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Speculative Ethics: Valid Enterprise or Tragic Cul-De-Sac?

Michael King, Maja Whitaker and Gareth Jones
Bioethics Centre and Department of Anatomy, University of Otago
New Zealand

1. Introduction

The excitement generated by major scientific advances almost inevitably leads to intense speculation concerning the uses to which these advances will be put. Since some of these will be accompanied by ethical challenges, it is appropriate for bioethicists to delve into their potential ethical implications. If the ethical dimensions of such advances can be outlined and analyzed in advance, this would appear to be a welcome contribution to any public debate that may ensue. However, the speculations range from those that could eventuate within the near future and would represent an incremental change to present practices, to those that are vastly less likely to come to pass and predict paradigmatic shifts of momentous proportions. The challenge for bioethicists is to determine whether they should devote their attention to such extreme speculative possibilities, or to more circumscribed speculations, or indeed whether it is better to focus on existing issues, rather than those that are merely possible.

An illustration of more circumscribed speculation is provided by no less a scientific authority than Francis Collins in his 1999 Shattuck Lecture, in which he speculated on the medical and societal consequences of the Human Genome Project in 2010, just 11 years into the future. He described this as a hypothetical clinical encounter in which a 23-year-old undergoes a battery of genetic tests. This was because by 2010 Collins speculated that the field of pharmacogenetics would have blossomed to such an extent that a prophylactic drug regimen based on personal genetic data could be prescribed to reduce cholesterol level and the risk of coronary artery disease (Collins, 1999). As we look back at 2010 we can see that these goals have not as yet been realized at the level hypothesized by Collins. The question then is whether bioethical enquiry into the prospects opened up by genomic medicine has been weakened by this excessive optimism.

Interestingly, at much the same time, Holtzman and Marteau (2000) contended that the new genetics would not revolutionize the way in which common diseases are identified or prevented. In wanting people to see beyond the genetic hype, they pointed to the importance of existing issues, such as social structures, lifestyle and environment, for much of disease. They also questioned how much interest would be shown in being tested genetically and even more in making appropriate lifestyle choices. These too are considerations calling for the attention of bioethicists.

It is evident then that even relatively focused speculation has its problems. What about far more exploratory and aggressive speculation? Garreau (2005) considers that we are at a

turning point in history since our technologies are now capable of altering our minds, memories, metabolisms, personalities and progeny, and similar conjectures motivate Bailey's (2005) "liberation biology". Such vistas have led serious scholars to devote considerable effort towards counteracting what they see as a dangerous drift towards human self-modification, genetic perfectibility and eugenic aspirations (Habermas, 2003). The end-result of these biomedical technologies, it is claimed, is the emergence of programmed people, epitomized by lack of moral responsibility since they are no longer the authors of their own selves. These concerns emanate directly from taking seriously highly speculative futuristic visions of medical accomplishments and often conflating these with current reality.

The question we are addressing here is whether bioethicists should spend time and effort on speculative possibilities like these. In this chapter we describe and analyze some areas of applied ethics (particularly bioethics) in which speculation is at its most adventurous, such as nanotechnology, genetic technology, regenerative medicine, and cryonics. Possibly the most speculative of these is cryonics, which draws on the rest as potential means for fulfilling its vision. Because of these qualities, cryonics will be explored in greater depth as a case study in speculative ethics.

The technologies underlying these areas require ethical attention and analysis; they deliver new abilities into the hands of those who seek to use them, and ethical reflection helps to determine the nature and extent of use that can be defended as being responsible. There may be instances where this leads to a call for a prohibition on the use of a particular technology, as has been the case of genetic engineering. Further, a new technology can have unintended consequences that ethical scrutiny can help to reveal and evaluate.

In evaluating new and emerging technologies one of the major problems is arriving at an understanding of what the technologies are, and of how they might be developed in the future. This, as we have seen, is a path beset by uncertainties, yet understanding them as much as possible is integral to informing moral evaluation of them. This is because judgments that rely on false beliefs about new technologies can have pernicious consequences for the use of the technologies, and for the credibility of applied ethics. As speculation becomes more radical, and our uncertainty about the prediction increases, the epistemic status of applied ethics becomes less secure, and its value more questionable. To explore these issues, we address arguments for and against the role of speculation in ethical analysis of technology, and suggest some boundaries on ethical engagement with speculative matters. First, we will survey some areas of science and technology, focusing on the role that speculation has played in their development.

