would be evacuated. Jet aircraft would be disallowed. And so on.

The truth, of course, is that the principle that radiation exposure is best avoided is not now, and never can be, absolute. Merely to rationalize present patterns of life, people have to acknowledge that the heavily loaded part of the premise must be extended somehow, perhaps to read "should be avoided whenever possible" or, more tangibly, "should be weighed in a cost–benefit calculation and then, when the costs exceed the benefits, avoided". The snag for the simplifiers is that any such qualification undermines the logic of the syllogism. Only if the interdiction of radiation exposure is absolute does the conclusion follow that nuclear power stations must never be built. In all other circumstances, the most that can be said is that the benefits of nuclear power must be weighed against the costs, one of which is the potential damage done by radiation exposure, both as a matter of routine (to workers at reprocessing plants) and after accidents (as at Chernobyl).

All this is familiar stuff. For thirty years, those who build (or would build) nuclear power stations have been saying just this. It may be true that, for much of that period, the professionals have been less than frank about the potential scale of the hazards, but nobody has sought to conceal the need for a rational trade-off between risks and benefits. What Chernobyl might rationally have accomplished is a demonstration that, within a well-run nuclear programme, the avoidance of major reactor accidents deserves even more attention than it has received since the close attention given to the problem by the monumental Rasmussen study just over a decade ago. It is also possible to argue that it is worth paying something extra to avoid self-imposed risks, such as those unavoidably attending a nuclear industry, on the principle that there is a difference between unavoidable sources of risk (cosmic rays, for example) and those that are self-imposed. Yet even that seductive argument leaks. By what tests is it virtuous to claim (as the British Labour Party now does) that nuclear power should be replaced by coal when one of the few certainties in the trade-off is that many more miners will be killed per gigawatt-hour in the coalmining industry than members of the public by exposure to the radiation accompanying the routing operation of a nuclear industry?

If Chernobyl and its consequences were to lead to a more public re-examination of these questions in the countries where nuclear power is potentially an economic benefit, nobody would complain. The trouble is that the accident has come at a time when the populations most likely to need nuclear power in the decades ahead have been dissuaded from regarding the issues calmly by siren voices seeming to proclaim that there is such a thing as a free lunch — electricity without the risk to those who consume it. The sad truth is that governments are often unwittingly the abetters of these seductive propagandists, as when European governments band together to settle on a limit for the contamination of imported foodstuffs that provocatively plays over-safe. They seem not to have appreciated that, by taking such a line, they have gone a long way to accepting the loaded premise of the false syllogism which will be used against them when they plan to build a nuclear reactor. Is it too late to ask that they should mend their ways? □

Teaching by numbers

A British committee has produced an enlightening report on future trends in education.

WHAT is the difference between a teacher and a teaching machine? This question, widely asked in the sense pejorative of teachers a decade or more ago, has usually been answered by the claim (usually on behalf of teachers) that even the best teaching machines are merely mechanical, incapable of firing the imagination and the aspirations of students. For the most part, the teachers' case has been vindicated by the appalling quality of

what has previously been passed off under the label of educational technology. Some teaching machines have been literally machines whose mastery required not merely skills available to, say, high-school students, but those of ambidextrous conjurors as well. Others have looked like books but have been seen, on casual inspection, to be ways of drilling students in lessons which it is possible, but inappropriate, to learn by rote, leaving the real work to be done by real teachers. It is no wonder, that after a brief fashion for educational technology in the 1960s, the exercise should have been discredited. But equally, now that professional people are agog with the idea that "expert" systems should be used as aids to judgement in fields as different as medicine and engineering, it is natural that the old claims of educational technology should be dusted off and re-examined.

One result, in Britain, is a sensible slim document by a government committee called the Information Technology Advisory Panel, set up when Mr Kenneth Baker, now Secretary of State for Education and Science, was the British government's cheer leader for the information revolution. One irony is that most of the panel's recommendations urge that the government should spend money on investigation and research on the application of information technology; Mr Baker, in his new role, would have to foot the bill. Another is that the panel was subsumed last April in another government committee, the Advisory Committee on Applied Research and Development, whose most recent public report some weeks ago consisted of an extended wringing of hands over the parlous condition of the British software industry, from which many of the defunct panel's members spring. Yet, curiously, the panel's report (*Learning to live with IT*, HMSO £4.00) is just the judicious blend of enthusiasm for change and caution about the means by which it may be accomplished that endears a committee to its discriminating followers.

On the leading question, not directly answered by the panel, the difference between a teacher and a machine is that the teacher alone can serve as an intelligent critic of an individual student's learning. Machines, of course, can automatically assess a student's performance by criteria written in their programs, providing reinforcement exercises whenever these seem necessary. But even as machines are now, or are likely to be tomorrow, there is only a poor prospect that they will be able to handle the unexpected difficulties that arise in most people's learning, among which the recurring question "Why bother?" is the most frequent. In one of its rosier passages, the panel does venture the guess that the simulation of the teacher's skills by sufficiently expert systems is not impossible, but for the most part it recognizes that the immediate need is for experiment and investigation to define the bounds of what may be possible.

The belief that the time has come for another wave of interest in new educational technology is even stronger than the panel says. First, and most notoriously, this is a time when few technically advanced societies are able to recruit enough skilled teachers for what are considered essential tasks, teaching mathematics or science more widely, for example. Shortages are especially acute in the field with which the panel is chiefly concerned, information technology. Second, because of the rapidly changing ethos of the high school, students are no longer content to sit and watch teachers make marks with chalk on the walls of the rooms they inhabit but appear (to teachers) to be subversively bent on deciding for themselves what they wish to learn, which is often a recipe for learning (too late, as things are) from their mistakes. Third, there is much more to learn, in circumstances in which the educationalists have not so far been able to devise a curriculum for the modern teenager. Fourth, this is a time when the old advocacy of the cause of continuing education has become an economic necessity; one package of youthful skills no longer lasts a lifetime. How, in these circumstances, can anybody resist this modest committee's appeal for a modest subvention of a programme to find out what computers have to offer students? Not, surely, Mr Kenneth Baker? □