote analytical progress. However, a relatively closed circuit of self-sustaining views can also stifle alternative perspectives. The book's concluding chapter, by Andrew Jamison, notes the presence of such paradigm block in the present case. The analytical consequences of such conceptual blinders can be far-reaching.

Thus the book devotes little discussion to the possibilities of developing electronic production in LDC's by utilizing direct investment or licensing agreements with multinational corporations. That omission may stem from an ideological perspective that considers the presence of foreign firms to be inconsistent with "true" development. Such an approach is common among many observers who specialize in the Third World. However, instituting arrangements with multinational corporations may in fact be one of the more viable options open to an LDC government in this area. The failure to consider that option systematically reduces the usefulness of the book to LDC policy-makers who would like to increase their countries' share of the net benefits in dealing with multinationals.

Similarly, the preoccupation with promoting R & D and production of modern electronics sometimes prevents the authors from seeing other aspects of the development problem. Thus, in India the "small-scale" industrial sector has played an important role in producing electronic components. Moreover, that

sector's labor-intensive production techniques create numerous jobs and seem to approximate the "appropriate technology" that United Nations development specialists advocate. Nevertheless, because this output is not identical to that produced by large, capital-intensive firms, one paper recommends measures (p. 277) that would in effect destroy the small-scale sector.

Likewise, the authors give little attention to the possibility that promotion of local electronics production may impede the achievement of other important development objectives. The technical and administrative resources available to an LDC at any point in time are usually limited. A decision to allocate those resources to a local electronics industry may mean that less R & D is done on domestic food production. Electronic technology can be imported, and usually from a number of competitive suppliers. By contrast, agricultural know-how is ecologically and geographically specific and must be developed locally. Hence an LDC may face a trade-off in which promoting domestic technical capacity in electronics involves high costs in terms of local agricultural development. Only one of this study's ten authors even mentions this trade-off. The others seem to have adopted a technological-prowess rather than a human-welfare view of development.

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Compact Objects

Black Holes, White Dwarfs, and Neutron Stars. The Physics of Compact Objects. STUART L. SHAPIRO and SAUL A. TEUKOLSKY. Wiley-Interscience, New York, 1983. xx, 646 pp., illus. $39.95.

The story of the discovery of compact objects—white dwarfs, neutron stars, and (still controversial) black holes—has been widely recounted in astronomical texts and popular books. There is general understanding of how these stellar corpses can be resurrected by simply pouring gas on them or letting them spin. This is one of the great successes of contemporary astronomy. However, so incessant and superficial appear the claims for new black holes and pulsars that the bystander might assume that the subject has rather feeble physical underpinnings. Not so. Neutron stars and black holes were seriously discussed by a distinguished series of physicists and astronomers (including one of the 1983 Nobel laureates) long before there was any observational evidence for their existence. White dwarfs were correctly interpreted within months of the formulation of Fermi-Dirac statistics. For over 50 years compact objects have fascinated scientists who have found in them arenas for the discovery of new effects through the application of physical principles under extreme conditions. It is extraordinary just how many of these effects are actually observed.

Black Holes, White Dwarfs, and Neutron Stars is the first serious textbook to consolidate this research. The authors, both active researchers in the field, have taught a graduate course on the subject at Cornell for several years. The book is firmly based in fundamental physics and observational astronomy. The equation of state for a degenerate electron gas is derived in considerable detail and then used to construct white dwarf models; likewise for the equation of state at nuclear densities and neutron star models. Cooling rates, which dictate the luminosities of isolated stars, are then calculated carefully. A short chapter on general relativity (possibly unnecessary in view of the excellent textbooks available) precedes a concise treatment of the standard results on the geometry of black hole space-times. The observational status of all three types of star is critically examined, and the reader is left in no doubt about the reality of neutron stars or, in contrast, about the genuine uncertainty that still lingers around the best black hole candidate, Cygnus X-1. Perhaps the most celebrated recent observational success—the quantitative confirmation of the general relativistic prediction of orbital decay through gravitational radiation in the binary pulsar PSR 1913 +16—is clearly described, and the incomplete but potentially just as decisive theory of stellar collapse is carefully outlined.

The book can be unreservedly recommended as a graduate textbook as well as a researcher's vade mecum. Among its many strong features is a consistent and clear distinction between generally accepted and applied theory, such as the Kerr metric, and still-controversial issues, such as the equation of state above nuclear density and pion condensation. There are over 250 exercises, many of which involve numerical solution—excellent training for the student. (This reviewer found the answer to a current research program worked out in one of them.) Basic principles are emphasized throughout by well-posed questions carefully answered and by an avoidance of some of the softer and possibly ephemeral lines of inquiry. The historical development of the subject is carefully sketched.

Of course, there are omission and superfluity. The subjects of surface effects on neutron stars and settling in white dwarf atmospheres are curiously absent. The difficult subject of radio pulsar emission mechanisms is largely, and probably wisely, avoided. The chapter on supermassive stars is quite out of place and is a poor reflection of contemporary research on active galactic nuclei. However, these are minor stylistic issues that cannot detract from the book's overall clarity and accuracy. "Astronecroscopy" flourishes and is well served by this excellent textbook.

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Austral Botany

Flora of Tierra del Fuego. DAVID M. MOORE. Line drawings by R. N. P. Goodall, Flora Patagónica, and S. Parkinson. Anthony Nelson, Oswestry, Shropshire, England, and Missouri Botanical Garden, St. Louis, 1983. x, 396 pp. $99.

Tierra del Fuego is one of the most remote areas of the world, climatically inhospitable and sparsely populated. Known to the public mostly from sporadic border disputes between Argentina and Chile and perhaps from stories of tall ships inching their way around Cape Horn, Tierra del Fuego has not been a focus of intensive botanical research. The publication of a current flora of the area is a scientific achievement in its own right. However, the importance of this work goes beyond this. Oil drilling is under way in Tierra del Fuego, and the population is increasing. Comprehensive ecosystems studies are needed to predict the degree of damage to the Fuegian environment that might occur and to find measures to keep the perturbations at a minimum. Moore's *Flora of Tierra del Fuego* provides a basic tool for such studies.

Several aspects of this flora are outstanding. For example, there is a table that summarizes the chronology of plant collections in the area that makes fascinating reading. One can sense the difficulties the first explorers experienced when they collected their specimens and assembled their plant presses. Not only names of collectors are given but also dates of visits, collecting areas, and the