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Nuclear Energy and Obligations to the Future

I. The Bus Example

Suppose we consider a bus, a bus which we hope is to make a very long journey. This bus, a third world bus, carries both passengers and freight. The bus sets down and picks up many different passengers in the course of its long journey and the drivers change many times, but because of the way the bus line is managed and the poor service on the route it is nearly always full to over-crowded, with passengers hanging off the back, and as in Afghanistan, passengers riding on the roof, and chickens and goats in the freight compartment.

In the bus's journey someone consigns on it, to a far distant destination, a package containing a highly toxic and explosive gas. This is packaged in a very thin container, which as the consigner well knows is unlikely to contain the gas for the full distance for which it is consigned, and certainly will not do so if the bus should encounter any trouble, for example if there is a breakdown and the interior of the bus becomes very hot, if the bus should strike a very large bump or pothole of the sort commonly found on some of the bad roads it has to traverse, or if some passenger should interfere deliberately or inadvertently with the cargo or perhaps try to steal some of the freight, as also frequently happens. *All* of these things, let us suppose, have happened on some of the bus's previous journeys. If the container should break, the resulting disaster would probably kill at least some of the people and animals on the bus, while others could be maimed or contract serious diseases.

There does not seem much doubt about what most of us would say about the morality of the consigner's action, and there is certainly no doubt about what the passengers would say. The consigner's action in putting the safety of the occupants of the bus at risk is appalling. What could excuse such an action, what sort of circumstances might justify it, and what sort of case could the consigner reasonably put up? The consigner might say that it is by no means

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certain that the gas will escape; he himself is an optimist and therefore feels that such unfavourable possible outcomes should be ignored. In any case the bus might have an accident and the passengers be killed long before the container gets a chance to leak; or the passengers might change to another bus and leave the lethal parcel behind.

He might say that it is the responsibility of the passengers and the driver to ensure that the journey is a smooth one, and that if they fail to do so, the results are not his fault. He might say that the journey is such a long one that many of the passengers may have become mere mindless vegetables or degenerate wretches about whose fate no decent person need concern himself, or that they might not care about losing their lives or health or possessions anyway by that time.

Most of these excuses will seem little more than a bad joke, and certainly would not usually be reckoned any sort of justification. The main argument the consigner of the lethal parcel employs, however, is that his own pressing needs justify his actions. He has no option but to consign his potentially lethal parcel, he says, since the firm he owns, and which has produced the material as a by-product, is in bad financial straits and cannot afford to produce a better container or to stop the production of the gas. If the firm goes out of business, the consigner says, his wife will leave him, and he will lose his family happiness, the comfortable way of life to which he has become accustomed and sees now as a necessity; his employees will lose their jobs and have to look for others; not only will the firm's customers be inconvenienced but he, the consigner, will have to break some business contracts; the inhabitants of the local village through loss of spending and cancellation of the Multiplier Effect will suffer financial hardship, and, worst of all, the tiny flow of droplets that the poor of the village might receive (theoretically at any rate) as a result of the trickling down of these good things would dry up entirely. In short, some basic and some perhaps uncomfortable changes will be needed in the village.

Even if the consigner's story were accepted at face value — and it would be wise to look critically at his story — only someone whose moral sensibilities had been paralysed by the disease of galloping economism could see such a set of considerations, based on "needs," comfort, and the goal of local prosperity, as justifying the consigner's action.

One is not generally entitled to thus simply *transfer* the risks and costs arising from one's own life onto other uninvolved parties, to get oneself out of a hole of one's own making by creating harm or risk of harm to someone else who has had no share in creating the situation. To create serious risks and costs, especially risks to life or health for such others, simply to avoid having to make some changes to a comfortable life style, or even for a somewhat better reason, is usually thought deserving of moral condemnation, and sometimes considered a crime: for example, the action of a company in creating risks to the lives or health of its workers or customers to prevent itself from going bankrupt. What the consigner says may be an explanation of his behaviour, but it is not a justification.

The problem raised by nuclear waste disposal is by no means a perfect analogy to the bus case, since, for example, the passengers on the nuclear bus cannot get off the bus or easily throw out the lethal package. In many crucial moral respects, however, the nuclear waste storage problem as it affects future people, the passengers in the bus we are considering, resembles the consignment of the faultily packaged lethal gas. Not only are rather similar moral principles involved, but a rather similar set of arguments to the lamentable excuses the consigner presents have been seriously put up to justify nuclear development, the difference being that in the nuclear case these arguments have been widely accepted. There is also some parallel in the risks involved; there is no *known* safe way to package the highly toxic wastes generated by nuclear plants that will be spread around the world if large-scale nuclear development goes ahead.¹ The wastes problem will not be a slight one, with each one of the more than 2,000 reactors envisaged by the end of the century, producing on average *annual* wastes containing one thousand times the radioactivity of the Hiroshima bomb.² The wastes include not merely the spent fuels and their radioactive by-products, but also everything they contaminate, from fuel containers to the thousands of widely distributed decommissioned nuclear reactors which will have to be abandoned, still in a highly radioactive condition, after the expiry of their expected lifetimes of about thirty years, and which have been estimated to require perhaps one and a half million years to reach safe levels of radioactivity.³ The wastes must be kept suitably isolated from the environment for their entire active lifetime; for fission products the required storage period averages a thousand years or so, and for the actinides (transuranic elements) which include plutonium, there is a half-million- to a million-year storage problem.⁴

Serious problems have arisen with both short-term and proposed long-term methods of storage, even with the comparatively small quantities of waste that have been produced over the last twenty years.⁵ With present known short-term surface methods of storage there is a continued need for human intervention to keep the material isolated from the environment, while with proposed longer-term methods such as storage in salt mines or granite to the risk of human interference there are added the risks of leakage, e.g. through water seepage, and of disturbance, for example through climatic change, earth movements, etc. The risks are significant: no reasonable person with even a limited acquaintance with the history of human affairs over the last 3,000 years could be confident of safe storage by methods involving human intervention over the enormous time periods involved. No one with even a slight knowledge of the geological and climatic history of the earth over the last million years, a period which has seen a number of ice ages and great fluctuations in climate for example, could be confident that the waste material could be safely stored for the vast periods of time required. Much of this waste is highly toxic; for example, even a beachball-sized quantity of plutonium appropriately distributed is enough to give every person on the planet lung cancer — so that a leak of even a small part of this waste material could involve much loss of life,

widespread disease and genetic damage, and contamination of large areas of land.⁶

Given the enormous costs which could be involved for the future, it is plainly grossly inadequate to merely speculate concerning untested, but possibly or even probably safe, methods for disposal of wastes. Yet none of the proposed methods has been properly tested, and they may prove to involve all sorts of unforeseen difficulties and risks when an attempt is made to put them into practice on a commercial scale. Only a method that could provide a rigorous guarantee of safety over the storage period, that placed safety beyond reasonable doubt, would be acceptable. It is difficult to see how such rigorous guarantees could be given concerning either the geological or future human factors. But even if an economically viable, rigorously safe long-term storage method *could* be devised, there is the problem of guaranteeing that it would be universally and invariably *used*. The assumption that it would be, especially if, as seems likely, such a method proved expensive economically and politically, seems to presuppose a level of efficiency, perfection, and concern for the future not previously encountered in human affairs, and certainly not conspicuous in the nuclear industry.⁷ Again, unless we assume continuous and faultless guarding of long-term storage sites through perhaps a million years of possible future human activity, weapons-grade radioactive material will be accessible, over much of the million-year storage period, to any party who is in a position to retrieve it.