2. Genomic medicine

Genetics has to some degree always played a role in modern health care, but it was thought that the decoding of the human genome in 2003 would provide unprecedented understanding of the functions and interactions of the entire genome, producing a revolution in health care under the rubric of genomic medicine (Guttmacher and Collins, 2002). It was hoped that a clearer picture of the human genome would particularly transform the treatment of multifactorial disorders such as breast and colorectal cancers, and Alzheimer's and Parkinson's diseases, where inherited risk has long been implicated but little understood. Genomics was expected to uncover the mechanisms of complex diseases, including asthma, hypertension, and diabetes. Vignettes were frequently proposed, featuring a patient visiting a doctor, who would order genetic testing that

revealed certain genetic predispositions, allowing the doctor to craft a personalized approach to care, ensuring optimized prevention, diagnosis and treatment. There can be little doubt that these confident claims for genomic medicine were put forward in good faith. However, it was faith in an overly reductive and deterministic view of genetics, and in the ability of biomedical scientists and their clinical colleagues to translate the believed promise of genetic science into clinical reality. The gulf between genomics and personalized medicine turned out to be far greater than envisaged, resulting in an overstated optimism (Guttmacher & Collins, 2002; van Ommen et al., 1999) that, as mentioned, resulted in what now appear to have been quite unrealistic timescales (Collins, 1999).

It has emerged that even though markers of human variation (single nucleotide polymorphisms) can be associated with disease predisposition in large population samples, they contribute little to the apparent heritable risk and have poor predictive power at the individual level (Kraft & Hunter, 2009). Sequencing an individual's genome can produce a large amount of information, but the data is difficult to interpret, and so genomic medicine still has little effect on the health care of individuals (Collins, 2010; Hall et al., 2010).

The push to decode the genome carried with it an impetus to explore the ethical, legal and social implications of the new genetic knowledge, with the Human Genome Project dedicating five per cent of its budget to this cause. The program focused on clinical integration of genetic technology, public and professional education, and the fair use of genetic information, particularly in employment and health insurance (Collins, 1999). The aspiration to anticipate these implications before they transpire has been beneficial in allowing the formulation of appropriate guidelines and legislation, even though the timescales expected have proved awry (Ginsburg & Willard, 2009).

In terms of speculative ethics, therefore, genomic medicine stands as a beacon of hope. There has been speculation, some of which has been astray. Nevertheless, it has been limited in scope and concerted efforts have been made, and continue to be made, to tie in the scientific advances with considered ethical input and direction. The resulting liaison between the science and the ethics has been to the benefit of both.

3. Nanotechnology

The term "nanotechnology" was coined in 1974 by Norio Taniguchi (Taniguchi, 1974) and popularized in 1986 by Eric Drexler (who may have been unaware of its earlier usage) in his book "Engines of Creation: The Coming Era of Nanotechnology" (Drexler, 1986). "Nanotechnology" refers to the manipulation of matter at the atomic level. At this scale particles have different mechanical, electrical, thermal, optical and magnetic properties, possibly allowing the development of a whole range of materials and devices with new applications in fields as diverse as medicine and energy production. It has been postulated that nanomachines will one day be responsible for food production, biological repair, sewage processing, commodity fabrication, and house cleaning (Milburn, 2002).

Early discussions of molecular manufacturing were preoccupied with self-replicating nanomachines, and the prospect of the world being converted into a grey goo by these nanobots, a scenario sketched by Drexler in his seminal work (Drexler, 1986). Thus, a speculative doomsday scenario has characterized the field of nanotechnology from its earliest beginnings. Unfortunately, this has continued to dominate popular perception of nanotechnology (Sheetz et al., 2005), so much so that Drexler wishes he had never coined the term (Giles, 2004). He writes, "Fears associated with that old scenario are interfering with

current research. . . . Researchers resent it and I want to clean up the mess." (Giles, 2004). Drexler now acknowledges that nanoscale manufacturing does not require self-replicating devices, and so this conjectural danger can be avoided through prohibition (Phoenix and Drexler, 2004). The most fruitful area of research to date has been the production of nanoscale particles, such as carbon nanotubes, for the manufacture of characteristic materials for use in electrical circuits, textiles, and cosmetics (Coyle et al., 2007; Mu & Sprando, 2010).

However, the fears provoked by the "grey goo" scenario have persisted, and apparently have been manipulated by some environmental groups to engender support for their present concerns regarding technology profiteering (Giles, 2004). By contrast, in informed circles the nanotechnology debate has settled down into less spectacular, but more substantive issues, such as the possible toxicity of nanomaterials (Xia et al., 2009), their effects on biological systems (Navarro et al., 2008) and the global economic effects of a possible nanotechnology revolution.

The relevance of this area for the present essay is the role of applied ethics in such ongoing debate. To what extent does bioethical commentary continue to grapple with speculative and alarmist scenarios? It is likely that the "grey goo" possibilities occupied attention that could otherwise have been directed towards the issues that ethicists are now focusing on, to far greater benefit. However, the dramatic and catastrophic threat described by Drexler's scenario seems to demand addressing. These typify the problems posed by speculative matters in applied ethics, which we will explore later.

4. Regenerative medicine

The term "regenerative medicine" first appeared in the literature in 1992 as a hypothetical future technology that could revolutionize clinical treatment (Kaiser, 1992). The idea gained momentum when embryonic stem cells were isolated in 1998 (Thomson et al., 1998), and the possible clinical significance of their growth potential and pluripotency was appreciated. In theory, damaged tissues and organs could be regenerated by insertion of stem cells, stimulation of endogenous stem cells, or transplantation of tissues or organs grown *in vitro* from the patient's own stem cells (Mironov et al., 2004). The underlying hope is that these techniques will radically advance the treatment of diseases as wide-ranging as Alzheimer's and Parkinson's diseases, diabetes and spinal cord injury.

