Radiation Protection and Moral Theory

DAVID SUMNER[*] AND PETER GILMOUR[†]

[*]*Moss Park*
Ravenstone
Whithorn, DG8 8DR, UK

[†]*13 Crown Terrace*
Glasgow G12 9ES, UK

ABSTRACT: It seems likely that there is no threshold for the induction of cancer by ionising radiation. Hence even small radiation doses may result in a finite number of premature deaths if a large number of people are exposed. Various arguments are used to demonstrate that such deaths, if they occur, are acceptable; these arguments are shown to be flawed. Many of the arguments, and the ICRP's principle of justification, appear rooted in a utilitarian system of moral philosophy. Such a system is superficially attractive as it appears objective and rational; however, the objectivity may be an illusion masking the underlying aims of the interested parties.

KEYWORDS: Radioactive discharges, utilitarianism, emotivism, justification, cost-benefit analysis

INTRODUCTION

The main, and possibly only, delayed effect of exposure to ionising radiation is the induction of cancer, several years and perhaps even decades later. Continuing study of the survivors of Hiroshima and Nagasaki, and some other smaller groups of people exposed to radiation, show a dose-response relationship which, broadly speaking, is consistent with linearity; that is to say, the risk increases in direct proportion to the dose. However, the radiation doses received by these groups are in general much higher than the typical doses encountered in occupational or environmental exposure; and so the problem of extrapolating the dose-response relation to low doses has been a matter of much debate and indeed controversy. We still have to rely on extrapolation to obtain estimates of risk, because cancer is a common disease and small increases due to radiation exposure will be lost in the inevitable statistical fluctuations. On radiobiological grounds (Baverstock, 1991) it seems increasingly likely that there is no threshold

Environmental Values **4** (1995): 241-55

for cancer induction, and that any additional dose, no matter how small, will increase the risk of cancer for an exposed individual. The no-threshold model has been endorsed by both the International Commission on Radiological Protection (ICRP) (ICRP, 1990, para B48) and the National Radiological Protection Board (NRPB) (NRPB, 1993a). If the no-threshold model is correct, it follows that even small doses may result in a finite number of premature deaths if a large number of people are exposed. Since these deaths are predicted and (at present) undetectable, they are sometimes referred to as 'theoretical' or 'notional' deaths.

It seems to us that if there really is no threshold for cancer induction, important moral consequences arise which have not yet been fully addressed. It is the purpose of this paper to open up the discussion.

An example: krypton-85

In the Draft Authorisation for disposal of waste gases from Sellafield, issued by HMIP in 1992 (HMIP, 1992), the collective dose to the world's population from one year's discharges of krypton-85 (at the authorised limits) is estimated to be 123 man Sv. Assuming a world population of 4.5×10^9 people, this results in an extremely small average dose to an individual of 27 nSv, about 100,000 times smaller than the average annual dose from natural background radiation. Yet this collective dose of 123 man Sv could cause 6 fatal cancers, if the current ICRP risk factor is correct (Sumner, 1992).

There is of course nothing particularly special about krypton-85 discharges; it just happens to be a convenient example for which estimated cancers have been published. Similar arguments can be applied to the discharge of any radionuclide into the environment. However, it seems appropriate to focus our discussion on Sellafield, for a number of reasons: its discharges are significantly larger than those from nuclear power stations in the UK, and will soon increase significantly; and the justification for these discharges has been the subject of a recent judicial review.[1]

Risks to populations and individuals

The risk to an individual from (say) krypton-85 discharges is indeed, as we have seen, very small. It is sometimes argued that this in itself makes the risk acceptable:

> …the levels of annual attributable risk to individuals in the world population are vanishingly small (DoE, 1993, para 56)

However, it seems to us that, if the risk to an individual is very small, we cannot then proceed to argue that the consequences to a population – say 6 cancer deaths – are acceptable. A suitable analogy might be a gunman roaming London, a gunman who has vowed to kill one person at random. For any individual

Londoner, the risk of being killed is clearly very small – several millions to one – but it is also clear that the killing should be prevented. This view would find general acceptance even when the result of the killing would be beneficial (for example, see the 'survival lottery' discussed by Harris [Harris, 1975]), and even although it is sometimes argued that killing cannot be equated with exposing individuals to the risk of death from radiation.