Our behaviour in creating this nightmare situation for the future is certainly no better than that of the consigner in the bus example. Industrialized countries, in order to get out of a mess of their own making—essentially the creation of economies dependent on an abundance of non-renewable energy in a situation where it is in fact in limited supply—opt for a “solution” which may enable them to avoid the making of uncomfortable changes during the lifetime of those now living, at the expense of passing heavy burdens on to the inhabitants of the earth at a future time—burdens in the shape of costs and risks which, just as in the bus case, may adversely affect the life and health of future people and their opportunity to lead a decent life.⁸

It is sometimes suggested that analogies like the bus example are defective; that morally they are crucially different from the nuclear case, since future people, unlike the passengers in the bus, will benefit directly from nuclear development, which will provide an abundance of energy for the indefinite future. But this is incorrect. Nuclear fission creates wastes which may remain toxic for a million years, but even with the breeder reactor it could be an energy source for perhaps only 150 years. It will do nothing for the energy problems of the people of the distant future whose lives could be seriously affected by the wastes. Thus perhaps 30,000 generations of future people could be forced to bear significant risks, without any corresponding benefits, in order to provide for the extravagant energy use of only five generations.

Nor is the risk of direct harm from the escape or misuse of radioactive materials the only burden the nuclear solution imposes on the future. Because the energy provided by nuclear fission is merely a stop-gap, it seems probable

that in due course the same problem, that of making a transition to renewable sources of energy, will have to be faced again by a future population which will probably, again as a result of our actions, be very much worse placed to cope with it. For they may well have to face the change to renewable resources in a over-populated world not only burdened with the legacy of our nuclear wastes, but also in a world in which, if the nuclear proponents' dream of global industrialization is realized, more and more of the global population will have become dependent on high energy consumption and associated technology and heavy resource use, and will have lost or reduced its ability to survive without it. It will, moreover, probably be a world which is largely depleted of non-renewable resources, and in which such renewable resources as forests and soils as remain, resources which will have to form a very important part of the basis of life, are in a run-down condition. Such points tell against the idea that future people must be, if not direct beneficiaries of nuclear fission energy, at least indirect beneficiaries.

The “solution” then is to buy time for contemporary industrial society at a price which not only creates serious problems for future people but which reduces their ability to cope with those problems. Just as in the bus case, contemporary industrial society proposes to get itself out of a hole of its own making by creating risk of harm, and by transferring costs and risks, to someone else who has had no part in producing the situation and who will obtain no clear benefit. It has clear alternatives to this action. That it does not take them is due essentially to its unwillingness to avoid changing wasteful patterns of consumption and to its desire to protect the interests of those who benefit from them.

If we apply to the nuclear situation the same standards of behaviour and moral principles that we acknowledge (in principle if perhaps often not in fact) in the contemporary world, it will not be easy to avoid the conclusion that the situation involves injustice with respect to future people on a grand scale. It seems to us that there are only two plausible moves that might enable the avoidance of such a conclusion. First, it might be argued that the moral principles and obligations which we acknowledge for the contemporary world and the immediate future do not apply because the recipients of our nuclear parcel are in the non-immediate future. Secondly, an attempt might be made to appeal to overriding circumstances; for to reject the consigner's action in the circumstances outlined is not of course to say that there are *no* circumstances in which such an action might possibly be justifiable, or at least where the case is less clearcut. It is the same with the nuclear case. Just as in the case of the consigner of the package there is a need to consider what these justifying circumstances might be, and whether they apply in the present case. We turn now to the first of these possible escape routes for the proponent of nuclear development, to the philosophical question of our obligations to the future.

II. Obligations to the Distant Future

The area in which these philosophical problems arise is that of the distant (i.e. non-immediate) future, that is, the future with which people alive today will

make no direct contact; the immediate future provides comparatively few problems for moral theories. The issues involved, although of far more than academic interest, have not received any great attention in recent philosophical literature, despite the fact that the question of obligations to future people presents tests which a number of ethical theories fail to pass, and also raises a number of questions in political philosophy concerning the adequacy of accepted institutions which leave out of account the interests of future people.

Moral philosophers have predictably differed on the issue. But contrary to the picture painted in a recent, widely read, and influential work discussing it, Passmore's *Man's Responsibility for Nature*, a good many philosophers who have explicitly considered the question have come down in favour of the same consideration being given to the rights and interests of future people as to those of contemporary or immediately future people. Other philosophers have tended to fall into three categories—those who acknowledge obligations to the future but who do not take them seriously or who assign them less weight, those who deny, or who are committed by their general moral position to denying, that there are moral obligations beyond the immediate future, and those like Passmore and Golding who come down, with admirable philosophical caution, on both sides of the issue, but with the weight of the argument favouring the view underlying prevailing economic and political institutions, that there are no moral obligations to the future beyond those to the next generation.

According to the most extreme of these positions against moral obligations to the future, our behaviour with respect to the future is morally unconstrained; there are no moral restrictions on acting or failing to act deriving from the effect of our actions on future people. Of those philosophers who say, or whose views imply, that we don't have obligations to the (non-immediate) future, i.e. those who have opted for the unconstrained position, many have based this view on accounts of moral obligation which are built on relations which presuppose some degree of temporal or spatial contiguity. Thus moral obligation is seen as grounded on or as presupposing various relations which could not hold between people widely separated in time (or sometimes in space). For example, obligation is seen as grounded in relations which are proximate or of short duration and also non-transitive. Among such suggested bases or grounds of moral obligation, or requirements for moral obligation, which would rule out obligations to the non-immediate future are these: First, there are those accounts which require that someone to whom a moral obligation is held be able to claim his rights or entitlement. People in the distant future will not be able to claim rights and entitlements as against us, and of course they can do nothing to enforce any claims they might have for their rights against us. Secondly, there are those accounts which base moral obligations on social or legal convention, for example a convention which would require punishment of offenders or at least some kind of social enforcement. But plainly these and other conventions will not hold invariantly over change in society and amendment of legal conventions and so will not be invariant over time. Also future people have no way of enforcing their interests or

punishing offenders, and there could be no guarantee that any contemporary institution would do it for them.

Both the view that moral obligation requires the context of a moral community and the view that it is contractually based appear to rule out the distant future as a field of moral obligation, as they not only require a commonality, or some sort of common basis, which cannot be guaranteed in the case of the distant future, but also a possibility of interchange or reciprocity of action which cannot apply to the future. Where the basis of moral obligation is seen as mutual exchange, the interests of future people must be set aside because they cannot change the past and cannot be parties to any mutual contract. The exclusion of moral obligations to the distant future also follows from those views which attempt to ground moral obligations in non-transitive relations of short duration such as sympathy and love. There are some difficulties also about love and sympathy for (non-existent) people in the far distant future about whose personal qualities and characteristics one must know very little and who may well be committed to a life-style for which one has no sympathy. On the current showing in the case of nuclear energy it would be easy to conclude that contemporary society lacks both love and sympathy for future people; and it would appear to follow from this that contemporary people have no obligations to future people and can harm them as it suits them.

