demonstrated that in any European conflict, with 1,000 tons of nerve gas used each day by both sides, civilian casualties would be counted in millions and the ratio of civilian to military casualties would be 20:1. While biological weapons are generally discounted for use on the battlefield — nerve gases act much more quickly — the authors of *No Fire No Thunder* do not ignore the "social repercussions" of CBW warfare, including the overwhelming of medical services and the breakdown of public order, not to mention the appalling consequences of the use of biological weapons in sabotage actions. I do not regard this as scare talk: consider the death, havoc and tribulations brought about with the deliberate random poisoning of a patent medicine in the United States, a small instance of what might come to pass.

If this were not enough, Chapter 8 outlines further developments in CB weapons, with discussion of the military exploitation of genetic engineering, bringing with it the possibility of "rampant pathogens and large-scale production of both known and new toxins". According to the authors, the search is on for "undercover tactical agents" specifically designed to debilitate the opposition. Nor does the work on chemical agents stop, with US binary munitions including a new agent crossed between Sarin and VX, "modified soman" (EA5774), and growing interest in civilian control agents.

The authors conclude, not implausibly, that both the United States and Soviet Union envisage operations in Europe which will be chemical as well as nuclear, though rational argument would suggest that no appreciable strategic or tactical gain can accrue from increasing CW arsenals. Yet the burden of Chapter 5 — on military scenarios — is that there is appreciable operational advantage to be gained from CW and serious potential in BW for sabotage and disruption. The last chapter takes the form of an impassioned appeal for chemical disarmament, for a "CW-free Europe" propounded by a pan-European movement: with Britain "a nuclear and chemically disarmed country", the authors go on to admit a need to consider the defence of the population against any chemical attack. I should have thought that might be considered even now, though politically it is ruled out if only because it raises the whole question of population protection, as opposed to shelter for select élites.

Meanwhile this timely, coherent and highly informative book should receive very wide attention: it is not comfortable reading but it is highly urgent reading, even for those who might think themselves informed on the subject. □

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Radiating sense

K.V. Ettinger and
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Nuclear Radiation: Risks and Benefits.

By Edward Pochin.

Clarendon: 1983. Pp.197. £17.50, \$32.50.

... The B vocabulary consisted of words which had been deliberately constructed for political purposes, that is to say, which not only had in every case a political implication, but were intended to impose a desirable mental attitude. ... (George Orwell, *Nineteen Eighty-Four*).

THE complete edition of *Newspeak B Vocabulary* is not available through the book trade and we are not certain whether the expression "radiation protection" is a part of it. But whatever the gestation of this term, it served perfectly well to calm the minds of Project Manhattan workers, who, as we know nowadays, were on many occasions exposed to doses of radiation which would be unacceptable today.

Edward Pochin's *Nuclear Radiation: Risks and Benefits* serves as a reminder that a large part of radiation protection is just monitoring doses of radiation received by individual radiation workers, and that "protection" is afforded by the legislative process which itself is in part a function of public sensitivity on the matter. So that the reader may arrive at an informed comparison between risks and benefits of ionizing radiations (not only nuclear, as the title implies), the author gives a detailed exposition of the techniques of radiation measurement as well as an account of the amounts of radiation which we receive from natural and man-made sources. And so that the deleterious effects of radiation are understood, there is a good review of the relevant parts of radiobiology. The counterbalancing of risks and benefits is not discussed in quantifiable terms, however, simply because such analysis is not available as yet; after all "the quality of life" is not easily reduced to numbers.

Instead, in his final chapter Pochin provides a careful comparison between risks (expressed in number of deaths per

Nuclear power

Oxford University Press have issued a major reference work in three volumes, *Nuclear Power Technology: The State of the Industry*, which (according to the publisher) "will provide the scientist and layman alike with a comprehensive and up-to-date reference on all aspects of nuclear power".

Editor of the work is Walter Marshall, Chairman of the Central Electricity Generating Board, and the contributors are all specialists drawn from the industry itself. Titles of the individual volumes are: *Reactor Technology*, *Fuel Cycle* and *Nuclear Radiation*. Price is £35, \$65 per volume.

100,000 per year) for various occupations and for workers exposed to cancer-causing agents, and also gives the general number of fatalities due to accidents. This comparison indicates that it is a valuable exercise to analyse avoidable risks in many industries and, as a corollary, to get rid of those technologies and agents which needlessly contribute to the misery, high death rate and sickness of people exposed to them. Again, however, it is extraordinarily difficult to weigh the risks against the benefits of these factors in precise terms since we are often dealing with a situation in which industry benefits financially from the technologies it uses — the risks are borne by the employees personally and by the state fiscally, but how do we compare individual risks with community benefits or vice versa?

Be this as it may, and despite the fact that Pochin's tables indicate that radiation hazards are not the top priority if resources are limited, for many the conclusion to be drawn from the book is that positive action is needed: a determined effort to reduce and even eliminate the use of ionizing radiation in all circumstances in which it can be replaced by other agents. Recently developed analytical techniques, both chemical and physical, offer the possibility of replacing radioactive tracers by stable compounds. Many of the gauges used in industry for measurement of thickness, moisture content and so on can be replaced by instruments based on other techniques, and it is worthwhile examining alternatives to industrial radiography. A similar approach has already been taken in the field of medical applications of radiation and radioisotopes. The use of nuclear magnetic resonance for tissue imaging is making fast progress and the population-averaged radiation doses from medical radiology, which according to Pochin exceed those from radiotherapy, should be gradually reduced to the unavoidable minimum. Obviously, the nuclear industry, and particularly the nuclear power industry, are the cynosure of the public eye in this respect, and the subjects of a broader debate.

The book is well and smoothly written, with a sense of wry humour, though it sadly lacks extra drawings, photographs and graphs which could have made the going so much easier. Those illustrations which are included seem to be the end result of some random selection. Nonetheless the book can be certainly recommended to those who are concerned with the effects of ionizing radiation, whether professionals or laymen. They will acquire an excellent source of information, impartially presented. But it will not serve everybody equally well. After all, it was Winston Smith who said: "Ignorance is strength". □

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