

contains more than enough fissile material to cause a nuclear explosion does not make every fast reactor a potential bomb.

The most likely sources of potential hazard are, on the contrary, mundane — the apparently devilish capacity of liquid sodium to work its way through leaks and cracks, the formation of vapour bubbles in the circulating sodium which can increase the reactivity of the system (at least if it is physically large enough) and the possibility of chemical interaction between liquid sodium and fuel cans or impurities (such as water). The most likely source of criticality problems is not the formation of a single critical mass of fissile material but, rather, mechanical oscillation within the reactor core which, on paper at least, may be symmetrical enough to set in train a sustained and rapid increase of reactor power. The fact that the nuclear reaction involves fast (1 MeV or so) neutrons rather than thermal neutrons is not in itself a source of potential hazard. The power density of the system (400 W per cm³ in Super-Phénix) does, however, carry heat-transfer engineering into a novel field, while the use of liquid sodium as a heat transfer medium presents another set of once unfamiliar problems. On balance, however, there is no reason to dispute the claim of the nuclear engineers that individual fast reactors need be no more hazardous than conventional reactors. In Britain, the intended public inquiry, unfortunately now delayed at least until 1985, will provide sceptics a splendid opportunity to test the proposition.

Fears that fast reactors mean a greater risk of proliferation are less substantial, and should now be exorcized. The argument is

that if plutonium is separated from spent fuel from thermal reactors, stocks of plutonium will increase as will the opportunities for theft and illicit diversion into bomb-making. In its simplest form, the argument perversely overlooks the simple truth that reprocessing facilities are at present few and far between. The bomb-making states, anxious as they are that the nuclear club should not be enlarged, control the only substantial plants now in operation. Others, even that being built in Brazil, are under international control. India is the exception that proves the rule — its reprocessing facilities are uncontrolled, but their capacity is small. In the past year, and especially in the wake of the International Fuel Cycle Evaluation, there has been much talk of internationally operated reprocessing facilities.

Such schemes, imaginative though they are, are not, however, the most urgent needs in the international effort to control proliferation. Certainly the pace of fast reactor development now on the cards is not going to increase the opportunities of governments to join the nuclear club, at least in the remainder of this century. Moreover, given that such plutonium as fast reactor programmes will produce will accumulate in the stockpiles of well-ordered states (and will also, not doubt, be put back into fast reactors as quickly as possible) there is no reason to think that the chances of illicit diversion will be proportional to the total quantity of plutonium in existence. Safety, in brief, is something to worry about. The risk of proliferation at least for the time being, is not.

Technical innocence in the public service

With much of the British Scientific Civil Service still seething over the pay settlement for this year (*Nature*, 24 July), the Civil Service Commission on Tuesday went some way to acknowledging that scientists in the Civil Service often have a raw deal. The publication of the *Review of the Scientific Civil Service (1980)* (Cmnd 8032, HMSO, £6.10), prepared by a group of officials with Dr Martin Holdgate, Chief Scientist at the Department of the Environment, is not pure emollient, however. The remedies which the review suggests, valuable as far as they go, do not touch the problem which many people (not only scientists in the Civil Service) consider the most serious — the continued separation of scientists (and of other professionals) from the Administrative Group, the body chiefly responsible for the formulation of policy within the British government and within which true mandarins grow up. Although, at the higher reaches of the Scientific Civil Service, a handful of posts are considered as "open" grades, it is inevitable that for most people in the public service the Holdgate review will seem to rub salt in open wounds. So too will the date in parentheses at the end of the title, which is an awkward reminder of how often the question has been considered, and to how little effect.

The case for a merger of scientists (and others) in the public service with the administrators is not to feather the nests of scientists, nor to ensure that each and every one of them can look forward, from the beginning of his career, to being a powerful head of a Department of State, with a briefcase and chauffeur to match. Many scientists would in any case prefer to avoid that path. The need is rather that the public service as a whole should be more able to understand the problems of a technical character with which it has increasingly to battle. The Holdgate review acknowledges this need at the outset of its report. It goes on to record the failure, in the past few years, of the schemes devised to help scientists transfer from their ghetto to the Administrative Group. The explanation is, of course, straightforward. Scientists in early or mid-career do not relish giving up their science to become administrators. Afterwards, it is often too late. The Holdgate remedy is that, in planning people's careers in the Scientific Civil Service, care should be taken that promising people should be given training in the "management skills" supposed essential to administration. The trouble is that without a common understanding throughout the public service that posts

as administrators would be found for those wishing to transfer, more training may simply mean more frustration. In any case, for as long as most of those responsible for policy-making persist in their innocence of technical questions, the public service will be less effective than it needs to be. This broad question is outside the terms of reference of the Holdgate review, for reasons which are not necessarily sinister. Nobody should forget that it is the question most in need of answering.

If tinkering with the present system can help, however, Holdgate and his men (*sic*) have some useful things to say, especially on the careers of scientists in the public service. Scientists need to know more clearly than at present what their career prospects are, and to be helped (if they wish) to broaden them. Merit needs to be rewarded, especially in those following less glamorous careers such as the provision of technical services. Decorously, the report skirts round the issue of pay, and also timorously accepts that probationary and fixed-term appointments to the Scientific Civil Service would be impracticable. The truth is that they would be unwelcome, which is another matter. The review comes close to acknowledging the need for a more effective scientific contribution to general policy with its plea (to the administrators) that they should more openly look for and welcome scientific advice within the public service. We shall no doubt see (or not see) what happens

What will happen now? The Civil Service Department (responsible for employing all Civil Servants) will urge everybody in sight to follow the Holdgate recommendations. After a few months, or a few years, this review will join its predecessors in the archives of British public administration. The innocence of the Civil Service as a whole of what the modern world is like will be found to persist. It will be forgotten, then, that the Holdgate review included within its terms of reference the question of what the Scientific Civil Service is for; its report dutifully includes a list of the duties scientists in the public service perform. Now and again there is a hint that the committee of officials knew it was avoiding a crucial issue — and the recommendation that research establishments might be decentralized may absolve it of some blame. But is it not high time that somebody asked seriously how best 17,000 of the most highly qualified scientists in Britain should serve the public interest? Influencing policy is one thing. Making government research establishments more useful is another.