What all these views have in common is a naturalistic picture of obligation as something acquired, either individually or institutionally, something which is conditional on doing something or failing to do something (e.g. participating in the moral community, contracting), or having some characteristic one can fail to have (e.g. love, sympathy, empathy). Because obligation therefore becomes conditional, features usually thought to characterize it, such as universality of application and necessitation (i.e. the binding features), are lost, especially where there is a choice of whether or not to do the thing required to acquire the obligation, and so of whether to acquire it. The criteria for acquisition suggested are such as to exclude people in the distant future.

However, the view that there are no moral constraints with respect to future people, that one is free to act as one likes with respect to them, is a very difficult one to sustain. Consider the example of a scientific group which, for no particular reason other than to test a particular piece of technology, places in orbit a cobalt bomb which is to be set off by a triggering device designed to go off several hundred years from the time of its despatch. No presently living person and none of their immediate descendants would be affected, but the population of the earth in the distant future would be wiped out as a direct and predictable result of the action. The unconstrained position clearly implies that this is an acceptable moral enterprise, that whatever else we might legitimately criticize in the scientists' experiment, perhaps its being unduly expensive or badly designed, we cannot lodge a moral protest about the damage it will do to future people. The unconstrained position also endorses as morally acceptable the following sorts of examples: A firm discovers it can make a handsome profit from mining, processing, and manufacturing a new type of material which,

although it causes no problems for present people or their immediate descendants, will over a period of hundreds of years decay into a substance which will cause an enormous epidemic of cancer among the inhabitants of the earth at that time. According to the unconstrained view the firm is free to act in its own interests, without any consideration for the harm it does to future people.

Such counterexamples to the unconstrained view might seem childishly obvious. Yet the unconstrained position concerning the future from which they follow is far from being a straw man; not only have a number of philosophers writing on the issue endorsed this position, but it is the clear implication of many currently popular views of the basis of moral obligation, as well as of economic theory. It does not appear, on the other hand, that those who opt for the unconstrained position have considered such examples and endorsed them as morally acceptable, despite their being clearly implied by their position. We suspect that when it is brought out that the unconstrained position admits such counterexamples, that being free to act implies among other things being free to inflict pointless harm, most of those who opted for the unconstrained position would want to assert that it was not what they intended. What those who have put forward the unconstrained position seem to have had in mind in denying moral obligation is rather that future people can look after themselves, that we are not responsible for their lives. The view that the future can take care of itself also seems to assume a future causally independent of the present. But it is not. It is not as if, in cases such as those discussed above and the nuclear case, the future is simply being left alone to take care of itself. Present people are influencing it, and in doing so must acquire many of the same sorts of moral responsibilities as they do in causally affecting the present and immediate future. The thesis seems thus to assume an incorrect model of an independent and unrelated future.

Also, to say that we are not responsible for the lives of future people does not amount to the same as saying that we are free to do as we like with respect to them, that there are no moral constraints on our action involving them. In just the same way, the fact that one does not have, or has not acquired, an obligation to some stranger with whom one has never been involved — that one has no responsibility for his life — does not imply that one is free to do what one likes with respect to him, for example to rob him or to pursue some course of action of advantage to oneself which could seriously harm him.

These difficulties for the unconstrained position arise in part from the failure to make an important distinction between, on the one hand, acquired or assumed obligations toward somebody, for which some act of acquisition or assumption is required as a qualifying condition, and on the other hand moral constraints, which require, for example, that one should not act so as to damage or harm someone, and for which no act of acquisition is required. There is a considerable difference in the level and kind of responsibility involved. In the first case one must do something or be something which one can fail to do or be, e.g. have loves, sympathy, be contracted. In the second case responsibility arises as a result of being a causal agent aware of the consequences or probable

consequences of his action, and thus does not have to be especially acquired or assumed. Thus there is no problem about how the latter class, moral constraints, can apply to the distant future in cases where it may be difficult or impossible for acquisition or assumption conditions to be satisfied. They apply as a result of the ability to produce causal effects on the distant future of a reasonably predictable nature. Thus also moral constraints can apply to what does not (yet) exist, just as actions can cause results that do not (yet) exist. While it may be the case that there would need to be an acquired or assumed obligation in order for it to be claimed that contemporary people must make special sacrifices of an heroic kind for future people, or even to help them especially, only moral constraints are needed in order for us to be constrained from harming them. Thus, to return to the bus example, the consigner cannot argue in justification of his action that he has never assumed or acquired responsibility for the passengers, that he does not know them and therefore has no love or sympathy for them, and that they are not part of his moral community, in short that he has no special obligations to help them. All that one needs to argue in respect of both the bus and the nuclear case is that there are moral constraints against harming, not that there are specially acquired obligations to take responsibility for the lives of the people involved. . . .

III. Uncertainty and Indeterminacy Arguments

Covered
(to be discussed)

Although there are grave difficulties for the unconstrained position, qualification leads to a more defensible position. According to the *qualified position* we are not entirely unconstrained with respect to the distant future: there are obligations, but these are not so important as those to the present, and the interests of distant future people cannot weigh very much in the scale against those of the present and immediate future. The interests of future people then, except in unusual cases, count for very much less than the interests of present people. Hence such things as nuclear development and various exploitative activities which benefit present people should proceed, even if people of the distant future are disadvantaged by them.

The qualified position appears to be widely held and is implicit in most modern economic theories, where the position of a decrease in weight of future costs and benefits (and so of future interests) is obtained by application over time of an (opportunity cost) discount rate. The attempt to apply economics as a moral theory, something that is becoming increasingly common, can lead then to the qualified position. What is objectionable in such an approach is that economics must operate within the bounds of moral (deontic) constraints, just as in practice it operates within legal constraints, and cannot determine what those constraints are. There are, moreover, alternative economic theories and simply to adopt one which discounts the future is to beg all the questions at issue. The discounting move often has the same result as the unconstrained position; if, for instance, we consider the cancer example and consider costs as payable compensation, it is evident that, over a sufficiently long period of time, discounting at current prices would lead to the conclusion that there are

no recoverable damages and so, in economic terms, no constraints. In short, even certain damage to future people could be written off. One way to achieve the bias against future people is by the application of discount rates which are set in accord with the current economic horizons of no more than about fifteen years,⁹ and application of such rates *would* simply beg the question against the interests and rights of future people. Where there is certain future damage of a morally forbidden type the whole method of discounting is simply inapplicable, and its use would violate moral constraints.¹⁰

