ETHICAL NORMS IN THE USE OF RADIATION AND NUCLEAR POWER

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There is a very extensive literature and philosophy treating the ethics, morals and the principles underlying our behaviour as individuals and as members of an organized world. But when it comes to the point of applying ethical norms to practical (real or hypothetical) situations involving decisions by more than one or a few individuals, the principles become less clear and the guidelines less specific. Patterns of behaviour which appear simple and straightforward when applied to individuals' behaviour and life, become fuzzy and difficult to handle when upscaled to encompass many individuals and many lifespans.

Ethically satisfactory behaviour in work with radiation should be governed by the same basic moral requirements as are our other functions in society. These requirements may be condensed into three concepts: honesty, consistency, and generosity.

The first two are easier to define and explain acceptably to most people, though both of them carry their own intrinsic difficulties. _Honesty_ is telling the whole truth and nothing but the truth, _and_ admitting and stating ignorance when information is _lacking_. The ethical problem comes perhaps mainly in how far honesty should be pursued in terms of information: Should the cancer patient always be told of his prospects? Should the public be informed to the last confusing and disturbing detail?

Consistency means applying the same scales and standards to all comparable situations. This principle is easy to follow, if the scales and standards are accepted generally and across the board. Difficulties arise if differing scales and new standards are brought to bear on the same subjects.

The resolution of the latter type of conflict may lead us into the last category, that of _generosity_. This is the soft element of the structure. Certainly it is the most difficult one to define and delimit, and - simply due to its softness, and ad hoc non-rational character - also the least acceptable, in relations already so complex that the ground rules must be kept as simple as possible. But this softness is the factor which elevates ethics to a set of rules above the cook-book recipies for human behaviour. Also, it introduces an aspect of flexibility which enables the set of rules to cover new and unforseeable consequences of a given situation or action.

As examples for discussion are chosen three or four situations where ethics are to some extent involved in the way questions or problems are approached and might be solved. These are

a) the way we specialists present our information and our arguments to the non-specialists and the public in general, and
b) the way we handle possible radiation damage and fears of damage in individual cases today, and
c) the way we evaluate the effects inflicted, today or later, on future generations.

These are areas with real problems and difficulties, which may be resolved according to various models, and where ethical attitudes may be important for the choice of solution. Many of us have worked through these questions not only once but several times, and yet the same and definite answer does not come up every time.

First, the presentation of our - the specialists' - views and arguments to our employers - the public. Let us start with a look at two cost-benefit analysis presentations.

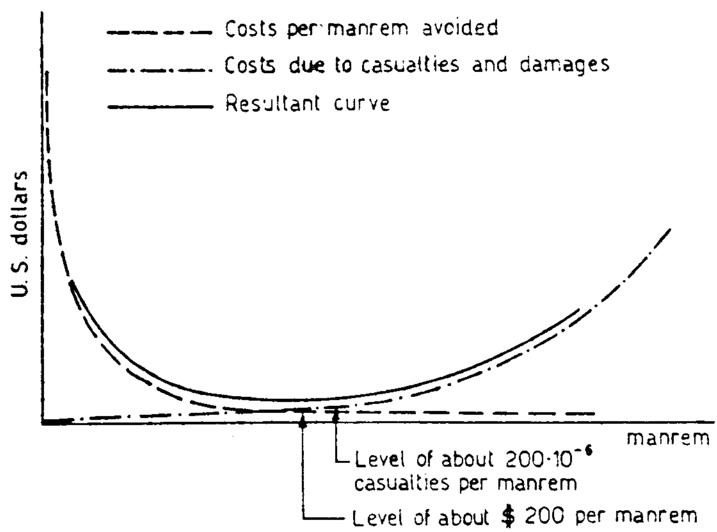
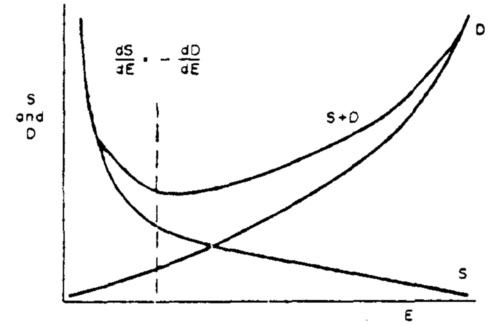


Fig. 1

Fig.1 is a curve I showed some years ago indicating cancer risk and cost per man-rem avoided, according to the numbers which were accepted at that time. The point I wanted to make is very clear from the way I chose my dimensions. My speaking point was that the trough of the resultant curve is flat, and that there is a fairly wide dose range where the curve gives little advice on where to settle. My conclusion was then that experts with responsibility for protection would tend to advice a lower, more restrictive limit, whereas experts - equally expert - with responsibility tied to production will tend to settle at the higher limit of the flat area, leaving a range where a politically determined choice will have to be made.



Differential cost-benefit analysis.
E = a variable reflecting the exposure, possibly in man-rems.
S = total cost of achieving a value of E.
D = total cost of detriment associated with a value of E.

Fig. 2

In some contrast then, the official ICRP version in Fig.2 which represents an idealized description of the elements entering into a cost-benefit analysis, resulting in a very well defined minimum. I have even heard this minimum described as the point where the tangents of the two curves have equal and opposite values.

There is nothing unethical about either of these presentations. In the first case, the form of the curve was chosen to demonstrate the complexity of the situation and to emphasize the responsibilities of the non-specialist authorities. In the second case, the presentation is constructed to demonstrate the elements and principles involved.

The question of ethics comes in when models of this kind are used without comments, and presented as if they were the full and absolute truth, with no doubts, uncertainties or alternatives.

