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Biotechnology research is constantly confronted by legal and ethical boundaries. Occasionally, research has to be halted while we attempt to understand the consequences of what we are doing.

On the boundaries of ethics

Does ethics define the conditions for science – or is it the other way around? Two recent cases highlight the relationship between biotechnology research and the boundaries of ethics. Many countries, including Norway, have banned research on fertilised egg cells older than 14 days (1). This limit was first proposed by an American advisory body for ethical issues in 1979 (2). Part of the justification is that the formation of the three germ layers and the primitive streak, from which the central nervous system develops, occurs only at a later stage. Opinions differ as to the time at which an embryo should be awarded a separate moral status, and many regard fertilisation as the crucial stage. The formation of the primitive streak may nevertheless be regarded as the first expression of an *individual development* in the embryo, since this is the boundary to its further division and ability to produce a number of independent individuals (2). Until now, nobody has succeeded in keeping human embryos alive for so long. Now, however, two research groups have shown that they can be kept alive *in vitro* for 12–13 days. This brings new relevance to the discussion of the 14-day rule (2).

The other example concerns the American National Institutes of Health, which last year halted the funding of research that involved injection of human pluripotent cells in vertebrate embryos before the formation of the three germ layers (3). There is uncertainty regarding how human cells might interfere with the animal brain, and at worst provide it with human characteristics. The discontinuation of funding – the moratorium – represented a recognition that biotechnology research is colliding with established research policies and ethical boundaries, and that a time-out was needed to consider the issues involved. For example, the question of the legal status of these laboratory animals is raised: should they be regarded as regular laboratory animals? The institute is currently considering whether or not to lift the moratorium and grant support to such research projects, although under regulated conditions. On their website they therefore welcome comments to the proposal (3).

Both cases may provide support for the argument that technology guides ethics, not the other way around. We should not forget, however, that the boundaries that have been drawn are a product of a specific time and culture. Biotechnology legislation varies from one country to another, and in retrospect we can see that social conditions have historically played a key role in shaping our attitude to modern biotechnology. Changes in attitude to assisted conception over the last 30 years serve as an example. It has been argued that this change in attitude cannot be understood without reference to other processes of social change, such as the increased focus on rights, individualisation and new forms of union between couples (4). History shows that values and technology have a reciprocal

influence. The boundaries that we live within today must therefore be revised in light of new knowledge, and each case should be analysed separately: what are the ethical implications of this technological development, and what practical consequences may it entail? The discussion may equally well give rise to moral self-scrutiny revealing that the boundaries that we have already drawn up may have been too wide.

Since research is an international activity, these issues must be discussed at the international level. Last year, large research institutions in China, the UK and USA met to discuss a shared direction for research that involves heritable changes to the human genome (5). Here too, the parties agreed to halt such research for the time being. Such issues also impinge on national legislation and should therefore be discussed also in our domestic context. The Biotechnology Council (formerly the Biotechnology Advisory Board) was established to act as an interdisciplinary advisory body in discussions of ethical issues. Recently, the council endorsed genetic editing of gametes and redundant fertilised eggs, while also making it clear that «changes to the genetic material of future generations is an ethical line that should not be crossed» (6).

The champions of technology and those who look with scepticism towards the future both make use of moral arguments, but flaws in the lines of argumentation of both camps have been pointed out (7, 8). Theoretically based ethical analysis may help us discover such flaws and inconsistencies in our thinking. Those who undertake basic research in the natural sciences have a particular responsibility for clarifying the practical consequences of new technology. However, they should also be required to reflect on the ethical implications of any extensions of the boundaries to biotechnology research.

«Do we still want to understand ourselves as normative creatures?» Such was the question that the philosopher Jürgen Habermas asked in an essay on pre-implantation diagnostics and ethics in 2001 (9). He argues that such techniques represent a specific form of objectification of human nature that cannot be disregarded «if morality itself is not to start slipping». Could it be that some of the techniques that we have come to possess are so powerful as to challenge the core of our moral status as humans? That there are certain boundaries that we cannot cross without losing our humanity? This debate should evidently not be left to the experts alone. We need to establish spaces for conversation where the legal, cultural and ethical aspects of these questions can be elucidated and analysed independently of each other. Such conversations ought to include a diversity of voices – and they will take time.

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