Another argument for the qualified position, which avoids the objections from cases of certain damage, comes from probability considerations. The distant future, it is argued, is much more uncertain than the present and immediate future, so that probabilities are consequently lower, perhaps even approaching or coinciding with zero for any hypothesis concerning the distant future.¹¹ But then if we take account of probabilities in the obvious way, by simply multiplying them against costs and benefits, it is evident that the interests of future people, except in cases where there is an unusually high degree of certainty, must count for (very much) less than those of present and neighbouring people where (much) higher probabilities obtain. So in the case of conflict between the present and the future where it is a question of weighing certain benefits to the people of the present and the immediate future against a much lower probability of indeterminate costs to an indeterminate number of distant future people, the issue would normally be decided in favour of the present, assuming that anything like similar costs and benefits were involved. But of course it can't be assumed that anything like similarly weighted costs and benefits are involved in the nuclear case, especially if it is a question of risking poisoning some of the earth for half a million or so years, with consequent risk of serious harm to thousands of generations of future people, in the shape of the opportunity to continue unnecessarily high energy use. And even if the costs and benefits were comparable or evenly weighted, such an argument would be defective, since an analogous argument would show that the consumer's action is acceptable provided the benefit, e.g. the profit he stood to gain from imposing significant risks on other people, was sufficiently large. Such a cost-benefit approach to moral and decision problems, with or without the probability frills, is quite inadequate where different parties are concerned, or for dealing with cases of conflict of interest or moral problems where deontic constraints are involved, and commonly yields counterintuitive results. For example, it would follow on such principles that it is *permissible* for a firm to injure, or very likely injure, some innocent party provided the firm stands to make a sufficiently large gain from it. But the costs and benefits involved are not transferable in any simple or general way from one party to another. Transfers of this kind, of costs and benefits involving different parties, commonly raise moral issues — e.g. is *x* entitled to benefit himself by imposing costs on *y*? — which are not susceptible to a simple cost-benefit approach of the sort adopted by some proponents of nuclear energy, who attempt to dismiss the costs to future people with the soothing remark that any development involves

costs as well as benefits. The transfer point is enough to invalidate the comparison, heavily relied on by McCracken¹² in building a case for the acceptability of the nuclear risk, between nuclear risks and those from cigarette smoking. In the latter case those who supposedly benefit from the activity are also, to an overwhelming extent, those who bear the serious health costs and risks involved. In contrast the users and supposed beneficiaries of nuclear energy will be risking not only, or even primarily, their own lives and health, but also those of others who may be non-beneficiaries and who may be spatially or temporally removed, and these risks will not be in any direct way related to a person's extent of use.

The transfer objection is essentially the same as that to the utilitarian's happiness sums as a way of solving moral conflict between different parties, and the introduction of probability considerations does not change the principles involved but merely complicates analyses. One might further object to the probability argument that probabilities involving distant future situations are not always less than those concerning the immediate future in the way the argument supposes, and that the outcomes of some moral problems such as the bus example do not depend on a high level of probability anyway. In some sorts of cases it is enough, as the bus example reveals, that a significant risk is created; such cases do not depend critically on high probability assignments.

Uncertainty arguments in various forms are the most common and important ones used by philosophers and others to argue for the position that we cannot be expected to take serious account of the effects of our actions on the distant future. There are two strands to the uncertainty argument, capable of separation, but frequently entangled. Both arguments are mistaken, the first on *a priori* grounds, the second on *a posteriori* grounds. The first argument is a generalized uncertainty argument which runs as follows: In contrast to the exact information we can obtain about the present, the information we can obtain about the effects of our actions on the distant future is unreliable, woolly, and highly speculative. But we cannot base assessments of how we should act on information of this kind, especially when accurate information is obtainable about the present which would indicate different action. Therefore we must regretfully ignore the uncertain effects of our actions on the distant future. More formally and crudely: One only has obligations to the future if these obligations are based on reliable information; there is no reliable information at present as regards the distant future; therefore one has no obligations to the distant future.

The first argument is essentially a variation on a sceptical argument in epistemology concerning our knowledge of the future (formally, replace "obligations" by "knowledge" in the crude statement of the argument above). The main ploy is to considerably overestimate and overstate the degree of certainty available with respect to the present and immediate future, and the degree of certainty which is required as the basis for moral consideration both with respect to the present and with respect to the future. Associated with this is the attempt to suggest a sharp division as regards certainty between the present

and immediate future on the one hand and distant future on the other. We shall not find, we suggest, that there is any such sharp or simple division between the distant future and the adjacent future and present, at least with respect to those things in the present which are normally subject to moral constraints. We can and constantly do act on the basis of such "unreliable" information as the sceptic regards the future conveniently labels "uncertainty"; for sceptic-proof certainty is rarely, or never, available with respect to much of the present and immediate future. In moral situations in the present, action often takes account of risk and probability, even quite low probabilities. A good example is again the bus case. We do not need to know for certain that the container will break and the lethal gas escape. In fact it does not even have to be probable, in the relevant sense of more probable than not, in order for us to condemn the consigner's action. It is enough that there is a significant risk of harm in this sort of case. It does not matter if the decreased well-being of the consigner is certain and the prospects of the passengers quite uncertain; the resolution of the problem is still clearly in favour of the so-called "speculative" and "unreliable." But if we do not require certainty of action to apply moral constraints in contemporary affairs, why should we require a much higher standard of certainty in the future? Why should we require epistemic standards for the future which the more familiar sphere of moral action concerning the present and adjacent future does not need to meet? The insistence on certainty as a necessary condition before moral consideration can be given to the distant future, then, amounts to an epistemic double standard. But such an epistemic double standard, proposed in explaining the difference between the present and the future and to justify ignoring future peoples' interests, in fact cannot itself provide an explanation of the differences, since it already presupposes different standards of certainty appropriate to each class, which difference is in turn in need of justification.

2. The second uncertainty argument is a practical uncertainty argument, that whatever our *theoretical* obligations to the future, we cannot in practice take the interests of future people into account, because uncertainty about the distant future is so gross that we cannot determine what the likely consequences of actions upon it will be and therefore, however good our intentions to the people of the distant future, in practice we have no choice but to ignore their interests. Uncertainty is gross where certain incompatible hypotheses are as good as one another and there is no rational ground for choosing between them. The second uncertainty argument can also be put in this way: If moral principles are, like other principles, implications in form, that is of such forms as "if x has character h then x is wrong, for every (action) x ," then what the argument claims is that we can never obtain the information about future actions which would enable us to detach the antecedent of the implication. So even if moral principles theoretically apply to future people, in practice they cannot be applied to obtain clear conclusions or directions concerning contemporary action of the "it is wrong to do x " type.

Many of the assumptions of the second argument have to be conceded. If the distant future really is so grossly uncertain that in every case it is impossible

to determine in any way that is better than chance what the effects of present action will be, and whether any given action will help or hinder future people, then moral principles, although they may apply theoretically to the future, will not be applicable in practice for obtaining any clear conclusions about how to act. Hence the distant future will impose no practical moral constraints on action. However, the argument is factually incorrect in assuming that the future is always so grossly uncertain or indeterminate. Admittedly there is often a high degree of uncertainty concerning the distant future, but as a matter of (contingent) fact it is not always so gross or sweeping as the argument has to assume. There are some areas where uncertainty is not so great as to exclude constraints on action, especially when account is taken of the point, noticed in connection with the first argument, that complete certainty is commonly not required for moral constraints and that all that may be needed in some cases is the creation of a significant risk. Again there is considerable uncertainty about many factors which are not highly, or at all, morally relevant, but this does not extend to many factors which are of much greater importance to moral issues. For example, we may not have any idea what the fashions will be in a hundred years in girls' names or men's footwear, or what brands of ice cream people will be eating if any, but we do have excellent reason to believe, especially if we consider 3,000 years of history, that what people there are in a hundred years are likely to have material and psychic needs not entirely unlike our own, that they will need a healthy biosphere for a good life; that like us they will not be immune to radiation; that their welfare will not be enhanced by a high incidence of cancer or genetic defects, by the destruction of resources, or the elimination from the face of the earth of that wonderful variety of non-human life which at present makes it such a rich and interesting place. For this sort of reason, the second uncertainty argument should be rejected. While it is true that there are many areas in which the morally relevant information needed is uncertain or unavailable, and in which we cannot therefore determine satisfactorily how to act, there are certainly others in which uncertainty in morally relevant areas is not so great as to preclude moral constraints on action, where we ascertain if not absolute certainties at least probabilities of the same sort of order as are considered sufficient for the application of moral principles in parallel contemporary cases, especially where spatially remote people are involved. The case of nuclear waste storage, and of uncertainty of effects of it on future people, seems to be of the latter sort. Here there is no gross indeterminacy or uncertainty; it is simply not true that incompatible hypotheses about what may happen are as good as each other. It is plain that nuclear waste storage does impose significant risks of harm on future people, and, as we can see from the bus example, the significant risk of harm is enough in cases of this type to make moral constraints applicable.