The point has been eloquently expressed by Bo Lindell, of the Swedish National Institute of Radiation Protection:

> …it is not a sufficient requirement for acceptance that every individual accepts his own individual risk. Even with a very small risk to each individual, the situation may well be such that it is almost certain that somebody will be harmed or die. When we sum up the impact on each individual, we must therefore count not only his or her small risk of being affected, but also the regret or resentment which each individual may feel at knowing that *somebody* will be harmed. (Lindell, 1989)

For many people, if killing is to be morally allowable, there has to be some kind of *justification* – self-defence, for example. It is to the question of justification in radiation protection that we now turn.

JUSTIFICATION

The philosophical context of Radiation Protection, such as it is, is essentially contained in the three principles of the International Commission on Radiological Protection (ICRP). The three principles are as follows:

- No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes (the justification of a practice).
- …the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable, economic and social factors being taken into account… (the optimisation of protection).
- The exposure of individuals … should be subject to dose limits … aimed at ensuring that no individual is exposed to radiation risks that are judged to be unacceptable… (ICRP, 1990, para 112).

It is with the first of these principles – the principle of justification – that we will be mainly concerned here. ICRP recognise that the application of the principle of justification will involve many considerations other than radiological protection:

The Commission recommends that, when practices involving exposure, or potential exposure, to radiation are being considered, the radiation detriment

should be explicitly included in the process of choice. The detriment to be considered is not confined to that associated with radiation – it includes other detriments and the costs of the practice. Often, the radiation detriment will be a small part of the total. The justification of a practice thus goes far beyond the scope of radiological protection … to search for the best of all the available options is usually a task beyond the responsibility of radiological protection agencies (ICRP, 1990, para 115).

In general the principle of justification has received much less attention than the other two principles,[2] although it was one of the themes of the recent judicial review of Sellafield discharges.

Cost-benefit analysis

Cost-benefit analysis assumes that everything, including human life, may in principle be given a value by which its worth can be compared with that of anything else, even though the actual measurement of such value may be difficult in practice. In their 1977 recommendations, ICRP said that:

> The net benefit, B, of a product or an operation involving irradiation can be regarded as equal to the difference between its gross benefit, V, and the sum of three components: the basic production cost, P, the cost of achieving a selected level of protection, X, and the cost, Y, of the detriment involved in the operation or in the production, use and disposal of the product, so that
>
> $$B = V - (P + X + Y)$$
>
> Cost as used here includes social as well as purely economic costs. (ICRP, 1977)

Presumably the justification principle requires that B should be greater than zero.

Clearly such a principle is rooted in a utilitarian system of moral philosophy. Bearing in mind the well known problems of utilitarianism (see, for example, the critique by Bernard Williams [Williams, 1972]), any attempt to apply the justification principle to real and very complex cases (such as reprocessing at Sellafield) seems fraught with difficulty. However, suppose for the purposes of argument that we attempt to apply the principle to a fairly circumscribed problem, such as the krypton example described above. In this example, we kill (say) six people and save money (the cost of removing krypton from the discharges). To compare benefit and loss here is difficult enough, but the situation is made even more complex by the realisation that those who will die will almost certainly not be in the UK, and will gain no financial benefit at all.

Despite these considerable practical difficulties in applying the justification principle, there seems to be an implicit assumption in the literature of Radiation Protection that there will be some situations in which the deaths are acceptable, even without an explicit comparison of risks and benefits. Why is this? The arguments seem usually to contain one or more of the following points:

(1) cancer deaths are not quite the same as (say) accidental deaths in the work place, or on the roads; in particular, they tend to occur more commonly in older people. What is important, it is implied in this argument, is not the number of deaths but the *number of years of life lost.*

> There is a difference between accidental deaths, where there is an average loss of life of about 35 years, and radiation-induced cancer death, for which the loss of life is an average of about 15 years (NRPB, 1993b).

We will refer to this as the *years lost* argument.

(2) cancer deaths from radiation are not identifiable at present (the cases of childhood leukaemia around Sellafield may be an important exception to this, although this is controversial). We will refer to this as the *undetectable deaths* argument.

