Chapter 24
Science, Ethics, Education and Religion: Connecting and Disconnecting

John Bryant

Introduction

I was recently a member of a panel considering the question 'Are scientists playing God?' (On Common Ground 2017). Playing God is a term quite frequently used in relation to modern medical science, to the applications of science in medicine and rather less often in other areas of science, such as plant breeding. What exactly it means is often not clear, even to those who use it (many of whom do not actually believe in God!). However in general we may take it as a term of disapproval. There is a sense of boundaries or limits: scientists or doctors are going further than they should, taking actions or making decisions that exceed their authority and that this is morally wrong. Thus we see that there is a moral or ethical dimension in the ways in which scientific knowledge is used.

However, it does not stop there. In respect of ethical issues, these also arise in two areas within the actual practice of scientific research. Firstly there is the question of whether there are any areas of research or types of experiment that are beyond acceptable moral limits. Secondly, there are the moral norms of scientific research itself. This then leads to a general consideration of ethics and science.

Ethics and the Practice of Science

It is not surprising that ethical issues arise in respect of doing science. Scientific research is just one of a wide range of activities that characterise modern society (Resnik 1998). Indeed, in all industrialised countries and in increasing numbers of

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less developed countries, a significant proportion of GDP is devoted to it. Associated with this, societies (or at least their governments) place different values on different types of research. This in itself carries the notion that some areas of research are regarded as more worthwhile than others. Despite this, some authors have insisted that the actual performance of science is neutral, free from social or ethical construction (e.g. Wolpert 1992). In my view the latter view is not sustainable (see also Resnik 1998).

Like all human activities, there are actions associated with science that are regarded as morally wrong. Thus, experiments carried out by the notorious SS doctor, Josef Mengele, elicit universal condemnation and feelings of disgust, as any of our students of twentieth century history will tell us. Involvement of human subjects in research is now subject to the Declaration of Helsinki (7th revision, 2013).[1] In many cases it is very clear that particular research activities are wrong and should not be carried out. However, there are also grey areas in which moral decision-making is more fluid or where it involves deciding which course of action is less bad or more good. Many of these relate to, for example, use of experimental treatments where all else has failed: the person being treated is both a patient and a subject of research (e.g. Reardon 2015).

There are also wider aspects of this topic. For example, is it morally acceptable to use animals in research and, if so, what species of animal and what types of research? Further, some people are concerned about the trialling in the field of crop varieties bred by GM techniques, thus making the general environment a subject of our ethical concern. (See Bryant and la Velle (2018) for a much fuller discussion of the two latter issues.)

When we consider the ethical norms of science, again, what is right and wrong may sometimes seem obvious. Just as there is condemnation amongst sports fans (and within the organisations that govern sport) of cheating and of 'throwing' matches, there is equal condemnation of those scientists who present fraudulent data, fraudulent either because they are actually made up or because they have been 'optimised' to give the best possible impression. In both sport and science, unethical practices deceive the relevant communities and the wider public. Other examples in science include failure to publish negative results (especially in drug trials: Goldacre 2013) and plagiarism – copying someone else's work or, even more blatant, claiming someone else's work as one's own. However, several recent high-profile cases of scientific fraud show that the moral norms of science are not always observed; in this respect science may be no different from any other human activity. However, we may also note that although, in the words of Mark Twain, 'right is right and wrong is wrong', there are contexts in which transgressing moral codes has greater effects than in other contexts. In science, we 'stand on the shoulders of giants' – we are dependent on the work of those who have gone before – but if those giants turn out to have fabricated data, then our perch on their shoulders may be very unsteady. So at what point are school students introduced to the ethics of science? Up to Key

[1] It is not actually legally binding under international law but has been very widely adopted into national laws across the world.

Stage 4, ages 14–16, (UK Department of Education 2014), there is a gradual development of an understanding of scientific method and scientific thinking, but, apart from discussing objectivity and the need to avoid bias, there is no *specific* mention of the ethical norms of science itself. However, the *teaching objectives* at KS 4 include helping students in 'appreciating the power and limitations of science and considering ethical issues which may arise'. The greater flexibility at Key Stage 5 (ages 16–18) may allow this topic to be discussed in more depth, but in the main, detailed teaching about ethics and morals lies outside science.