In terms of the defects of the preceding uncertainty arguments, we can see the corresponding defects in a number of widely employed uncertainty arguments used to write off probable harm to future people as outside the scope of

proper consideration. Most of these popular moves employ both of the uncertainty arguments as suits the case, switching from one to the other in a way that is again reminiscent of sceptical moves. For example, we may be told that we cannot really take account of future people because we cannot be sure that they will exist or that their tastes and wants will not be completely different from our own, to the point where they will not suffer from our exhaustion of resources or from the things that would affect us.¹³ But this is to insist upon complete certainty of a sort beyond what is required for the present and immediate future, where there is also commonly no guarantee that some disaster will not overtake those we are morally committed to. Again we may be told that there is no guarantee that future people will be worthy of any efforts on our part, because they may be morons or forever plugged into enjoyment- or other machines.¹⁴ Even if one is prepared to accept the elitist approach presupposed — according to which only those who meet certain properly civilized or intellectual standards are eligible for moral consideration — what we are being handed in such arguments as a serious defeating consideration is again a mere outside possibility — like the sceptic who says that the solid-looking desk in front of us is perhaps only a façade, not because he has any particular reason for doing so, but because he hasn't looked around the back, drilled holes in it, etc. Neither the contemporary nor the historical situation gives any positive reason for supposing that a lapse into universal morosity or universal pleasure-machine escapism is a serious possibility, as opposed to a logical possibility. We can contrast with these mere logical possibilities the very real historically supportable risks of escape of nuclear waste or decline of a civilization through destruction of its resource base.

The possibilities just considered in these uncertainty arguments of sceptical character are not real possibilities.¹⁵ Another argument which may consider a real possibility, but still does not succeed in showing that it is acceptable to proceed with an action which would appear to be harmful to future people, is often introduced in the nuclear waste case. This is the argument that future people may discover a rigorously safe and permanent storage method for nuclear wastes before they are damaged by escaped waste material. Let us grant for the sake of the argument that this is a real possibility (though physical arguments may show that it is not). This still does not affect the fact that there is a significant risk of serious damage and that the creation of a significant risk is enough to rule out an action of this type as morally impermissible. In just the same way, future people may discover a cure for cancer, and the fact that this appears to be a real and not merely a logical possibility, does not make the action of the firm in the example discussed above, of producing a substance likely to cause cancer in future people, morally admissible. The fact that there was a real possibility of future people avoiding the harm would show that actions of these sorts were admissible only if what was required for inadmissibility was certainty of harm or a very high probability of it. In such cases, before such actions could be considered admissible, what would be required is far more than a possibility, real or not — it is at least the availability of

an applicable, safe, and rigorously tested, not merely speculative, technique for achieving it, something that future people could reasonably be expected to apply to protect themselves.

The strategy of most of these uncertainty arguments is fairly clear then, and may be brought out by looking yet again at the bus example, where the signifier says that he cannot be expected to take account of the effect of his actions on the passengers because they may find an effective way to deal with his parcel or some lucky or unlucky accident may occur, e.g. the bus may break down and they may all change to a different bus leaving the parcel behind, or the bus may crash, killing all the passengers before the container gets a chance to leak. These are all possibilities of course, but there is no positive reason to believe that they are any more than that, that is they are not real possibilities. The strategy is to stress such outside possibilities in order to create the false impression that there is gross uncertainty about the future, that the real possibility that the container will break should be treated in the same way as these mere logical possibilities, that uncertainty about the future is so great as to preclude the signifier's taking account of the passengers' welfare and of the real possibility of harm from his parcel, and thereby excuse his action. A related strategy is to stress a real possibility, such as finding a cure for cancer, and thereby imply that this removes the case for applying moral constraints. This move implicitly makes the assumptions of the first argument, that certainty, or at least a very high probability, of harm is required before an action can be judged morally inadmissible, and the point of stressing the real possibility of avoidance of damage is to show that this allegedly required high degree of certainty or probability cannot be attained. That is, the strategy draws attention to some real uncertainty implying that this is sufficient to defeat the application of moral constraints. But, as we have seen, this is often not so.

— An argument closely related to the uncertainty arguments is based on the non-existence and indeterminacy of the future.¹⁶ An item is indeterminate in a given respect if its properties in that respect are, as a matter of logic, not settled (nor are they settleable in a non-arbitrary fashion). The respects in which future items are indeterminate are well enough known for a few examples to serve as reminders: all the following are indeterminate: the population of Australia at 2001, its distribution, its age structure, the preferences of its members for folk music, wilderness, etc., the size and shape of Wollongong, the average number of rooms in its houses and in its office blocks, and so on. Philosophical discussion of such indeterminacy is as old as Aristotle's sea battle and as modern as truth-value gaps and fuzzy logics, and many positions have been adopted on the existence and determinacy of future items. Nevertheless theories that there are obligations to the future are not sensitive to the metaphysical position adopted concerning the existence or non-existence of the future. Any theory which denied obligations to the future on the metaphysical grounds that the future did not exist, and did not have properties, so that the present could not be related to it, would be committed to denying such obvious

facts as that the present could causally influence the future, that present people could be great-grandparents of purely future people, and so on, and hence would have to be rejected on independent grounds. . . .

Future items *will* have properties even if they do not have them now, and that is enough to provide the basis for moral concern about the future. Thus the thesis of obligations to the future does not presuppose any special metaphysical position on the existence of the future.

If the non-existence of future items creates no special problems for obligations to the future, the same is not true of their indeterminacy, [which] . . . creates major difficulties for certain ethical theories and their treatment of the future.

The difficulties arise for theories which appear to require a high level of determinacy with respect to the number and character of future items, in particular calculus-type theories such as utilitarianism in its usual forms, where the calculations are critically dependent on such information as numbers, totals, and averages, information which so far as the future is concerned is generally indeterminate. The fact that this numerical information is typically indeterminate means that insofar as head-count utilitarianism requires determinate information on numbers, it is in a similar position to theories discussed earlier; it may apply theoretically to future people, but since the calculations cannot be applied to them their interests will be left out of account. And, in fact, utilitarianism for the most part does not, and perhaps cannot, take future creatures and their interests seriously. . . .

