of printing. From one of these, the US rubber industry discovered koresin, the tack-producing agent required for synthetic rubber. But most technology acquired, and the most valuable part, was probably never described in public reports. That went direct to US firms which had sent employees, dressed up as colonels, specifically to acquire it. Gimbel gives dozens of examples of the intellectual property stolen by individual American firms.

One feels for German companies encouraged to reconstruct themselves by official allied policy for German self-sufficiency, and yet subject to other policy which stripped them of any technology of any value. For example, the metals and chemicals firm, Degussa, received 200 visits from investigators in one year. Bosch was visited 73 times in February 1946 and over 100 times in March. Their only compenstion was the cost of reproducing documents. Failure to co-operate might have attracted accusations of Nazi sympathy and would certainly have dashed the hopes of individuals seeking employment in the United States. The United States was somewhat slower than her allies to appreciate the value of the human container of information. Immigration to work for US industry was arranged, even for ex-Nazis, but Truman proved reluctant to stimulate what he called "competition for our own home boys".

What Gimbel has given us is a thorough account of technological carpetbagging in the chaos of postwar Germany. With the return of some semblance or order, brigandry sanctioned by government was no longer acceptable. What, one wonders, became of all the technology seized by American privateers? What happened to all that taken by the British, the French, and the Russians, who seem to have been equally active? And how, having divulged its key technology, did Germany manage its economic miracle? Interesting questions, but beyond the scope of *Science, Technology and Reparations.* Gimbel, though, has allowed them to be asked and has prepared sound foundations on which others may eventually construct some answers.

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Setting Directions for Australian Research *by the Australian Science and Technology Council*
(AGPS, Canberra, 1990), pp. xvi + 94, ISBN 0-664-12379-6.

Technology Strategies in Australian Industry *by The Centre for Technology and Social Change, University of Wollongong (Ron Johnston, Don Scott-Kemmis, Terry Darling, Fran Collyer, David Roessner and John Currie),* (AGPS, Canberra, 1990), pp. vii + 89, ISBN 0-644-12441-5.

Small Country, Big Science *by the Australian Science and Technology Council*
(AGPS, Canberra, 1990), pp. viii + 60, ISBN 0-644-11982-9.

Increasingly over the past few decades, firms and governments alike have come to see themselves as actors striving to achieve objectives in an environment of

threat and opportunity, sustained by their strengths but hobbled by weaknesses which can only gradually be remedied. The paths to achieving their objectives are their strategies, but given their strengths and weaknesses, they have to select among candidate routes to identify the most promising. This is strategy formulation.

While strategy formulation as a general approach to decision-making has now been around for some time it is only rather recently that attention has started to focus on how to use science and technology to meet corporate and national objectives. Two of the three titles here are about devising research and technology strategies in Australia, and the third deals with a rather specific aspect of how such strategies might operate.

Setting Directions for Australian Research is ASTEC's response to a Prime Ministerial commission to define the R&D environment in Australia, to assess the need for setting priorities in R&D, and to say how priorities might in principle and practice be set. In an important sense this is all about the formulation of a national research strategy for Australia, though principally in relation to government funded R&D, which comprises about two thirds of the total.

The word 'national' is important here, for ASTEC deliberately distinguishes between guidelines drawn up at this highest level (by Cabinet), and the priority setting carried out by government departments (CSIRO and the like) or the detailed comparison of one project with another undertaken by the ARC or individual universities. ASTEC focuses on the national level since it perceives there to be a gap here where there could instead be a statement identifying needs and opportunities within which departments and agencies might then be responsible for setting their own more detailed priorities. This is a gap ASTEC believes should be filled.

That filling the gap amounts to an exercise in strategy formulation is shown by the useful analogy that the report offers with the operation of a research based corporation (p.55). Setting national directions or research, says the report, is analogous to preparing a business plan for such a firm. In that framework, the context is set by national goals, both short- and long-term. And later we are again told that the purpose of the exercise is to help fulfil the government's overall policy objectives (p.69).

Elsewhere in the report we are reminded that the ill-fated National Technology Strategy (May, 1985) specified socio-economic goals, principally aimed at increasing Australia's international competitiveness, as well as objectives related directly to science and technology themselves (pp.19-20). The failure to implement the National Technology Strategy reflects an ambivalence towards longer term planning in the bureaucracy, says ASTEC, and I am inclined to wonder whether the language of priorities and direction-setting in the report (avoiding the use of strategy *per se*) is an attempt to escape association with an unsuccessful predecessor.

ASTEC are also anxious to avoid being accused of promoting the narrow cause of 'picking winners', arguing that decisions about thematic priorities work best at the departmental and agency level. What they say national direction setting actually means is addressing structural priorities — such as the health of science, technology transfer, the R&D workforce and training, the appropriate balance between basic science and applied research, or between directed and undirected research (p.55).