Ethics and the Applications of Science

We now move on to consider how the results of scientific research may or may not be used. In the science fiction film *Jurassic Park*, scientists had discovered that they could re-create creatures using ancient DNA and decided to use it to clone dinosaurs and to set up a 'Jurassic' wild-life park. This prompted one of the characters in the film, Dr. Ian Malcolm,[2] to say *'Yeah, yeah, but your scientists were so preoccupied with whether or not they could that they didn't stop to think if they should'*. The word 'should' here is interesting firstly because it actually implies that the scientists *should not* have done what they did and secondly because there is a sense of imperative, similar to that in a sentence such as 'I know that I should have visited my grandmother but I went to the cinema instead'. Going back to the film, the implication is that cloning the dinosaurs was wrong, and as the plot unfolds, we learn that Dr. Malcolm thinks it is wrong because it is risky and that there is danger of harm both to the environment and to human visitors to Jurassic Park. Imposing unquantifiable and unknown risks is wrong.

The film thus presents one of the ethical issues that arise in the applications of science, the imposition of risk on those who have not chosen it or who are unaware of it (see also Bruce 2002). It featured strongly in early discussions about GM crops (see, e.g. Mayer 2002) and more recently in the debate about mitochondrial donation in IVF (often called, very misleadingly, three-parent IVF).

However, there are many more issues than risk in the applications of science. In considering this we need to think of the remit of ethics or morals. At its most basic, ethics is concerned with the moral rightness or wrongness of the ways in which humans treat and interact with each other. In the distant past, that consideration was confined to those within one's own group, society or tribe. Those outside the in-group were often treated very differently; sadly some elements of that attitude have persisted to the present day. However, in Christian teaching, everyone else is our neighbour and thus, in theory at least, we regard all humans as being morally significant. But it does not stop there. The discussion of Jurassic Park raised the possibility that the environment is a morally significant entity, not just because of its value to humankind but also because it has intrinsic moral value (see also Southgate 2002,

[2] Played by the American actor, Jeff Goldblum.

and Bryant and la Velle 2018). We also noted earlier that there are ethical issues concerning the use of animals in research and that again is related to extending moral significance beyond the human species (see Frey 2002 and Bryant and la Velle 2018, for further discussion of this).

The final general point that needs to be made is this: we need to understand that, in discussing ethical issues arising from the applications of science, in common with other areas of human activity, different people come to different conclusions as to what is right and what is wrong. Indeed, in some issues, deciding what is right or wrong may be difficult. As we noted earlier, it may be a case of deciding which action is better (from a particular ethical standpoint) rather than which one is clearly right or clearly wrong, thus leading to fluidity or even ambiguity in decision-making. This becomes very apparent when dealing with bioethics as is shown in the next section.

Bioethics

Introduction

Bioethics is the term used to cover those ethical issues that arise from or within biological, biomedical and medical science; it may also be extended to include environmental issues. In respect of the school curriculum, Key Stage 4 Science (UK Department of Education 2014) includes, as mentioned above, '*appreciating the power and limitations of science and considering ethical issues which may arise'* and '*evaluating risks both in practical science and the wider societal context, including perception of risk'*. Further, the specific elements of the biology syllabus include *the uses of modern biotechnology including gene technology and some of the practical and ethical considerations of modern biotechnology*. Ethical/bioethical issues are certainly there but are worded in a very general way.