As is often the case at the cutting edge of scientific development, exciting prospects raise unwarranted hopes bereft of a feasible scientific basis, and this has been particularly so in the field of regenerative medicine (Kirkpatrick et al., 2006). The prospects within regenerative medicine have captured the imagination of commentators from a variety of backgrounds, who too often have moved with undue haste from considering the use of stem cells to treat disease and disability to the potential to redesign human nature (Bostrom, 2005; Glannon, 2008; Ip, 2009b). Regenerative medicine is depicted by some as being "rich with Promethean promises"(Ip, 2009a, p. 3). It is here that we enter the realm of transhumanism and posthumanism, where ethicists have considered the implications of these in terms of the exacerbation of social inequalities, intergenerational fairness, environmental ethics, and the problems posed by endless life spans, with subsequent divergence of enhanced and unenhanced human species (Agar, 2007).

Far away from these highly speculative vistas, in today's laboratories the field of regenerative medicine faces complex difficulties that are hampering the clinical application of stem cells at the most basic level. For example, scientists are yet to ascertain how to reliably direct cell differentiation to the desired lineage and modify cells without raising the

risk of tumor formation (Kirkpatrick et al., 2006). While this is a rapidly moving area of research, solutions to these basic problems will likely come gradually and hype should be tempered with caution (Daley, 2010).

Regenerative medicine raises bioethical challenges at different levels. Discussion that uncritically conflates regenerative medicine and its likely prospects with grandiose claims about remaking what it means to be human (e.g. Ip, 2009b) is profoundly misleading. Distaste over the latter claims may unfairly taint regenerative medicine, with the end-result of discouraging what could turn out to be extremely helpful medical interventions. While this may not be the intention of such commentators, it will only be avoided by clearly distinguishing the speculative hype from the serious science. Regenerative medicine in the clinic is not being driven by a program that views the human body as infinitely plastic, or that denies human finitude and mortality, and yet this is the concern of some who have been taken in by speculative hype (e.g. Song, 2009). Speculative bioethics of this ilk will simply perpetuate fundamental misconceptions.

Also of concern is the preoccupation of ethical debate on stem cells with the moral status of embryos. It is true that embryos are destroyed in the process of deriving embryonic stem cells. This is therefore a legitimate topic for debate and should not be avoided. However, this is not the sole area of bioethical debate on the potential of stem cells, especially as they relate to regenerative medicine. Lysaght and Campbell have cogently argued that bioethicists must also give due attention to the largely neglected issues of informed consent processes, the exploitation of women, the commodification of human tissue, science communication and the ownership of immortal cell lines (Lysaght & Campbell, 2011). All these are core ethical considerations for regenerative medicine as it seeks to enter the clinic. The fact that devoting attention to the issue of the embryo's moral status has left other important issues unattended shows the scarcity of moral consideration as a resource, and raises the question of how this consideration should be distributed. Speculative scenarios, with little if any relation to current clinical practice, such as the remaking of human nature through regenerative medicine, threaten to displace attention further from pressing current and emerging issues.

5. Cryonics

In simple terms cryonics is the practice of storing at very low temperatures the bodies or heads of legally deceased people (or animals), termed cryonic suspension. The purported value of cryonic suspension is that, from the stored body/head, the dead individual may be able to be resuscitated, allowing physical life after an indefinite period of death.

If there is a landmark publication for cryonics, it is Robert Ettinger's book "The Prospect of Immortality" (Ettinger, 1965). This is an attempt at a systematic evaluation of, and positive program for, the cryonics project. At the time of its publication no human bodies had been stored using cryonics, although the principle of freezing and reviving whole animals had been successfully demonstrated by Audrey Smith in the 1950s (Parry, 2004). Smith had succeeded in reviving some hamsters after freezing at -5 ^{o}C for 50-70 minutes, a minority of which survived for times approaching the normal hamster lifespan. However, Smith also established that this limited success disappeared if animals were frozen for longer than 70 minutes.