As a guide to action, I find the presentation of this interpretation less than transparent — but perhaps that does not matter, for when the report gets down

to saying how the job should be done, we are back on familiar ground. In the process of priority setting the report emphasises intelligence gathering, data analysis and consultation as crucial. But what is the information to be gathered and processed? It turns out ASTEC have in mind information on scientific and technological advances, challenges and opportunities throughout the world, and the analysis of local strengths and weaknesses in responding. This sounds very much like gathering information to formulate a strategy which is after all related to thematic priorities.

ASTEC's favoured mechanism for setting directions is a quadrennial White Paper, the first of which is planned for May 1992. The report considers a variety of alternative approaches but argues that the White Paper provides a formal mechanism or debate, an authoratative basis for implementing government proposals and has the advantage of being familiar within the Australian context. To give the White Paper the authority, legitimacy and credibility the report says the process needs in order to work, it suggests ASTEC should consult with the community to put together an Issues and Options paper (this is already in hand), that a draft be prepared by the Co-ordination Committee on Science and Technology, and that the Prime Minister table the paper, with the endorsement of his Science Council. The whole process would be integrated with the Budget cycle.

Drawing on international and local experience of devising national research guidelines, this is an ambitious and carefully structured attempt to get long term planning for at least government funded R&D considered in a systematic way. But when it comes to writing the White Paper, it is hard to believe that the thematic specifics with which ASTEC appeared uncomfortable will, after all, be missing. In fact, in a background paper calling for submissions to the Issues and Options document ASTEC are quite explicit in saying that the White Paper "will address the problems Australia faces (such as sustainable development, innovative manufacturing) . . .[and] will also contain a forward looking element to alert decision-makers to likely new research directions, technological advances and social implications"[1]

The report thus tries to lead us away from the temptation of simply drawing up lists but, it has to be said, never quite defines what is the alternative. I suspect we shall finish up with a hybrid.

Technology Strategies in Australian Industry is much more concerned with what is than what might be. Its objectives are to review the significance of corporate technology strategy, to examine its use in Australia, and to assess the impact of government policy in changing companies' strategies.

To achieve its aims, a project team from the Centre for Technology and Social Change at the University of Wollongong surveyed the incidence, content and management of technology strategies in the communications and food processing industries, and in large Australian R&D performing firms. The report quotes Dodgson[2] in defining a technology strategy as "an understanding within a corporation . . .of the importance and potential of technology for its competitive position, how in future this potential is to be realised, and how this complements the other aspects of strategy such as finance, marketing and personnel" (p.8).

The team found the level of adoption of technology strategies in Australian industry was low by international standards — but the rate of adoption over the past three to five years was high. In their samples, 80 per cent of large communications firms had adopted, but only 40 per cent of small firms and 35 per cent of firms in the food processing industry. How important this is

depends, of course, on the relationship between technology strategies and commercial success with innovation. The report again cites Dodgson in arguing that while unambiguous links are impossible to identify, significant advantages do flow to firms with appropriate strategies.

While the effect of technology strategies cannot (yet) be known with confidence in Australia, the report gives a good idea of what firms' strategies look like. Small firms were usually more aggressive than large ones and had strategies designed to get them first into the market with new products. Much larger firms designed their strategies instead with an emphasis on avoiding risk — though they sensibly enough focused on building on previous success to meet identified market needs. But there are changes afoot. Technology strategies adopted in the last two years by firms of all kinds have been driven by taking the offensive, particularly in foreign markets.

All this suggests that firms are increasingly making a conscious effort in Australia to harness technological advance for their competitive advantage. But there is still a way to go. The team finds that the most important source of technology for local firms is in-house development and engineering. (I wonder how much weight the 'not invented here' syndrome still carries?). This is useful up to a point but denies firms the additional flexibility they would acquire by looking farther afield. In particular, the report suggests the importance of developing stronger links with public sector research organisations.

Small Country, Big Science is another report from ASTEC, but much more narrowly focussed than *Setting Directions for Australian Research.* It examines the need of Australian scientists for access to major research facilities unavailable locally because of their very high cost — with particular attention to synchrotron light, neutron scattering and high energy physics. In all, it recommends spending $8.5 million over three years on gaining access to research facilities in Japan, France and Switzerland. And it also recommends setting up an advisory committee to co-ordinate Australian participation in major international scientific research facilities.

The report spells out in detail potential industrial applications of new knowledge which might be gleaned from participation in work at centres abroad. But it cannot, of course, put dollar values on these expected benefits — and is also honest enough to admit that at CERN, for example, Australia's role will always be small. While not denying the potential commercial advantages, therefore, I am inclined to believe that participation in this work will offer as its main benefit a conduit of information which will help sustain the vitality of the scientific community in Australia — which, in turn, will sustain its longer term capacity to respond to local needs.

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