

Ethics and the microbiologist

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The questions 'what has ethics to do with microbiology?' or 'why should microbiologists bother with ethics?' are now firmly planted on the academic agenda. This is largely as a consequence of the emergence, over the past 25 years, of the techniques which enable us to read and engineer the genes of micro-organisms, and to produce cloned animals from cells in culture. Some have argued that these abilities rank above those of the nuclear engineer in terms of their potential to transform civilization. So it is not surprising that the way these techniques might be deployed is a matter of great concern to the wider society. It therefore behoves microbiologists to be aware of the likely impacts of their vocation which, in turn, requires that they become familiar with the ethical issues raised and possible ways by which such concerns can be treated.

Ethical issues pose questions about the appropriate behaviour required in a given situation. Answers to these questions can be derived from a 'descriptive ethics' which denotes the way different cultures respond to ethical questions, or answers can be obtained by reference to a compilation of 'normative ethics' assembled from statements about what is right behaviour or a good thing. These latter statements may be derived from a basic ethical premise such as "the end of all behaviour is happiness" (Aristotle) or "do to others what you would have others do to you" (sometimes referred to as the Golden Rule which may also be stated in its negative version) or "obey God" (the Bible). The examination of the arguments as to which basic premise to use is called 'meta-ethics'. So, when making ethical judgements, it is useful to be able to ground one's deliberations in one or other ethical system.

On examining the ethical issues facing microbiologists, it is helpful to consider them in two segments. The first centres on the way in which microbiologists work [the process (means) of doing microbiology], while the second pertains to the practical and theoretical objectives to which the work is directed [the products (ends) of microbiology].

From a consideration of the way microbiologists work and as a result of the increasing pressure placed on all academics through reviews and assessments, it has become increasingly necessary to recognize that unacceptable behaviour might result. For example, the falsification and fabrication of data coupled with the theft of data, ideas or published material (plagiarism, which could also occur when refereeing papers or reviewing grant applications) have been recognized as leading areas of scientific misconduct. Undeclared interests which could bias the selection of results is also a serious worry and many journals now require funding sources to be declared (if not always published). Other issues are raised when academics withhold information or provide misleading impressions to possible competitors. The authorship of papers and grant applications is also a source of contentious behaviour as the

various parties wrestle over who has made the intellectual versus the practical contribution to the final document. Many microbiologists use animals to test vaccines or raise antibodies; it is important in such work that the minimum number of animals is used to the greatest effect while achieving as much of the toxicity work as possible in cell cultures.

In the product category, the genetic engineering of micro-organisms has roused many criticisms from which four major themes can be discerned. The first is that the genetic manipulation of a human pathogen may result in the production of a 'doomsday bug'. This is equated to the disaster personified in Frankenstein's created monster. The projection of such work to the area of biowarfare is also held in dread. However, the application of the self-same skills enable us to fabricate antidotes to existing and future pathogens as we are well on the way to achieving the total elimination of virally caused polio by the early years of the new millennium. It is also expected that measles and the range of diseases caused by *Haemophilus influenzae* b will also be eradicated. Nevertheless, the threat from a readily made biowarfare agent needs to be taken seriously and the deployment of additional resources to meet such a contingency cannot be obviated. A second view of genetic engineering is that it usurps the functions of the deity or it involves microbiologists and genetic engineers in 'playing God'. One could argue that the deity intended us to develop and use these techniques, and in any case humans no longer posture as gods. The third contention is that it is not natural for humans to deliberately alter the genomes of other organisms. We have, of course, been producing different mutant microbes by the billion over the last 50 years in seeking those cultures which produce the greatest quantities of the most efficacious antibiotics and vitamins without a trace of a suggestion that this was unethical. In this work it would be the selection process which would provide a deliberate human-determined outcome but without incurring the criticism of unnaturalness. Such a precedent may be used to counter the criticism of the efforts of the genetic engineer who seeks the same outcome but by using a method which, it is hoped, can achieve the same or similar ends in a shorter time. Fourth, some argue that as big business is alleged to be the only agency which profits from genetic engineering, the imbalance in the distribution of community wealth is exacerbated. Here the criticism is not about genetic engineering *per se*, but rather the nature of big business. As such the remedy is in the socio-economic system rather than in the Petri dishes of the microbiologist.

Specific issues pertain to a welter of microbiological products amongst which we can discern vaccines; viral vectors carrying genes for therapeutic, prophylactic or enhancement effects; animal cell cultures which can provide nuclei for the production of animal and, potentially, human clones; foods and beverages made from or with genetically modified microbes; the effect of such organisms on both the

biological and physico-chemical environment; and a plethora of bioprocesses used to make improved detergents, digest polluting effluents, change the properties of paper pulp and provide the capability to effect stereospecific bio-transformations. While only some of these activities generate serious ethical concerns, it would be salutary were microbiologists prepared to meet such issues in a prepared and measured way. In so doing, the reputation of the discipline would be enhanced with a corresponding decrease in the unease which is voiced on behalf of the community via the media. This means that ethics has to become part of the microbiologist's armamentarium of understandings and capabilities.

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