Presumably seeing the cup as half-full, Ettinger attempted to outline a viable approach to cryonics. Not a cryobiologist (he was a retired college maths and physics teacher at the time), Ettinger provided a semi-scientific evaluation of the problems facing the success of the cryonics enterprise, and an optimistic view of its eventual success. In a section entitled

"After a Moment of Sleep" (Ettinger, 1965, pp. 5-6) he describes a tired old man who will think of his death as merely a moment of dreamless sleep, like anaesthesia. This man will "awaken" unaware of the potentially vast period of time elapsed, and find himself in either a rejuvenated state, or about to undergo a process of "renovation". This can provide, if desired, the "physique of Charles Atlas". His "weary and faded wife" may also choose a physique to "rival Miss Universe" if she wishes. And, more importantly, "they will be gradually improved in mentality and personality". He imagines a future world which resembles "the present, king-sized and chocolate covered", in which "the resuscitees, will be not merely revived and cured, but enlarged and improved, made fit to work, play, and perhaps fight, on a grand scale and in a grand style." (Ettinger, 1965, p. 6)

With fanciful claims such as these in a foundational document of cryogenics, it is not surprising that the movement has been subject to ridicule. However, Ettinger acknowledges that "to remove the prospect of immortality from the realm of thin, hazy speculation or daydreams and secure it in the domain of emotional conviction and work-a-day policy… objections must be met, [and] a host of troublesome questions answered." (Ettinger, 1965, pp. 6-7) This is what his book aimed to do.

Many of the objections and troublesome questions may be of ethical importance. For instance, is cryonics impossible, perhaps even in principle? If so, are companies offering cryonic services being misleading at best or fraudulent at worst? What is the legal and moral status of the bodies in cryonic storage? If the claims of cryonicists are borne out in the future, what lives would the patients awake to, and could they reasonably be said to have consented to this given what they knew before they died? Should cryonics be judged more as a medical or mortuary procedure?

In order to evaluate cryonics ethically, it is necessary to know what the process might involve. In the light of this how likely is it that any of these currently impossible stages of the process will eventuate in the foreseeable future?

Cryonics may be divided into four stages: patient preparation and freezing, storage, renovation and resuscitation, and life. The first stage is the preparation and freezing of the cryonics patient. Here, the body of a patient is prepared for freezing, and rapidly cooled to a temperature below -120ºC. Various procedures are undertaken by cryonicists with the aim of minimizing post-mortem damage to the body (see Best, 2008). This damage is in part what would occur to any body after breathing and blood circulation cease (broadly termed ischemic injury (Kerrigan & Stotland, 1993)), and in part injury that can result from the cooling process (mainly ice crystal formation (Best, 2008)).

Once the body is appropriately prepared, cooling to temperatures below -120ºC occurs. The goal for cryonicists at this stage is to achieve vitreous cooling with the aim of avoiding the cellular damage caused by conventional freezing through ice crystal formation (Best, 2008). Cooling a large biological system like a human body to a contiguous vitreous state is not achievable at present – something cryonicists appear to freely admit (Fahy et al., 1990; Fahy, 2004). The main focus of cryonics is the resuscitation of the person who died (i.e. their identity or conscious self), not merely their body. Consequently, cryonics has tended to focus on achieving vitrification primarily in the part of the body they believe necessary for this to occur, *viz.*, the brain (Best, 2008), hoping that its smaller size will give greater chance of success. Many cryonics facilities offer storage for so-called "neuro-suspension or neuro-preservation" (Parry, 2004, p. 394) patients, namely, the preserved heads (with enclosed brain) of those who have died.

The second stage is the storage of the cooled cryonics patient at low temperatures until scientific advances make successful resuscitation possible. The main issue here seems to be

storing the patient at a sufficiently low temperature that vitrification is maintained, yet high enough to minimize cracking and fracturing of the glassy, vitreous tissue which can occur at very low temperatures (Parry, 2004). A second issue in the storage phase is the maintenance of the patient in the cooled state continuously for an undefined period of time. This is dependent on the cryonic facilities being operational for that time, and also the storage being funded by the patient for the undefined duration – difficult matters to ensure with certainty.

The third stage is the renovation and resuscitation of the patient. Here speculation is at its most extreme. While there are considerable problems associated with the previous stages, these pale in comparison to the problems faced in thawing, repairing, reviving and perhaps enhancing the cryonics patient. However, cryonics has an in-built defence against these problems – the seemingly limitless potential for science and medicine to advance and overcome obstacles, if it is provided with sufficient time. The strength of cryonics is that the stored cryonics patients have plenty of time to spare.

Thus, while cryonicists give the impression of taking seriously the challenge of reducing obstacles to successful revival, there is always the possibility of appealing to speculative possibilities within future science as the solution. This means that scientific limitations do not have to be addressed too directly. Nevertheless, the potential problems are legion. These include: repair of whatever dysfunction or injury caused the death of the patient, and damage occurring between this time and freezing; repair of any damage caused by the first and second stages of cryonic intervention, such as toxic effects of the cryoprotectants, ice damage or fracturing of vitrified tissue; thawing the body, avoiding or treating de-vitrification (cellular collapse) and any other damage caused; removal of cryoprotectants and reperfusion of the body with blood, while avoiding reperfusion-induced injury; any problems associated with reviving the conscious person from their deceased state, to a healthy and possibly enhanced state.

Cryonicists argue that these seem like huge problems from the point of view of current science and technology. A strong theme underlying their confidence in the power of future science and technology is often a highly reductive view of biology and medicine. According to this, all of the problems mentioned above are simply a matter of atoms being in the wrong configuration within a biological system; move the atoms into the correct configuration and energy state, and the patient is resuscitated. The clearest statement of this is provided by Merkle (1992, pp. 6-7): "… the purpose of medicine is to change arrangements of atoms that are 'unhealthy' to arrangements of atoms that are 'healthy'."