> …any calculation of fatalities is a notional statistical one; the deaths cannot be attributed to any particular individuals, any particular country or any particular time during the hundreds or thousands of years over which this estimate is made. (DoE, 1993, para 61)

(3) 1 in 4 people die of cancer at present, so the *additional* risk to most individuals of dying from a radiation-induced cancer is small. In other words, the number of cancer deaths that can be attributed to (say) radioactive discharges is small compared with the total number of cancer deaths (or sometimes the number of deaths from other causes, e.g road accidents). This is often referred to as 'putting the deaths in perspective' (an argument in fact used by one of us in a book about radiation risks [Sumner, 1994]). We will refer to this as the *comparative* argument.

Two rather different (but, as we shall see, related) points are also often made:

(4) doses from (say) discharges are very small compared with background;

> …the worldwide collective dose estimated to infinity from one year's discharges from the Sellafield site represents 0.03% of the annual worldwide collective dose resulting from natural background radiation. (DoE, 1993, para 59)

and, rather less frequently:

(5) doses are small compared with doses from medical procedures.

We will now examine each of these points in more detail.

The 'years lost' argument

We find it difficult to accept that there is any *moral* difference between causing different *kinds* of death. Indeed it could be argued that, at least for the

individual concerned, the 'disutility' of a prolonged and probably painful death from cancer is greater than (say) death in a road accident. However, since some cancers strike late in life (or mainly do so), it is often held that they are less bad than cancers which are more or less equally spread over all age groups. Those who will die of them, it is argued, have less to contribute and fewer years in which to be happy. From a utilitarian point of view, therefore, it seems that such cancers are less objectionable than the other ones.

Whether this is true or not, however, does appear to depend on circumstances. In some cases the elderly might turn out to have a greater capacity for happiness and – because of more intelligence, power and money – more to contribute (and more to contribute than the others will have at *any* stage of their lives). A pessimist might even say that what the younger age groups have is more time in which to be unhappy, to suffer the slings and arrows of outrageous fortune. What emerges is that from a utilitarian point of view the issue is not decidable: a case cannot be made for preferring the one group of cancers to the other. What the utilitarian has to know to be confident of his rule about late-striking cancers cannot be known; so there cannot be such a rule. There is no alternative then but to accept the rule that all lives are equally to be saved, equally risked.

To this a utilitarian might respond that what concerns him is not actual utility, definitely knowable, but expected utility, about which it is only possible to speculate. But to claim this is to move from the actual consequences of actual actions to the hypothetical consequences of hypothetical actions, and to make such a move is to leave behind utilitarianism as it was originally conceived, a quasi-empirical moral philosophy with a direct purchase on reality. As Bernard Williams has written:

> This sort of model, at least, cannot render palatable to a consistent utilitarian a form of argument which invokes neither the actual consequences of a particular choice, nor the actual consequences of the general following of a rule, but the *hypothetical* consequences of an *imagined* following of a rule. (Williams, 1972, p. 106)

Another point can be made here. Even if it is accepted that life expectancy does have a bearing on moral decisions, causing us, for instance, to save the young man with a particular kidney disorder rather than the very elderly man with the same disorder (where resources are such that only one can be saved), it doesn't follow from this that it is justifiable to expose a section of the population to the risk of death from radiation. To claim that it does follow is to be guilty of conflating the former situation, where there are definite constraints, with the latter situation, where, although there may be constraints, they are not of this kind.

It doesn't follow, either, that there are no grounds of any kind for favouring groups of children over groups of adults. There are, but they need not be utilitarian ones. Most of them are evident to intuition and derive from the child's need to be protected in the world if he is not to die in it. He is obviously more in

need of this kind of protection than adults; we talk of him as having a right to it. We talk of him as being more vulnerable to 'the thousand natural shocks that flesh is heir to' than the experienced adult. We talk of him as not being responsible for certain mistakes, because he is not morally knowledgeable enough to see that they are mistakes. Allowances are made and special protection provided. Someone who claimed that this was not obvious, not evident to intuition at all, would strike us as having a different concept of childhood (a strangely different one at that), even although we might want to concede, here and there, that childhood and adulthood do not differ categorically, only in degrees. The child's innocence, that is, makes an unconditional claim on our attention. It is thus a serious matter that a child born in the Sellafield area is ten times more likely to develop leukaemia than a child born elsewhere.