. . . We have yet another case of a theory of the sort that applies theoretically but in practice doesn't take the future seriously. But far from this showing that future people's interests should be left out of account, what these considerations show are deficiencies in these sorts of theories, which require extensive determinacy of information. This kind of information is commonly equally unavailable for the accepted areas of moral constraint, the present and immediate future; and the resolution of moral issues is often not heavily dependent on knowledge of such specific determinate features as numbers or other determinate features. For example, we do not need to know how many people there will be on the bus, how intelligent they are, what their preferences are or how badly they will be injured, in order to reach the conclusion that the consigner's action in despatching his parcel is a bad one. Furthermore, it is only the ability of moral considerations to continue to apply in the absence of determinate information about such things as numbers that makes it possible to take account of the possible effects of action, as the risks associated with action — something which is quite essential even for the present if moral considerations are to apply in the normal and accepted way. For it is essential in order to apply moral considerations in the accepted way that we consider alternative worlds, in order to take account of options, risks, and alternative outcomes; but these alternative or counterfactual worlds are not in so different a position from the future with respect to determinacy; for example, there is indeterminacy with respect to the number of people who may be harmed in the bus case or in a

possible nuclear reactor melt-down. These alternative worlds, like the distant future, are indeterminate in some respects, but not totally indeterminate.

It might still be thought that the indeterminacy of the future, for example with respect to number and exact character, would at least prevent the interest of future people being taken into account where there is a conflict with the present. Since their numbers are indeterminate and their interests unknown, how can we weigh their competing claims against those of the present and immediate future where this information is available in a more or less accurate form? The question is raised particularly by problems of sharing fixed quantities of resources among present and future people, when the numbers of the latter are indeterminate. Such problems are indeed difficult, but they are not resolved by *ignoring* the claims of the future, any more than the problems raised by the need to take account in decision-making of factors difficult to quantify are resolved by ignoring such factors. Nor are such distributional problems as large and representative a class of moral problems concerning the future as the tendency to focus on them would suggest. It should be conceded then that there will be cases where the indeterminacy of aspects of the future will make conflicts very difficult or indeed impossible to resolve — a realistic ethical theory will not deliver a decision procedure — but there will equally be other conflict cases where the level of indeterminacy does not hinder resolution of the issue, e.g. the bus example which is a conflict case of a type. In particular, there will be many cases which are not solved by weighing numbers, numbers of interests, or whatever, cases for which one needs to know only the most general probable characteristics of future people. Moreover, even where numbers are relevant often only bounds will be required, exact numerical counts only being required where, for instance, margins are narrow; e.g. issues may be resolved as in parliament where a detailed vote (or division) is only required when the issue is close. It is certainly not necessary then to have complete determinacy to resolve all cases of conflict.

The question we must ask then is what features of future people could disqualify them from moral consideration or reduce their claims to it to below those of present people? The answer is: in principle, none. *Prima facie* moral principles are universalizable, and *lawlike*, in that they apply independently of position in space or in time, for example. But universalizability of principles is an outcome of those ethical theories which are capable of dealing satisfactorily with the present; in other words, a theory that did not allow properly for the future would be found to have defects as regards the present, to deal unjustly or unfairly with some present people, e.g. those remotely located, those outside some select subgroup such as (white-skinned) humans, etc. The only candidates for characteristics that would fairly rule out future people are the logical features we have been looking at, uncertainty and indeterminacy; what we have argued is that it would be far too sweeping to see these features as affecting the moral claims of future people in a general way. These special features only affect certain sorts of cases (e.g. the determination of best probable or practical course of action given only present information). In particular they

do not affect cases of the sort being considered, the nuclear one, where highly determinate or certain information about the numbers and characteristics of the class likely to be harmed or certainty of damage are not required.

To establish obligations to the future a full universalizability principle is not needed: it is enough to require that the temporal position of a person cannot affect his entitlement to just and fair treatment, to full moral consideration;¹⁷ inversely that it is without basis to discriminate morally against a person in virtue of his temporal position. As a result of this universalizability, *there is the same obligation to future people as to the present*; and thus there is the same obligation to take account of them and their interests in what we do, to be careful in our actions, to take account of the probability (and not just the certainty) of our actions' causing harm or damage, and to see, other things being equal, that we do not act so as to rob future people of what is necessary for the chance of a good life. Uncertainty and indeterminacy do not free us of these obligations. If, in a closely comparable case concerning the present, the creation of a significant risk is enough to rule out an action as immoral, and there are no independent grounds for requiring greater certainty of harm in the future case under consideration, then futurity alone will not provide adequate grounds for proceeding with the action, thus discriminating against future people. Accordingly we cannot escape, through appeal to futurity, the conclusion tentatively reached in our first section, that proposals for nuclear development in the present state of technology for future waste disposal are immoral.

IV. Overriding Consideration Arguments

In the first part we noticed that the consigner's action could not be justified by purely economic arguments, such as that his profits would rise, the firm or the village would be more prosperous, or by appealing to the fact that some possibly uncomfortable changes would otherwise be needed. We also observed that the principle on which this assessment was based, that one was not usually entitled to create a serious risk to others for these sorts of reasons, applied more generally and, in particular, applied to the nuclear case. For this reason the economic arguments which are thus most commonly advanced to promote nuclear development—e.g. cheapness, efficiency, profitability for electricity utilities, and the need otherwise for uncomfortable changes such as restructuring of employment, investment, and consumption—do not even *begin* to show that the nuclear alternative is an acceptable one. Even if these economic assumptions about benefits to present people were correct (and there is reason to doubt that most of them are),¹⁸ the arguments would fail because economics must operate within the framework of moral constraints, and not vice versa.

What one does have to consider, however, are moral conflict arguments, that is, arguments to the effect that, unless the *prima facie* unacceptable alternative is taken, some even more unacceptable alternative is the only possible outcome, and will ensue. For example, in the bus case, the consigner may argue that his action is justified because unless it is taken the village will starve.

It is by no means clear that even such a justification as this would be sufficient, especially where the risk to the passengers is high, as the case seems to become one of transfer of costs and risks onto others; but such a moral situation would no longer be so clearcut, and one would perhaps hesitate to condemn any action taken in such circumstances.

Some of the arguments advanced to show moral conflict are based on competing duties to present people, and others on competing obligations to future people, both of which are taken to override the obligations not to impose on the future significant risk of serious harm. The structure of such moral conflict arguments is based crucially on the presentation of a genuine and exhaustive set of alternatives (or at least practical alternatives), and upon showing that the only alternatives to admittedly morally undesirable actions are even more undesirable ones. If some practical alternative which is not morally worse than the action to be justified is overlooked, suppressed, or neglected in the argument—for example, if in the bus case it turns out that the villagers have another option to starving or to the sending off of the parcel, namely, earning a living in some other way—then the argument is defective and cannot readily be patched. We want to argue that suppression of practicable alternatives has occurred in the argument, designed to show that the alternatives to the nuclear option are even worse than the option itself, and that there are other factual defects in these arguments as well. In short, the arguments depend essentially on the presentation of false dichotomies.

The first argument, the *poverty argument*, is that there is an overriding obligation to the poor, both the poor of the third world and the poor of industrialized countries. Failure to develop nuclear energy, it is often claimed, would amount to denying them the opportunity to reach the standard of affluence we currently enjoy and would create unemployment and poverty in the industrialized nations.