By contrast, syllabuses[3] for religious education at this stage usually have a much more detailed statement about a range of bioethical topics, including abortion, 'beginning of life', *in vitro* fertilisation, genetic modification and stem cells (see for example AQA 2017). It is here that problems begin to arise. While one probably does not need to know much (or indeed anything) about nuclear fission to have an ethical discussion about atomic bombs, we cannot make a similar statement about ethical discussion of, for example, genetic engineering or of genetic selection of embryos. Some understanding of the actual biology is necessary in order to inform our ethical decision-making; teachers of religious education, appropriately qualified in their own area, may lack the required biological knowledge to guide their pupils through the discussion. Now we might argue that the pupils themselves have

[3] Detailed syllabuses in religious education are set by local education authorities usually with reference to the requirements of the relevant examination board(s).

obtained the relevant knowledge in their biology classes.[4] However, that makes two assumptions. Firstly, it is assumed that the relevant material in biology is taught before the bioethical discussion comes up in religious education, but in fact, unless there is close cooperation between the relevant teachers, this is often not so. Secondly, it is assumed that pupils will readily use knowledge gained in one area and apply it in another. It is the experience of teachers at all levels (including university) that this often does not happen (see, e.g. Haws 2001; Leggett and Robertson 1996; Stacey-Chapman 2015 and, for a theological perspective, Park 2013). So, although the better pupils may be able to transfer and apply knowledge across subject boundaries, for the most part it does not happen. There is the basis of an argument here in favour of lessons jointly run by teachers of science and of religious education. However, space does not permit further discussion of this, so instead we move on to consider particular issues in bioethics in more depth.

Bioethics and the Beginning of Life

Many of the issues mentioned in the list of ethical topics relate to the early stages of human development; indeed, several of them deal with human embryos in the first few days after fertilisation. The question is raised 'when does human life begin?', but actually the real question is 'when do we start to ascribe to a developing human the same moral significance as a born person?'. It is thus the same question as was addressed earlier – viz. who or what is a morally significant entity – but given greater poignancy because it involves human development. In relation to 'human rights', a foetus is not regarded as having such rights until it is actually born. However, the complexity of this issue is illustrated by the fact that in the law of the UK and in other countries where abortion is legal, there is a time limit within gestation after which abortion may not be carried out (except in very exceptional circumstances). Thus it is decided that after a foetus has reached a particular stage of development, it has the moral right to be protected even if it does not 'possess' human rights. Nevertheless, even with this level of protection, those who espouse a strict 'pro-life' position hold the view that abortion is always (or, for some, nearly always) wrong, however early in pregnancy it occurs.

But let us go back to those first few days after fertilisation. It is during this period that, in IVF, embryos exist outside of the human body, prior to being inserted into the uterus of the prospective mother. It is because of the development of IVF in the 1970s, with the first IVF baby being born in 1978, that so many other procedures can now be performed on the early embryo. In order to set the scene for understanding and evaluating both IVF and other procedures dependent on it, a brief description of developmental processes is necessary (see also Bryant and la Velle 2018).

[4] However, detailed discussion in biology may not occur until Key Stage 5.

- Firstly, fertilisation results in the entrance of one sperm cell into the egg. Normally it takes an ‘assault’ on the egg of about 100,000 sperm to achieve the entry of one, although in IVF this can be bypassed if necessary by the injection of a single sperm into the egg (a process known as ICSI).
- Fertilisation takes about 10 h, so, if ‘conception’ is being used to describe fertilisation, it is difficult to define ‘the moment of conception’.
- After about 24 h, the two sets of genetic material merge to form one diploid nucleus and cell division starts (embryologists call this ‘cleavage’ because of the appearance of one big cell being ‘cleaved’ into smaller cells). The embryo is moving down the fallopian tube towards the uterus.
- After about seven days, the blastocyst stage is reached. The embryo consists of a hollow ball with an outer skin of cells to which it is attached, protruding into the interior of the ball, the inner cell mass (Fig. 24.1). It is at this stage that some differentiation of the embryo becomes apparent with the outer layer of cells and the inner cell mass having different functions.
- If the blastocyst attaches to the wall of the uterus, a process known as implantation, a pregnancy is established. In humans this occurs only with 20–30% of blastocysts. The outer layer of cells forms the placenta and the inner cell mass will form the embryo proper. The embryo may split within the first few days after implantation to form identical twins. Note that the term ‘foetus’ is used from about eight to ten weeks after fertilisation.