The 'undetectable deaths' argument

What moral difference does it make if the deaths due to radiation exposure are not detectable? We may need to make a distinction between deaths being undetectable *in principle*, and the deaths being undetectable *with present techniques*. It is sometimes assumed that to be able to specify a minority is to give it a greater claim on our sympathies than in the case of minorities which cannot be specified (e.g. those dying as a result of radioactive discharges – we cannot know who they will be, only that there are likely to be a certain number of them). But while our sympathies may run more readily towards the known than the unknown, it does not follow that our obligations to the unknown are less than towards the known. This point must be stressed, for the unspecifiable minority is quite often talked about, not as having no claims (for the utilitarian does not allow the claims of minorities to weigh in the moral balance), but as having virtually no existence.

Glover has pointed out that variations in our emotional response to known deaths as opposed to what he calls 'statistical' deaths reflect our limitations rather than any differences that can readily be defended as morally important:

> We perhaps cannot very much alter the limitations of our sympathies, but we need not use these limitations as an argument for saying that a policy of relatively downgrading 'statistical' lives is morally right (Glover, 1977, p. 212).

However, it seems unlikely that the deaths will forever remain undetectable and 'statistical'. There is increasing evidence to show that the DNA damage caused by ionising radiation is different in nature from that caused by other mutagens, and even some evidence that lung cancer caused by radon may have an identifiable genetic signature (Vahakangas, 1992). Given the speed of progress in unravelling the human genome, it seems quite probable that before long we may be able to label specific cancers in specific individuals as having been caused by radiation. It seems fairly clear that if radiation-induced cancers were

definitely identifiable as such, the implied argument that they are acceptable would collapse. So any apparently moral argument which is not robust enough to survive technological advance should be examined carefully.

The comparative argument

A letter from a Government Minister replying to an enquiry about cancers caused by fallout from nuclear weapons tests contained the following statement:

> The National Radiological Protection Board has calculated that fallout from atmospheric nuclear tests currently contributes less than 0.5% of the average annual radiation dose received in the UK by members of the public. According to the latest radiation risk data of the International Commission on Radiological Protection this could give rise to … around 25 [deaths] in the whole UK population … one may compare this with the 130,000 or so annual cancer deaths in the UK.

One may compare the 25 deaths with the 130,000, and perhaps one should; but a recommendation such as this cannot serve as an argument for the acceptability of the 25 deaths. Indeed an assertion of this kind surely cannot stand up to any scrutiny. There is some overlap with the 'undetectable deaths' argument given above; but there is an additional point to be made here, that the number of deaths is being compared with an arbitrary denominator, in this case the total number of cancer deaths in the UK. It is of course possible to make any number of deaths appear relatively small if compared with a large enough number of deaths from other causes. The comparative argument would not be and is not acceptable in the case of diseases related to industrial exposure to carcinogens. (It is instructive to consider the example of mesotheliomas resulting from occupational exposure to asbestos, which are regarded as industrial injuries for which compensation should be paid. An important feature of mesothelioma is that it is an unusual cancer which is caused only by asbestos, so damage caused by asbestos is readily identifiable). One cannot escape the suspicion here that this argument is essentially a manipulative one, a point that will be addressed in more detail later.

Another unacceptable feature of this assertion is that it involves a comparison across categories. The comparison is thus invalid. Preventable cancer deaths are being compared with deaths which are either not immediately preventable or not preventable at all. It is disingenuous to try and pretend that like is being compared with like when it is not.

It is sometimes claimed that it would be better not to spend money on preventing the relatively small number of deaths that might result from radioactive discharges, but use the money saved on apparently more worthwhile endeavours:

> The cost of the low active effluent treatment plant at Sellafield was £ 500 million. This was to prevent two theoretical deaths per year … this money could have been better

> spent on schemes that would genuinely benefit the community. (Winter, 1993)

However, money saved by not installing such plant, it would not be unduly cynical to suspect, is in fact very unlikely actually to be spent on other schemes that will benefit the community.