The unemployment and poverty argument does not stand up to examination either for the poor of the industrial countries or for those of the third world. There is good evidence that large-scale nuclear energy will help to increase unemployment and poverty in the industrial world, through the diversion of great amounts of available capital into an industry which is not only an exceptionally poor provider of direct employment, but also helps to reduce available jobs through encouraging substitution of energy use for labour use.¹⁹ The argument that nuclear energy is needed for the third world is even less convincing. Nuclear energy is both politically and economically inappropriate for the third world, since it requires massive amounts of capital, requires numbers of imported scientists and engineers, and creates negligible employment, while politically it increases foreign dependence, adds to centralized entrenched power and reduces the chance for change in the oppressive political structures which are a large part of the problem.²⁰ The fact that nuclear energy is not in the interests of people of the third world does not, of course, mean that it is not in the interests of, and wanted by, their rulers, the westernized and often military elites in whose interests the economies of these countries are usually

organized; but it is not paternalistic to examine critically the demands these ruling elites may make in the name of the poor.

The poverty argument then is a fraud. Nuclear energy will not be used to help the poor.²¹ Both for the third world and for the industrialized countries there are well-known energy-conserving alternatives and the practical option of developing other energy sources,²² alternatives which are morally acceptable and socially preferable to nuclear development, and which have far better prospects for helping the poor.²³

The second major argument advanced to show moral conflict appeals to a set of supposedly overriding and competing obligations to future people. We have, it is said, a duty to pass on the immensely valuable things and institutions which our culture has developed. Unless our high-technological, high-energy industrial society is continued and fostered, our valuable institutions and traditions will fall into decay or be swept away. The argument is essentially that without nuclear power, without the continued level of material wealth it alone is assumed to make possible, the lights of our civilization will go out.²⁴

The *lights-going-out argument* raises rather sharply questions as to what is valuable in our society, and of what characteristics are necessary for a good society. These are questions which deserve much fuller treatment than we can allot them here, but a few brief points should be made.

The argument adopts an extremely uncritical position with respect to existing high-technology societies, apparently assuming that they are uniformly and uniquely valuable; it also assumes that technological society is unmodifiable, that it can't be changed in the direction of energy conservation or alternative energy sources without collapse. Such a society has to be accepted and assessed as a whole, and virtually unlimited supplies of energy are essential to maintain this whole.

These assumptions are hard to accept. The assumption that technological society's energy patterns are unmodifiable is especially so — after all, it has survived events such as world wars which have required major social and technological restructuring and consumption modification. If western society's demands for energy are totally unmodifiable without collapse, not only would it be committed to a programme of increasing destruction, but one might ask what use its culture could be to future people who would very likely, as a consequence of this destruction, lack the resource base which the argument assumes to be essential in the case of contemporary society.

There is also difficulty with the assumption of uniform valuableness; but if this is rejected the question becomes not: what is necessary to maintain *existing* high-technological society and its political institutions? but rather: what is necessary to maintain what is *valuable* in that society and the political institutions which are needed to maintain those valuable things? While it may be easy to argue that high energy consumption is necessary to maintain the political and economic *status quo*, it is not so easy to argue that it is essential to maintain what is *valuable*, and it is what is valuable, presumably, that we have a duty to pass on to the future.

The evidence, e.g. from history, is that no very high level of material affluence or energy consumption is needed to maintain what is valuable. There is good reason in fact to believe that a society with much lower energy and resource consumption would better foster what is valuable than our own. But even if a radical change in these directions is independently desirable, as we believe it is, it is not necessary to presuppose such a change, in the short term at least, in order to see that the assumptions of the lights-going-out argument are wrong. No enormous reduction of well-being is required to consume less energy than at present, and certainly far less than the large increase over present levels of consumption which is assumed in the usual economic case for nuclear energy.²⁵ What the nuclear strategy is really designed to do then is not to prevent the lights going out in western civilization, but to enable the lights to go on burning all the time — to maintain and even increase the wattage output of the Energy Extravaganza.

In fact there is good reason to think that, far from the high energy consumption society fostering what is valuable, it will, especially if energy is obtained by nuclear-fission means, be positively inimical to it. A society which has become heavily dependent upon an extremely high centralized, controlled, and garrisoned, capital- and expertise-intensive energy source, must be one which is highly susceptible to entrenchment of power, and one in which the forces which control this energy source, whether capitalist or bureaucratic, can exert enormous power over the political system and over people's lives, even more than they do at present. Very persuasive arguments have been advanced by civil liberties groups and others in a number of countries to suggest that such a society would tend to become authoritarian, if only as an outcome of its response to the threat posed by dissident groups in the nuclear situation.²⁶

There are reasons to believe then that with nuclear development what we would be passing on to future generations would be some of the worst aspects of our society (e.g. the consumerism, growing concentration of power, destruction of the natural environment, and latent authoritarianism), while certain valuable aspects would be lost or threatened. Political freedom is a high price to pay for consumerism and energy extravagance.

Again, as in the case of the poverty arguments, clear alternatives which do not involve such unacceptable consequences are available. The alternative to the high-technology-nuclear option is not a return to the cave, the loss of all that is valuable, but the development of alternative technologies and life-styles which offer far greater scope for the maintenance and further development of what is valuable in our society than the highly centralized nuclear option.²⁷ The lights-going-out argument, as a moral conflict argument, accordingly fails, because it is also based on a false dichotomy. Thus both the escape routes, the appeal to moral conflict and the appeal to futurity, are closed.

If then we apply the same standards of morality to the future as we acknowledge for the present — as we have argued we should — the conclusion that the proposal to develop nuclear energy on a large scale is a crime against the future is inevitable, since both the escape routes are closed. There are, of

course, also many other grounds for ruling it out as morally unacceptable, for saying that it is not only a crime against the distant future but also a crime against the present and immediate future. These other grounds for moral concern about nuclear energy, as it affects the present and immediate future, include problems arising from the possibility of catastrophic releases of radioactive fuel into the environment or of waste material following an accident such as reactor melt-down, of unscheduled discharges of radiation into the environment from a plant fault, of proliferation of nuclear weapons, and of deliberate release or threat of release of radioactive materials as a measure of terrorism or of extortion. All these are important issues, of much moral interest. What we want to claim, however, is that on the basis of its effects on the future *alone*, the nuclear option is morally unacceptable.²⁸

NOTES

The following is a revised and abbreviated version of the Routleys' extensive and well-documented collection of supporting citations and notes. It has been revised to conform with the format of this anthology and abbreviated to meet space constraints. The reader who wishes to look further into the moral implications of nuclear technology is well-advised to examine the original article in *Inquiry* (Summer 1978). The complete article also contains careful and insightful criticisms of John Passmore's and John Rawls's view concerning the duty to future generations. — Ed.

1. Thus according to the Fox Report:

There is at present no generally accepted means by which high level waste can be permanently isolated from the environment and remain safe for very long periods. . . . Permanent disposal of high-level solid wastes in stable geological formations is regarded as the most likely solution, but has yet to be demonstrated as feasible. It is not certain that such methods and disposal sites will entirely prevent radioactive releases following disturbances caused by natural processes or human activity.

2. See A. Roberts, "The Politics of Nuclear Power," *Arena*, No. 41 (1976), pp. 24–5.
3. On all these points, see R. Nader and J. Abbotts, *The Metace of Atomic Energy* (Outback Press, Melbourne, 1977), esp. p. 141. According to the Fox Report (note 1, above), p. 110:

Parts of the reactor structure will be highly radioactive and their disposal could be very difficult. There is at present no experience of dismantling a full-size reactor.