From this reductive view, future developments in medicine will involve gaining better control over our ability to manipulate atoms – medicine (especially that involved in cryonics) will be a matter of nanotechnology (Merkle, 1992). The cryonics community's endorsement of nanotechnology is probably not welcome news to those scientists studying the behaviour of matter on a very small scale. In fact nanoscientists have often sought to distance themselves from this type of science fiction speculation (Milburn, 2002) in much the same way as cryobiologists have sought to distance themselves from cryonics.

The speculation increases even further when considering the life awaiting a resuscitated cryonics patient. An idealistic vision is exemplified by Ettinger's claim that "You and I, as resuscitees, may awaken still old, but before long we will gambol with the spring lambs – not to mention the young chicks, our wives." (Ettinger, 1965, p. 63). Less optimistic, but equally speculative, possibilities could include life in an impaired mental or physical state as a result of imperfect techniques – a life with unforeseen suffering, perhaps that one might judge not worth living. Another might be that continuity of consciousness is lost, causing

the revived person to effectively be a new individual without any memory of their previous pre-resuscitation life (that such loss may occur is even admitted by a cryonicist (Best, 2008)).

5.1 What is an appropriate ethical analysis of cyronics?

Each of the stages of cryonics as it is currently practised and envisioned by cryonicists is a potential focus of ethical scrutiny. Cryonics is regarded by its adherents as an indefinitely prolonged medical procedure. Considering it from this point of view, it should be analyzed as such, opening up a vast array of medical ethical considerations. For example, is the consent given by the cryonics patient adequate considering the unknown nature of much of what the full procedure may entail? Should patients be able to undergo cryonic preservation before legal death, when cryonicists claim it would be more likely to be effective? A practical legal issue is the property status of the revived person and their body. As current law stands in most jurisdictions in which cryonicists operate, property rights over the deceased person's body are ceded to the cryonics company (it is treated as a bequeathed cadaver) – is this reversible if the cadaver comes back to life? What is the moral and legal status of the frozen body, and what implications does this have for the standard of care provided by the cryonics facility? Is the prolonging of individual lives (potentially indefinitely, according to cryonicists' vision of future medicine) morally wrong, justifiable, or perhaps even required? And if the latter, should public funding be provided for the practice and for research to further its development and use?

Alternatively, cryonics could be viewed as an intricate and expensive mortuary procedure. From this point of view a largely different analysis emerges, characterized by different issues. For example, since cryonics is not marketed as an alternative to embalming and burial or cremation, are people who enter the contract being defrauded? What should be made of the (on this account) mistaken beliefs of those practising and undertaking the procedure? Should the wishes of cryonics patients be respected posthumously, especially when these are wishes that can (or, at best, may) never be realized? Is cryonics a repugnant use of a dead body, and, if so, does this have any normative implications?

Depending on one's judgment of the future success of cryonics, two quite different, and ultimately incompatible, avenues of ethical consideration will be pursued. It should be noted that, for those stored cryonically and for cryonicists, the decision of whether cryonics should be treated more or less speculatively by bioethicists is nothing less than a matter of life or death. Cryonics patients are at risk by their being incorrectly treated as cadavers – for example undermining research into their reanimation, and giving insufficient support for their care while in storage. The quality of their future lives is also at risk through insufficient preparation for eventual reanimation. Should bioethicists consider these questions even though they may be skeptical about the science? If the claims and objectives of cryonics are taken seriously, to focus on the wrong question could be decried as being complicit in killing (or perhaps letting die), or at best harming, these patients (Nordmann, 2007).

How should ethicists decide between these two possibilities? One option is to consider both, however this means that a great deal of time is devoted to considering highly speculative possibilities, which may never eventuate. Perhaps the likelihood of one or the other being correct should be estimated, and the lower probability, speculative scenario eschewed in favour of the other. This grounds ethical analysis in reasonable scientific understanding and expectation, and confines ethics to those moral issues that are currently present—in this case, the current reality of individuals having their cadavers frozen and stored indefinitely postmortem—rather than those that may never exist at all.

6. The problems of speculation in ethics

It is worth remembering what may be at stake, both in the case of cryonics, but also for speculative matters more broadly. If considerable attention is devoted to speculative possibilities like cryonics, what is at stake is the neglect of more current moral issues from which practical and ethical attention has, to some degree, been diverted (Nordmann, 2007). Whatever response one might make will have to take note of competing priorities: to devote attention to the ethical demands made by suffering due to famine, environmental disasters, or war, the needs of the infertile, the chronically sick or the terminally ill, against the demands of those who have freely decided to undergo cryonics in the hope of a better life at some indefinite time in an indefinite future.