Comparison with background radiation

If the linear no-threshold model is correct, then some cancers will be caused by background radiation; possibly several thousand fatal cancers a year in the UK. If this is so, the argument which seeks to justify increases in radiation exposure because they represent small increments in addition to natural background is really just a variant of the comparative argument given above. What is usually at issue is whether we are justified in adopting a new practice which will increase doses and thereby increase the number of premature deaths. To quote Bo Lindell again:

> …when we look at a particular radiation source, it is the benefit from that source that must outweigh the harm, and it is the effort of controlling that source which must be considered in relation to the magnitude of the harm. (Lindell, 1989)

It is interesting to note that there has in fact been some official advice to reduce high exposures to background radiation. In the UK on average about half the dose from natural background radiation is thought to be due to the gas radon; and people who live in homes with high radon concentrations have been advised to take measures to reduce this. The NRPB claim that 2500 lung cancer deaths a year are related to radon (NRPB, Radon 'At-a-Glance') although these deaths are (as yet) undetected; so evidently the fact that the deaths are (at present) 'statistical' has not deterred the NRPB from treating them as real.

Comparison with medical radiation

It seems fairly clear that it is not appropriate to make comparisons between doses from environmental radiation and medical radiation exposures; for in the latter case there is (or should be) a clear net benefit *to the individual receiving the dose*. There seems to be no clear difference between a medical exposure to radiation, and other diagnostic and therapeutic procedures in medicine, all of which involve some risk.

Competing causes

A more subtle argument is sometimes used to show that, in our krypton example, the predicted deaths will not occur, or at least there will not be as many as estimated. This argument says that, in our krypton example, most if not all the

people at risk from radiation-induced fatal cancers would die for other reasons; in many countries of the world those exposed would simply not live long enough to contract cancer.

The main objection to this is that it cannot be *known* that those at risk from radiation-induced cancers will die first from other causes. Sometimes three out of six may do so, sometimes none may do so. And, since it cannot be known, the risk is run of adding to those who will die of other causes a second group, those who will die of radiation-induced cancers. How, anyway, is the right not to be exposed to radiation removed or reduced by the possibility you might die first of other causes? Is a right contingent upon the certainty that you will be alive at a particular time to enjoy it? If so, there cannot be any rights for anyone, for there can never be such certainty.

ICRP60: A critique of the impurely unreasonable

Some years ago Greening pointed out that, because of proposed changes to the quality factor for neutrons,[3] the size of the unit of radiation dose would change by a factor of two. He went on to say that '…it is surely necessary that radiation doses are expressed in terms of stable quantities … the sooner radiation dose limitation is built on rock rather than on shifting sands, the better' (Greening, 1986). Notwithstanding these (perfectly reasonable) reservations, ICRP have continued their move into ever more treacherous quicksand. In their latest recommendations, ICRP 60, they propose that effective dose be calculated by adding radiation doses to different organs of the body, each of these doses being weighted by the risk of fatal cancer to that organ, the relative length of life lost by such a cancer, and a contribution to take account of the quality of life in the event of non-fatal cancers; a calculation that could involve more than forty parameters. Apart from the very real problem that many of the scientific parameters are subject to considerable uncertainty, we see here a much more sinister development: the incorporation of moral value judgements into scientific units. The apparent objectivity of scientific units is being used to mask the covert infiltration of a utilitarian value system – a system with serious weaknesses.

ARE RADIATION-INDUCED DEATHS A SPECIAL CASE?

It is often assumed that deaths from radiation-induced cancer do not constitute a special case, that there are no significant differences between such deaths and deaths in coalmines, factories, or on the road. The argument (again, a utilitarian one) runs as follows: such are the benefits to the community of having motorways, factories and coalmines that the deaths which occur in these areas need not

trouble us for long. They are inevitable, a fact of life, a price well worth paying for the huge advantages which come from cars, coalmines, factories. Just as, therefore, we do not consider closing down motorways, or not opening new ones, because of deaths on the roads; do not consider closing mines because of deaths in mines; do not consider closing factories, or scrapping plans for new ones, because of serious industrial accidents, so, it is held, we should not be deterred from expanding operations at Sellafield because of deaths associated with radiation:

> Fatalities may not be acceptable, but in the real world they are inescapable and there is some number which society finds tolerable associated with any activity. I cannot see any reason why the fatalities associated with a stochastic process such as radiation carcinogenesis should be treated any differently from those arising in other ways, eg mining accidents, gas explosions, drownings at sea, helicopter crashes, construction worker accidents, that are associated with energy generation. (Bridges, 1993)

To assimilate deaths from radiation-induced cancers to deaths from, say, accidents in coalmines is wrong however. There can be no blithe conflation here, for two reasons.