In respect of this chapter, the main question that arises is ‘What is the moral status of the early embryo?’ We can also ask whether the biological facts outlined above help to answer the main question. The answer provided by the Warnock Committee, set up by the government of the day to consider the ethics and regulation of working with gametes and embryos outside the body, was somewhat ambiguous: ‘… the early embryo is not yet a person but nevertheless should not be regarded

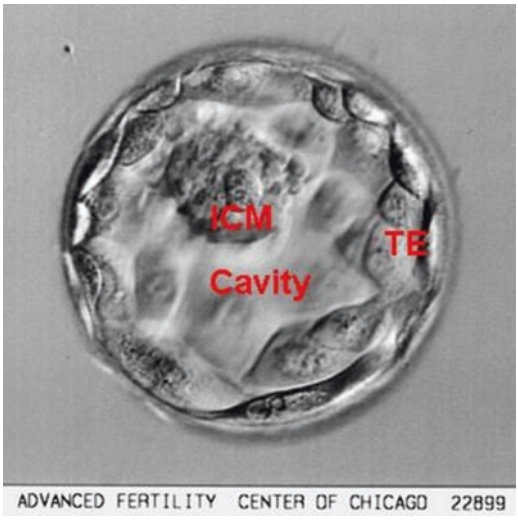

Fig. 24.1 Human blastocyst. *ICM* inner cell mass, *TE* trophoectoderm. Diameter of blastocyst is ca 150 цm

as just a ball of cells. Thus the embryo of the human species [should] be afforded some protection in law' (Warnock Committee 1984). The first part of the statement is clear enough – the early embryo is not a person, so our ethical frameworks for interacting with persons do not apply. It is therefore acceptable that in routine IVF procedures, several embryos are created and so some are 'spare'. But wait a minute – what does the second half of the statement mean? In practice it limits the type of research that can be done with human embryos and the uses to which spare embryos may be put.

The recommendations of the Warnock Committee became embedded in law with the passing of the Human Embryology and Fertilisation Act (1990). Nevertheless, significant numbers of MPs opposed the Bill that led to the establishment of the Act. Their view was that, despite the undifferentiated state of the early embryo, despite the high 'failure' rate at the implantation stage and despite the possibility of twinning, some people hold the view that from fertilisation onwards, the early embryo should be viewed as a person with all the moral significance that the term implies. For example, there can be no such thing as a spare embryo because it would imply that there can be such a thing as a spare person. This view is held by some evangelical Christians and by many Roman Catholic Christians. Indeed, the Roman Catholic Church totally opposes IVF in general, while those evangelical Christians who hold a very high view of the early embryo may accept IVF if no 'spare' embryos are created. However, many Christians find IVF, including the practice of creating several embryos, entirely acceptable. Muslims also find IVF acceptable but oppose gamete donation and surrogacy.

In addition to IVF itself, there is now a range of powerful genetic techniques that can be applied to the early embryo, ranging from genetic selection of embryos to genetic modification (GM). Under the terms of the HFE Acts (1990, 2008), GM techniques may be used in specific types of research on embryos, but GM embryos may never be used to start a pregnancy.[5] However, genetic *selection* of embryos is permitted and this forms the basis of the two case studies that now follow.

Case Studies in Embryo Selection

Before setting out the two case studies, it is emphasised that the procedures described are possible because of developments in genetics and molecular biology, in particular, the detection of specific mutations that lead to genetic disease and the ability to amplify specific DNA sequences. When we add our knowledge about early embryonic development and our very extensive experience of looking after embryos in vitro, we can see that we have a powerful set of techniques available to us. Thus it is relatively straightforward to remove one cell from an eight-cell embryo and to

[5] Exceptions are now allowed in respect of genome editing and mitochondrial donation. Details of these lie outside the scope of this chapter but may be found in Bryant and la Velle (2018).

test it for a particular mutation while it is being kept in a healthy state. This is known as pre-implantation genetic diagnosis (PGD). The first case study illustrates this.

Case Study One: Selecting Against Cystic Fibrosis[6].