One problem of speculative ethics is epistemological – the more speculative and removed from present experience possibilities become, the more uncertain our knowledge becomes. It will have little in common with current technology. For example, Drexler's speculative ideas about self-replicating nanomachines bore little resemblance to nanotechnology at the time he published *Machines of Creation*. Moreover, it bears little resemblance to current nanotechnology, which has advanced significantly in the manufacturing of nanoscale products using techniques such as self-assembly, rather than the more fanciful nano-machines of Drexler's speculation. While Drexler's general idea of the way in which nanotechnology will develop is not necessarily false (only time can determine this), there is little relationship between these speculative visions and existing technologies. This may do intense disservice to existing technologies and the way in which they are perceived (Jones, 2006).

However, like all empirical predictions about the way a technology will emerge or develop, speculations, such as those of Drexler, may indeed be false. In this way, speculative claims informing ethical reasoning suffer from the same weakness that afflicts the empirical version of slippery slope arguments. Empirical slippery slope arguments rest on an empirical prediction, arguing that (acceptable) policy or situation A will, as a result of social or psychological tendencies, result in the emergence of (unacceptable) policy or situation B. Like any forward-looking empirical claim, it is open to challenges on its assumptions about social or psychological tendencies or whatever mechanism is being used to justify the claim.

An overarching problem is that it is usually only in retrospect that we can know with any certainty whether our speculations or prognostications were accurate. Also of relevance to this discussion is our inability to predict future scientific developments with reliable accuracy. One only has to think of once assured dicta that, with hindsight, proved unwarranted obstacles to further research. There was the alleged inability of the central nervous system to regenerate to any discernible extent after birth, or to replace any of its neurons (Ramon y Cajal, 1928). Alongside this can be placed the alleged impossibility of cloning in mammals (McGrath & Solter, 1984). We have already discussed the opposite phenomenon, which is the occurrence of obstacles that either were not predicted, or were underestimated. Clearly, when dealing with predictions, ethicists, as much as other philosophers, scientists, and policy makers, need to be wary.

A second problem is that these epistemological problems have moral consequences. As ethics becomes more speculative, its relation to the technology that it is discussing grows increasingly tenuous. This raises problems we have already touched on. First, it diverts ethical attention away from current concerns pertaining to the technology, concerns often in need of ethical attention. Second, the speculative moral judgments about a technology can influence current perceptions of it. Hence, an emerging technology can be smothered or hampered, either by the weight of enthusiastic speculative expectations (such as has

arguably been the case for genomic medicine (Evans et al., 2011)), or by the weight of moral and social condemnation as a result of the harmful implications of the speculative aspects of the technology (such as the grey goo scenario for nanotechnology). Both can have unjustly negative consequences for the technology under discussion.

Applied ethics must be applicable to some ethical issue or problem. Unfortunately, speculative ethics relates to speculative. Consider the ethical discussion on genetic testing in assisted reproductive technologies (ARTs) regarding whether embryos with particular genetic combinations should or should not be implanted in a woman for further development. While a much of this work has addressed pressing issues such as the moral status of these types of procedures and the implications this may have for social regulation of reproductive choices, a troublingly large portion of this work anticipates or presupposes a future in which the desired genetic composition of a child can be determined or when all human reproduction is handled by technological means such as these (Sharma, 2007; Steinbock, 2008). Excessive concentration on the latter at the expense of the former is paying more attention to speculative scenarios far removed from current scientific reality than to current applied ethical considerations. Speculative ethics does not conform to paradigmatic work in applied ethics, in that it addresses imaginary (and perhaps never to be realized) moral problems, not extant, or often even very likely, practical problems.

This raises the question of whether ethicists should be free to consider whatever they like, or as we are arguing, should their attention be directed towards particular issues and projects? Moral reflection is not an infinite resource and this leads to the question of how it should best be distributed. One plausible way of distributing a scarce resource is to do so in a way that maximizes benefit. The *prima facie* case described here is that, unlike paradigmatic applied ethics, the benefits of speculative ethics are not clear, since it does not directly address extant moral problems (Nordmann, 2007; Nordmann & Rip, 2009).

We argue that, since those engaging in speculative ethics are doing so *at the expense* of addressing real (i.e. not imaginary) moral issues, there is a distributive justice problem here. This allows ongoing moral problems to persist, whether these be problems related to famine, harmful exploitation of the vulnerable, or health inequalities. These wrongs and the suffering they cause are immense and are currently occurring. The obligation to use moral reflection to address these problems ought to be a concern for every moral philosopher, motivating them to seek as just a distribution of their discipline's work as possible. If these problems and many like them are taken seriously, they lead to a commitment to work on problems like these rather than on highly speculative ones.

Thus, speculative ethics may squander the benefit that can be derived from the application of moral reasoning to current problems. However, speculative ethics may go further than this, reducing the potential of some current and emerging technologies to realize their benefits for society, and in this way diminishing the means available for addressing current problems. Examples already alluded to include nanotechnology and the self-replicating nanobots and "grey goo" scenarios, and regenerative medicine with speculative concerns about radical life extension and a posthuman future.