Firstly, there is the question of freedom of choice: its presence in the one set of cases, absence in the other. A person, that is, can choose not to drive, or to cross roads, can choose not to become a coalminer or to work in this or that factory. But this cannot be said about exposure to environmental radiation. The critical point is that we can't choose not to be exposed to it; there is no hiding place – we are all exposed, whatever precautions we take. If operations continue at Sellafield, all residents of the UK will be exposed, and indeed most of the population of the world.

Secondly, while coalmines, factories, and motorways can *in principle* be made safer – to the point, indeed, where certain kinds of death don't occur anymore – this does not seem to be the case with radioactive discharges, if the no threshold model is indeed correct. It may eventually be possible to say that no-one will die of asbestosis, but it will never be possible to say that no-one has died of radiation-induced cancer if discharges continue. Moreover, accepting the possibility of predicted deaths from discharges is not an alternative to accepting the possibility of death from accidents, since there will probably be some accidents at the nuclear installation *in addition to* the routine discharges.

Thirdly, nuclear power isn't the only way of generating electricity: there are alternatives which may not involve the same kind of risks. Also, more efficient use of energy would enable us to reduce consumption substantially:

> In 1990, of 319 TWh of power generated in the UK, 66 TWh came from the nuclear power stations; less than a quarter. There is no doubt that we could reduce electricity consumption by more than that, without loss of amenity. We could therefore do without nuclear power. (Agnew, 1994, p. 67)

It is sometimes argued that radiation receives more than its fair share of attention from environmentalists, and that radiation protection is both more sophisticated and more restrictive than comparable controls on, say, chemical discharges. However, if ionising radiation is the only environmental pollutant for which a no-threshold model applies, the arguments set out in this paper strongly suggest that radiation protection does indeed have to be accorded special attention; on the other hand, if there are agents other than radiation whose effects are described by a no-threshold model they too will be subject to the considerations outlined here.

DISCUSSION

Some years ago one of us wrote that if the linear no-threshold model were true, it would have 'interesting and curious consequences' (Sumner, 1994, p. 198). We now believe that the implications go far deeper than the merely curious and interesting. A lot depends on whether we are prepared to accept some form of utilitarianism in deciding on the acceptability of deaths from radioactive discharges. If we are not, then there is only one level of acceptable discharge – zero. But even if we do accept a utilitarian ethic, there remains the formidable difficulty of assigning relative values to a wide variety of items, from human life downwards.

There are two main ways in which much of the literature on radiation protection conspires to undermine our sense that the risks are real. Firstly, it tacitly exploits the utilitarian view – that because of the greatest happiness principle the rights of minorities can be discounted – to make it seem alright for a few to die as a consequence of some phenomenon beneficial to the majority. Secondly, the fact that this minority is not specifiable is used to create the impression that it barely exists anyway. To these manoeuvres can be added a third – that what isn't exactly measurable is morally insignificant. This is one of utilitarianism's most arrogant contentions (though attempts have been made to argue for it [Griffin, 1977]): that since moral debate is about the measurable, there cannot be debates in which someone tries to press the claims of the immeasurable.

In his book, *After Virtue*, Alasdair Macintyre develops the view that in the modern world social relations are essentially manipulative (Macintyre, 1985). The moral theory he uses to explain this is called *emotivism*. This holds that moral utterances do not involve claims to knowledge but are expressions of feeling, taste, or preference. To say that something is right or wrong is not to claim that it is known to be so; it is merely to say that you are favourably or unfavourably disposed towards it. There is no moral knowledge, only expressions of feeling. Even though it may seem that someone is not just claiming to have moral

knowledge but is able to substantiate his claim, the truth is otherwise: all he can ever do is express feelings of approval or disapproval. Furthermore, emotivism holds that through such expressions of approval or disapproval we seek to persuade others to share our feelings or preferences; we seek to manipulate them. There are no longer any objective standards by reference to which moral disagreements can be settled. Moral arguments are only apparently such; essentially they are confrontations between wills. If agreement is reached, it is not because both now see reason, but because one has managed to persuade the other to share his preferences. The person persuaded may believe that reason has prevailed, but it is not so; he has been manipulated. Rationality becomes a masquerade, one of several weapons in the armoury of persuasion. Will prevails, not reason, and instead of rational decisions there are arbitrary preferences.