- Peter and Helen[7], a British couple in their late 20s, wished to start a family
- Because of their family histories, they requested to be tested for the cystic fibrosis mutation.
- They were both heterozygous carriers of the mutation (CF is a recessive mutation, which means that people with just one mutated copy of the gene, i.e. who are heterozygous, do not have the disease).
- However, each child that the couple produced between them would have a one-in-four chance of being homozygous for the mutation, i.e. of having cystic fibrosis
- In order to avoid having a child with CF, the couple elected to use IVF and PGD
- Several embryos were created and were tested for the CF mutation
- An embryo free from the mutation was used to start a pregnancy; Helen eventually gave birth to a healthy child.

We should note two points in particular. First, as already noted, the usual procedure in IVF is to harvest several eggs and to create several embryos (a practice that, as noted above, some object to). In that respect, this procedure does not present us with anything new. Secondly, however, it is new that a further criterion has been added in deciding which embryo to place in Helen's uterus. Not only must the embryo be developing normally and look healthy, but it must also have the right genotype in respect of the CF mutation. Now, for many, that seems entirely reasonable, but others have suggested that it opens the way to selection for non-medical purposes. In the UK, the strict guidelines laid down by the Human Fertilisation and Embryology Authority do not permit selection for non-medical reasons, but that does not mean to say that such selection could not happen in other parts of the world.

The second case study illustrates how the technique may be used for other purposes, but still within the 'medical arena'.

Case Study Two: Selecting for a 'Saviour Sibling'

- Jack and Lisa Nash[8], an American couple living in Denver, Colorado, did not know that they were heterozygous carriers of the Fanconi anaemia[9] mutation until their first child Molly was born with the condition.
- In Fanconi anaemia, the bone marrow slowly fails and thus not enough blood cells are produced to keep up with the child's growth. Death usually occurs

[6] Details about cystic fibrosis may be found at https://www.cysticfibrosis.org.uk/what-is-cystic-fibrosis.

[7] The names are fictitious; this is a real case but the couple's real names are not known

[8] These names are real.

[9] Details about Fanconi anaemia may be found here http://www.fanconi.org.uk/wp-content/uploads/2008/08/fa-fact-sheet-11-0713.pdf

between the ages of five and fifteen, depending on the severity of the condition (although in some patients, symptoms do not appear until adulthood).
- Because it is a bone marrow condition, it may be cured by a stem cell transplant from an immunologically compatible donor who does not have Fanconi anaemia.
- No compatible donor could be found for Molly, so eventually the couple elected to opt for IVF and PGD, in order to select embryos that were free from the Fanconi mutation and which would also, when born, be immune-compatible donors for Molly.
- After several failures (which must have been heartbreaking), Adam was born. Molly was 6 years old and very ill.
- She received stem cells from Adam's umbilical cord which effectively cured her.

In addition to the points raised in connection with the first case study, more need to be made.

Firstly, because of the necessity to find a compatible donor, embryos that were free from the Fanconi mutation were nevertheless rejected because of incompatibility with Molly.[10] Secondly, there were concerns that Adam was regarded as a commodity. For these reasons, added to the points made in connection with the first case study, there was an outcry of opposition to the procedure.[11] Some 'pro-lifers' claimed that the science was becoming 'more and more monstrous', while in the UK it was suggested that the procedure transgressed the HFEA guidelines on genetic selection of embryos (but actually it did not). The term 'designer baby' was widely used in much of the discussion.

We may make two further points. First, we may wonder how Adam feels about his role in saving Molly (or even about his being born in order to save Molly). Secondly, there is the theoretical question of how he might have felt, had Molly not lived (presuming that the facts would come out at some point in his childhood). These points add a little more complexity to the ethical debate (see also Bryant 2012).