Table 3. Estimated number of cases of serious genetic disease per 10^6 man rem delivered at low doses and dose-rates (see Oftedal and Searle, 1979)

Type of effect	nos. at Equilibrium	1st and 2nd Generation
Unbalanced translocations: Risk at birth	30	23 + 6 = 29
Trisomics + XO	30	30 + 0 = 30
Simple dominants + sex-linked	100	20 + 16 = 36
Dominants of incomplete penetrance etc.	160	16 + 14 = 30
Multifactorial disease not maintained by mutation	0	0
Recessives	–	–
Total	320	89 + 36 = 125

Fig. 3

Now, let us look at a genetic risk estimate developed for an ICRP Task Group. On the basis of discussion of the limited and unsatisfactory scientific facts before us, and on our evaluation of them, we arrived at a risk estimate formulated as shown in Fig.3. The significant features of this table are

1) that it was made for radiation protection purposes, which means that it was evolved under the instruction that an updated genetic risk estimate was needed, in connection with the then forthcoming ICRP Publ. 26. If the geneticists did not produce specific numbers, someone else - presumably less qualified - would have to do so. The ethics of this situation then comes in as a conflict between the moral standards of the scientist - which tells you not to overinterpret your data - and the demand for us to shoulder the responsibilities as functioning members of public health/ technocracy sectors of the international society. In the actual situation, the obligation to act as advisors was deemed more important.
2) On the other hand, it became a necessity to make it quite clear that the risk estimate contains an element of non-scientific though honest and well informed guesswork. This comes out in the estimate of the risk for complexly inherited genetic ill health - dominants of incomplete penetrance etc, for which the basis for estimation is rather unsatisfactory - to be chosen as the sum of the chromosomal, simple dominant and sex-linked mutations - for which the basis for estimation is rather better.

The end figure comes out as a single number - which is what the commission needed - but there is obviously no claim to a mathematical exactness, nor any expression of the error attached to the figure. The number is quite close to the range of the BEIR and the UNSCEAR 1977 estimates.

The advantages are two-fold, as I see it: The most insecure number - the 160 due to incompletely penetrant dominant mutations etc - is linked to the more secure numbers, and any broad revision may be taken care of in the same way for all categories. Secondly, the number of calculating steps is reduced to a minimum.

The ethics of the exercise then really boils down to the very basic dogmas that we all learned in our homes, schools and undergraduate labs: Be honest, and don't take for your own things for which you have not worked. In that sense, this example is one of those that seems to be relatively simple to cope with.

The second situation pertains to a more or less legalistic problem, namely that of compensation for damage due to radiation, in particular cancer after relatively low doses. The problem arises because with stochastic events of this kind, cause may be unknown - and the case is usually termed "spontaneous", or it may be due to radiation exposure, but there is no way of distinguishing these two categories.

It is possible - by the use of Baye's theorem on conditional probability - to calculate what the relative probabilities are. The spontaneous frequencies of various cancers are quite well known in many countries, and the induction rates are fairly well established for many types. If the dose then is known, the conditional probability for one or the other being the cause may be calculated. However, at this point, we are in danger of moving into a numbers' game, which is bound to be unjust in some cases, and the outcome therefore not satisfactory. Regardless of whether one establishes probability criteria of 9:1, or 3:1 or 1:1 or 1:9, there is bound to be uncertainty and injustice, and also a sometimes disgraceful argument and dispute concerning the actual numbers used in the calculations.

An important aspect from an ethical point of view would be to shift the areas of dispute or of conflict of evaluation, into a frame of reference which is already well known and understood by all those involved. In other words, that the sense of security, or of assurance of justice, should depend not on technical subtleties (e g in dosimetry) or statistical refinements (e g in local cancer registration), but on straightforward and familiar categories like job description, and subjective risk evaluation.

Finally, the most difficult ethical questions of all, those of our attitudes to actions today which may mean trouble or ill health in lands far away and in future generations.

There is no doubt that the use of radiation and nuclear power puts a load on future generations. Partly so by introducing into present generations genetic damage which is not expressed in the immediately following generation but may crop up later, and partly by delayed exposure of future generations through the release of long lived radioactivity from reactors, reprocessing plants, and waste repositories.

In both these areas - the induction and manifestation of recessive mutations in humans, and the future radiation loads from repositories - we are fully ignorant - within limits - which means that we ought to use as our design criteria the most pessimistic assumptions, as advocated in principle by modern risk philosophy under such circumstances. This is in contrast to circumstances of uncertainty (and not ignorance) where a weighted risk may be accepted.

The ethical issue then falls into two parts:

Firstly, is it ethically permissible at all under any circumstance to charge future generations with the load of manifestations of damaged genetic material, in untold generations and therefore unavoidably in large absolute numbers, in order to attain advantages - e g energy - for ourselves and our immediate descendants.

And secondly, is it ethically permissible to charge distantly later generations with the obligation to maintain a social organization capable of an appropriate control function for the physical containment of radiation sources.

Parallel situations may be presented, showing that the problems are not unique for radiation. In general, we fall back on the same basic elements as was discussed above:

<u>Honesty</u> demands that we explain the situation fully to everyone interested. And if everyone interested are not able to grasp and understand the problems, this is our - the experts' - responsibility.

<u>Consistency</u> demands that the risks we ask our distant descendants to accept is not greater than those we would accept - in the absence of any corresponding benefits. This makes a cost-benefit evaluation very difficult, and the use of our present day ICRP standards for setting norms for the distant future may appear doubtful, and certainly needs a separate discussion and justification.

<u>Generosity</u> might be taken to mean that we should show reticence in utilizing our resources, even within our self-imposed limits, so as to leave our distant descendants a maximum of options to handle situations and problems which may be totally unknown today and completely unforeseen by us.