As a possible model for what goes on when decisions are made about nuclear power and nuclear discharges, this seems to us to have much to recommend it, for some of the arbitrary preferences mentioned by Macintyre are ideological ones. Usually, however, these have been carefully effaced from the official script or utterance. There is no hint in the official statement of any ideological purpose behind it. The language used is utilitarian, the suggestion strong that certain standards of objectivity have been met. Only from a consideration of the context can the purpose be discerned; only then can it be appreciated that the statement is not neutral with regard to ideology but, on the contrary, an expression of it. A statement like the one below, for example, has to be seen as part of a continuing attempt to defend the nuclear industry against attacks by environmentalists. To each 'it seems reasonable', therefore, it is necessary to respond with questions: to whom does it seem so? from what point of view? on what grounds? are these good grounds? Many of the questions which a 'neutral' or 'objective' paper would have considered are here begged. One of the indications, in fact, that they may have been is the air of ostentatiously scrupulous rationality. It might be termed the language of bogus expertise.

> The level of risk borne by the very small number of workers whose dose is near to the level of 15 mSv recommended by the National Radiological Protection Board as not to be regularly exceeded would probably approximate to that of many workers in the riskier groups in risky industries; such as that of workers in the offshore oil industry, faceworkers in mining, or roofworkers in the construction industry. The level of these risks is difficult to estimate precisely because of gaps in statistics, but we can say broadly, a risk of death around 1 in 1000 per annum is the most that is ordinarily accepted by substantial groups of workers in any industry in the UK, with that level being exceeded only by fishermen and relatively small sub-groups such as helicopter pilots, divers and demolition workers. It seems therefore reasonable to adopt a risk of death of around 1 in 1000 as the dividing line between what is just about tolerable as a risk to be accepted by any substantial category for any large part of a working life, and what is unacceptable for any but fairly exceptional groups. (HSE, 1992, para 169)

Just occasionally, however, the ideological preference is betrayed, either by the writer himself, or, as in the following, by someone else:

> The Department of Transport's proposed value for a life was pitched at the very bottom of the range of values for a life suggested by individual studies. This reflected the Department's concern not to make too large a shift from previous values which had enjoyed governmental and public acceptance at the time. (HSE, 1992, para 16)

To those who would say to these strictures that they have to have *some* way of arriving at their decisions, it can be replied that two things are objectionable: firstly, the claim that no ideology is involved; secondly, the denial of the high degree of arbitrariness both in the decisions and the means by which they are reached.

We have seen that, in the case of radioactive discharges, the arguments often used to justify possible deaths resulting from these discharges are seriously flawed. The implicit or explicit use of utilitarianism may confer the illusion of objectivity, but is likely to mask the underlying aims of the interested parties. It may be possible to compare estimates of deaths from different but broadly equivalent options (for example, a nuclear power station versus a coal-fired one[4]), but this must be done carefully, openly and honestly.

NOTES

David Sumner was for 20 years a Medical Physicist with the Greater Glasgow Health Board. He is now a Senior Research Fellow at the Department of Medicine and Therapeutics, University of Glasgow. Peter Gilmour has taught philosophy at the Universities of Glasgow and Strathclyde, and is an Arts Tutor with the Open University.

DS would like to thank Tom Wheldon for stimulating his interest in this subject, and for many helpful discussions.

[1] R v (1) Secretary of State for the Environment (2) HMIP (3) MAFF ex parte (1) Greenpeace (2) Lancashire County Council; March 1994

[2] A search of the QUEST radiation data base gave just five references to 'justification' as compared with 91 to ALARA (the principle of optimisation).

[3] The quality factor relates the absorbed dose of radiation (in joules/kg) to the equivalent dose (in sieverts); the latter is a measure of the biological effect of the radiation. The quality factor is supposed to take account of the way in which the energy is deposited.

[4] It should be noted here that Sellafield is not a nuclear power station and therefore does not generate electricity. It is a reprocessing plant, and is not an essential requirement of generating electricity by nuclear power; in fact only two countries (UK and France) undertake commercial reprocessing.

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