Wider Applications

The two case studies illustrate that, within the medical arena, pre-implantation genetic diagnosis is a versatile technique. Within that arena, it is used more and more widely as we discover more about the genetics of human disease, for example, through the 100,000 Genomes Project. However, the technique can also be used to select for those non-medically relevant traits for which we have clear genetic information (see Bryant 2013 and Bryant and la Velle 2018 for more detailed

[10] In the successful attempt, 14 embryos were created, of which several were healthy but could be used because of incompatibility with Molly

[11] See http://news.bbc.co.uk/1/hi/health/954408.stm

discussion). In the UK, such use of PGD is not permitted under HFEA Guidelines. However, in countries with less rigorous guidelines, it is possible that the use of PGD may be extended for non-medical use, and even in the UK, some have argued for a loosening of the guidelines, in some instances, to allow prospective parents to select for any trait that they wish. Thus, the Manchester philosopher John Harris states that *I cannot see a downside to research that increases the range of human possibility and choice* (Harris 2009). Meanwhile, in Oxford, Julian Savulescu has developed the idea of *procreative beneficence* that wherever possible we should 'select the best children'[12] (Savulescu 2001; Clarke et al. 2016). Similar ideas were expressed by the American commentator, Gregory Stock (Stock 2003), who went as far as saying '…neither governments, nor religious groups will be able to stop the coming trend of choosing an embryo's genes, and that there is little point in even trying'. The journalist Madeleine Bunting also wrote of the inevitability of such developments, although with very much less enthusiasm (Bunting 2006). Others are even more concerned about the liberalisation of genetic choices and the attitudes that lie behind it. For example, Celia Deane-Drummond (Deane-Drummond 2005) writes … *we should be more concerned with broader cultural trends that elevate liberalism to such an extent that children become rights which can be purchased according to parental desires and wishes.*

So, while for the present, the UK guidelines on genetic selection are maintained, there is amongst some secular ethicists and other commentators a wish for liberalisation. The issue will not go away and the debate will continue, emphasising the need for good ethical/bioethical education.

Bioethics and Religion: A Brief Comment

The attitudes of different Christians and of Muslims to aspects of IVF have already been mentioned. Here I will focus briefly on Christian attitudes. Reading some texts written by and for Christians on these topics, an impression is gained that there is a specific Christian view (and it is often very negative; see for example, Sutton 2008). Such ideas are often justified by use of the Bible, but it is here that we run into difficulties. The Bible is a collection of pre-scientific texts, written for several different purposes, but those purposes do not and cannot provide specific guidance on biotechnology, genetic modification, genetic selection and so on. However, some commentators have attempted to make biblical texts speak about science or, putting it another way, forcing science upon a text where it does not belong (see Bryant and Searle 2004, for a discussion of this). Two examples will suffice. First, in biblical times, nothing at all was known about the pre-implantation phase of human development that we have discussed here. Mammalian, including human, eggs were not discovered until the late seventeenth century (and rediscovered in the early nineteenth century). In the Bible, conception meant becoming pregnant, and it thus is

[12] Interestingly though, he also writes of the need for moral enhancement.

confusing that the word is now usually used to describe fertilisation. However, my point is clear: when the Bible talks about pre-birth life, it is talking about pregnancy and never about the pre-implantation phase because that phase was unknown. This leads on to the second example, namely, 'finding' in the Bible things that are not there. Thus, the conservative theologian and Christian ethicist Richard Hays points out that the Bible is totally silent on the subject of abortion (Hays 1996) and to say otherwise shows a misunderstanding of the text. In this example and in many others, we should therefore be wary of the statement that 'the Bible says' or the 'holy Qur'an says'.

However, along with Richard Hays (Hays 1996), we acknowledge that much of religious opinion on start-of-life issues (and on other issues in bioethics) is much more nuanced. For example, opposition to abortion may arise from application of general Christian principles and virtues, along with the idea found throughout the Bible, that a child is a gift from God. And so, going back to the pre-implantation phase of development, it might be said that it does not matter that this phase was unknown in biblical times; we do know about it now, and thus our care must extend back that far. This is of course the position taken by those who state that 'human life begins at conception' (where conception means fertilisation). And what all this leads to is that, as religious people think about these issues, there is likely to be a diversity of views. In recognising that, we will be better able to contribute to the ongoing ethical debates.

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