4. See, in particular, The Union of Concerned Scientists, *The Nuclear Fuel Cycle* (Friends of the Earth Energy Paper, San Francisco, 1973), p. 47; also, A. M. Weinberg, "Social Institutions and Nuclear Energy," *Science*, Vol. 177 (July 1972), p. 32, and Nader and Abbotts (see note 3, above), p. 149.
5. As the discussion in Nader and Abbotts (note 3, above), pp. 153–7, explains.
6. Cf. A. B. Lovins and J. H. Price, *Non-Nuclear Futures: The Case for an Ethical Energy Strategy* (Friends of the Earth International, San Francisco, 1975), pp. 35–6.

For much detail, see J. R. Goffman and A. R. Tamplin, *Poisoned Power* (Rondale Press, Emmaus, Pa., 1971).

7. On the pollution and waste disposal record of the infant nuclear industry, see Nader and Abbotts (note 3, above) and Lovins and Price (note 6, above).

The record of many countries on pollution control, where in many cases available technologies for reducing or removing pollution are not applied because they are considered too expensive or because they adversely affect the interests of some powerful group, provides clear historical evidence that the problem of nuclear waste disposal would not end simply with the devising of a "safe" technology for disposal, even if one could be devised which provided a sufficient guarantee of safety and was commercially feasible. . . .

It must be stressed then that the problem is not merely one of disposal technique. Historical and other evidence points to the conclusion that many of the most important risks associated with nuclear waste disposal are not of the kind which might be amenable to technical solutions in the laboratory. A realistic assessment of potential costs to the future from nuclear development cannot overlook these important non-technical risk factors.

8. Of course, the effect on people is not the only factor that has to be taken into consideration in arriving at a moral judgment. Nuclear radiation, unlike most ethical theories, does not confine its scope to human life. But since the harm nuclear development is likely to cause to nonhuman life can hardly *improve* its case, it suffices if the case against it can be made out solely in terms of its effects on human life in the conventional way.
9. Discount, or bank, rates in the economists' sense are usually set to follow the market; cf. P. A. Samuelson, *Economics*, 7th ed. (McGraw Hill, New York, 1967), p. 351. Thus the rates have little moral relevance.
10. Cf. Rawls, *A Theory of Justice* (Harvard University Press, Cambridge, Mass, 1971), p. 287. "From a moral point of view there are no grounds for discounting future well-being on the basis of pure time preference."

11. What the probabilities would be depends on the theory of probability adopted: a Carnapian theory, e.g., would lead back to the unconstrained position.
12. S. McCracken, "The War Against the Atom," *Commentary*, September, 1977, pp. 33–47.
13. Cf. Passmore, *Man's Responsibility for Nature* (Duckworth, London, 1974, and Scribner's, New York, 1974).
14. Cf. Golding, "Obligations to Future Generations," *Monist*, Vol. 56 (1972), pp. 85–99, also this collection.

15. A real possibility is one which there is evidence for believing could eventuate. A real possibility requires producible evidence for its consideration. The contrast is with mere logical possibility.
16. Thus, to take a simple special case, economists discuss distant future people from their assessments of utility, welfare, etc., on the basis of their non-existence; cf. Ng ("the utility of a non-existent person is zero") and Harsanyi ("only existing people [not even "non-existing potential individuals"] can have real utility levels since they are not the only ones able to enjoy objects with a positive utility, suffer from objects with a negative utility, and feel indifferent to objects with zero utility") (see Appendix B of Y. K. Ng, "Preference, Welfare, and Social Welfare," paper presented at the *Colloquium on Preference, Choice and Value Theory*, RSSS (Australian National University, August 1977), pp. 24, 26–7). Non-existent people have no experiences, no preferences;

distant future people do not exist; therefore distant future people have no utility assignments—so the sorites goes. But future people at least will have wants, preferences, and so on, and these have to be taken into account in adequate utility assessments (which should be assessed over a future time horizon), no matter how much it may complicate or defeat calculations.

17. Such a principle is explicit both in classical utilitarianism (e.g., Sidgwick, *The Methods of Ethics* (Macmillan, London 1962, reissue), p. 414), and in a range of contract and other theories from Kant and Rousseau to Rawls (see note 9, above). How the principle is argued for will depend heavily, however, on the underlying theory; and we do not want to make our use depend heavily on particular ethical theories.

18. See esp. R. Lanoue, *Nuclear Plants: The More They Build, The More You Pay* (Center for Study of Responsive Law, Washington, DC, 1976); also see Nader and Abbotts (note 3, above).

19. On all these points see R. Grossman and G. Daneker, *Guide to Jobs and Energy* (Environmentalists for Full Employment, Washington, DC, 1977), pp. 1-7, and also the details supplied in substantiating the interesting case of B. Commoner, *The Poverty of Power* (Knopf, New York, 1976). On the absorption of available capital by the nuclear industry, see as well Roberts (note 2, above), p. 23. On the employment issues, see too H. E. Daley in B. Commoner, H. Boksenbaum and M. Corr (eds.), *Energy and Human Welfare—A Critical Analysis*, Vol. III (Macmillan, New York, 1975), p. 149. A more fundamental challenge to the poverty argument appears in I. Illich, *Energy and Equality* (Calder & Boyars, London, 1974), where it is argued that the sort of development nuclear energy represents is exactly the opposite of what the poor need.

20. For much more detail on the inappropriateness see E. F. Schumacher, *Small is Beautiful* (Blond & Briggs, London, 1973). As to the capital and other requirements, see the Fox Report (cited note 1, above), p. 48, and also Commoner's *The Poverty of Power*, and Commoner, Boksenbaum and Corr (eds.), *Energy and Human Welfare* . . . (both cited in note 17, above).

21. This fact is implicitly recognized in the Fox Report (note 1, above) p. 56.

22. A useful survey is given in A. Lovins, *Energy Strategy: The Road Not Taken* (Friends of the Earth, Australia, 1977); reprinted from *Foreign Affairs*, October 1976). See also Lovins and Price (note 6, above), Commoner (note 17, above), Nader and Abbotts (note 3, above), and Schumacher (note 18, above).

23. This is also explained in the Fox Report (note 1, above), p. 56.

24. An argument like this is suggested in Passmore (note 11, above), Chs. 4 and 7, with respect to the question of saving resources. In Passmore this argument for the overriding importance of passing on contemporary culture is underpinned by what appears to be a future-directed ethical version of the Hidden Hand argument of economics—that, by a coincidence which if correct would indeed be fortunate, the best way to take care of the future (and perhaps even the only way to do so, since do-good intervention is almost certain to go wrong) is to take proper care of the present and immediate future. The argument has all the defects of the related Chain Argument discussed above and others.

25. See Nader and Abbotts (note 3, above), p. 66, p. 191, and also Commoner (note 17, above).

26. For such arguments see esp. M. Flood and R. Grove-White, *Nuclear Prospects: A Comment on the Individual, the State and Nuclear Power* (Friends of the Earth, Council for the Protection of Rural England and National Council for Civil Liberties, London, 1976).

27. For a recent sketch of one such alternative which is outside the framework of the conventional option of centralized bureaucratic socialism, see E. Callenbach's novel, *Ecotopia* (Banyan Tree Books, Berkeley, Calif., 1975). For the outline of a liberation socialist alternative see *Radical Technology*, ed. by G. Boyle and P. Harper (Undercurrents Limited, London, 1976), and references therein.

28. We have benefited from discussion with Ian Hughes and Frank Muller and useful comments on the paper from Brian Martin and Derek Browne.