A related manner in which speculative ethics can negatively affect current and emerging technology is the flipside of the first. This technology can be overwhelmed by a weight of expectation that it is unable to match. This has arguably been the case for genomic technologies, with their expectation of ushering in a new era of personalized medicine with its tailored pharmacological and behavioural prevention and treatment of disease (Collins, 1999).

This raises an interesting issue since in this case the problems have been created more by scientists than by ethicists. Much of the hype has come from scientists within the field, perhaps "talking up" the potential impact of their work in an attempt to gain research grants in an extremely competitive funding market, and also reflecting excitement at the promise certain emerging technologies might hold (Evans et al., 2011). As outlined earlier, the director of the National Human Genome Research Institute in 1999 anticipated the hugely beneficial effect that genomics would have on medicine by 2010 (Collins, 1999). Collins does caution that his vision has obstacles to its realization, but the ones he identifies are not scientific, but rather ethical and practical. According to Collins (1999) ethical and regulatory hurdles must urgently be addressed to ensure that genetic information is not misused, and health professionals, such as medical genetic specialists, must be educated to ensure that they are up to the task of understanding and treating patients using genomic medicine.

The moral imperative that Collins asserts is an example of what Nordmann has referred to as "foreshortening of the conditional", a general problem that he claims underlies much speculative ethics (Nordmann, 2007; Nordmann and Rip, 2009). He characterizes such speculative moral claims as having the conditional form: if conditions C obtain, then speculative scenario A will occur, and this will create or exacerbate ethical issues I^1, I^2, and so forth. The foreshortening of this conditional statement occurs when the "if" becomes subsumed by the "then", which he claims creates a mandate for action with respect to the scenario and the ethical issues that arise:

> 'If-and-then' statements begin by suggesting possible technological developments and then indicate consequences that seem to demand immediate attention. What looks like a merely possible, and definitely speculative future in the first half of the sentence (the 'if'), turns into something inevitable in the second half (the 'then'). As the hypothetical gets displaced by a supposed actual, the imagined future overwhelms the present (Nordmann & Rip, 2009, p. 273).

Thus:

> The true and perfectly legitimate conditional "if we ever were in the position to conquer the natural ageing process and become immortal, then we would face the question whether withholding immortality is tantamount to murder" becomes foreshortened to "if you call into question that biomedical research can bring about immortality within some relevant period of time, you are complicit with murder" – no matter how remote the possibility that such research might succeed, we are morally obliged to support it (Nordmann, 2007, p. 33).

Collins' speculative vision of personalized genomic medicine in 2010 was false. As a result of highly optimistic predictions such as this and others (Epstein, 2004), many of the promises of genomic medicine remain unfulfilled (Evans et al., 2011) despite considerable progress being made. It is now being asked whether time and money spent on genomic medicine has been wasted, or would have been better spent elsewhere, such as on population-based public health strategies to reduce smoking, obesity and risky alcohol use (Hall et al., 2010; Holtzman & Marteau, 2000). Nordmann (2009) argues that dramatic promises such as these are often made with regard to emerging technologies, and they support the "conditional foreshortening" arguments that he maintains provide much of the impetus for speculative ethics.

Evans et al. (2011) argue that conjectures, like that of Collins, about future developments within science and technology can be – perhaps counter-intuitively – an impediment to

their development. This is because they can underestimate the number and extent of hurdles that must be overcome in the course of development, and overestimate the benefits of their particular approach as a means to address problems. The combination of these factors means that other potentially promising approaches can be overlooked, leading to a crippling misallocation of resources, which can endanger the sustainability of the field (Evans et al., 2011). In addition, scientific and technological promises made are frequently not delivered on, which undermines the legitimacy of science in general, and the field from which the speculation arises in particular (Nordmann & Rip, 2009). This helps to explain the distance that many scientists seek from hyperbolic interpretations of their work (such as those working within nanotechnology and cryogenic science). A realistic appraisal of current and future developments in science, and the promises made about science and technological development, is needed in order for it to receive the level of trust and support that it deserves, but also, and perhaps more importantly, to allow for the allocation of research resources to those areas of most (genuine) promise and moral relevance.

Applying this approach to cryonics draws attention to the number and enormity of the scientific hurdles that must be overcome in order for reanimation of stored bodies to be possible, assuming that this is possible, even in principle. However, as mentioned above, the peculiar nature of cryonics affords its devotees a response to objections of this kind, namely, that the bodies can be maintained in storage until such time as science has developed techniques for repairing and reviving them. Thus the fact that time-consuming scientific hurdles must be overcome is not *in itself* seen as a problem with respect to the revival of the stored bodies. However, the longer it takes for these hurdles to be overcome, the more likely it is that other factors will arise to thwart or displace cryogenic aims, such as the possibility that medical advances will extend human life to the extent that cryonics becomes irrelevant. However, this assumes that revival of cryonically stored bodies is possible, *and* that continuity of strong personal psychological identity is maintained in the revived body – both extremely dubious assumptions.

While cryonics is an extreme illustration of speculation, both scientific and ethical, it typifies the problems of speculative ethics. The example of Collins shows that even relatively modest speculation can be problematic. These problems amount to a strong case for the rejection of speculative ethics in favour of grounding ethics in realistic and rigorous appraisals of science and technology, and a focus on current and imminent concerns.

7. Exploring Roache's defence of speculation

Our evaluation of speculative ethics would be incomplete without looking seriously at a counter analysis in its favour. Roache's (2008) article aims to defend speculative ethics against the objections we have so far leveled at it, so it is important we explore it here. Roache begins by pointing out the important role of thought experiments in philosophy, which are highly imaginative and serve to test and analyze our intuitions, while noting that these are imaginative analytic tools, rather than speculations about possible future events. Also, she argues that a vast amount of ethical thinking involves anticipating, evaluating, and choosing among possible future events – often very mundane ones – many of which will not come to pass.

Roache's main argument can be summed up like this. (1) Some speculative future possibilities may be great potential harms or goods. (2) We ought to determine which speculative future possibilities are harmful or beneficial, so that the former can be avoided

and the latter pursued; ethical analysis is required to make these value judgments. Therefore, (3) we ought to give ethical consideration to future possibilities.

This allows ethics to be in the business not merely of considering and solving current and emerging problems, but also of shaping the direction of social and scientific development away from future harms or towards future goods. To do otherwise would be to let science and society develop without any moral guidance, allowing ethicists only the job of solving problems once they have arisen or are imminent. She argues that many of our most important projects are the result of moral evaluation of a problem and speculation about potential future solutions to it. She cites as examples the development of the ARTs that allow the selective implantation of embryos, as a response to the moral problem of genetic disorders, and carbon capture technology as a response to the problem of global warming. In one respect, these examples do not serve her position well. They are both examples of current, not speculative, moral problems, for which technological responses are developed. Devoting the scarce resource of moral attention to these is therefore acceptable to the anti-speculation position. However, the development of solutions to these moral problems may require speculation about the nature of possible solutions, and the evaluation of these to determine which ones ought to be pursued. Roache argues that, without this moral engagement with speculative possibilities, scientific resources may be squandered by pursuing solutions that are morally problematic, or not maximally beneficial.

A difficulty with Roache's main argument arises with the quantifiers. Premise one can be accepted. However, even if we accept that *some* speculative and unlikely possibilities are worthy of ethical consideration, we must still determine which possibilities these are. This requires that all possible future possibilities must be imagined and ethically evaluated, no matter how unlikely. Thus the correct conclusion to the above argument is that we ought to give ethical consideration to *all* future possibilities. Given the consideration that ethicists are a scarce resource, it makes sense that their time should be spent wisely. Among the infinitely many speculative possibilities, and the vast number of actualities to which ethicists could direct their attention, it is plausible to argue that it would be best for them to attend to those that are most significant morally and most likely to eventuate. She disagrees, arguing that even moves to restrict scope to only those possibilities that are not known to be highly unlikely are misguided. She cites two counter examples, and she uses these as evidence that we take seriously highly unlikely possibilities when they promise great harm or benefit. First is the possibility that the Large Hadron Collider will create a black hole that will destroy the earth, which was the basis for a lawsuit to halt its activity (Boyle, 2008); second is the fact that heroic efforts are often expended to provide benefit (such as attempting to save a life) even when this is the least likely outcome.

The example of the Large Hadron Collider lawsuit is question-begging. While it does show that the plaintiffs took seriously the threat that they believed the Large Hadron Collider could pose to the future of the world, it does not show that anyone else did, or, more importantly, that anyone would be *right* to. The argument mounted by the plaintiffs is arguably an example of what Stich (1978) calls a "Doomsday Argument". This is an argument based on the principle that prohibition is required of any activity that holds a non-zero chance of causing an unthinkably immense catastrophe. Such a principle would prohibit a vast amount of innocuous work (in the sciences and elsewhere). For example, there may be a non-zero possibility that a chemical synthesized in a laboratory may initiate a chain-reaction that obliterates the ozone layer, destroying all life on earth. However,

prohibiting all chemical synthesis based on this possibility would be ridiculous. Van der Burg notes that these "Doomsday Arguments" are a philosophically uninteresting variant of slippery slope arguments, in which the objected-to outcome "is so highly speculative that the cogency of the argument—insofar as it exists—depends more upon the horror than upon the likelihood [of it occurring]" (van der Burg, 1991, p. 43).

More challenging is Roache's example of heroic attempts to save a life, such as a child trapped in a cave. A search and rescue team is available; however, it is highly unlikely that they will find the child alive. We may, she contends, react with horror to the suggestion that, in light of the small probability of success, it is not worth the cost (in terms of time, resources, risk of injury) deploying the search and rescue team. She argues that the value of the child's life is such that we deem it worth these heroic efforts, despite their highly unlikely chance of success.

Clearly we *do* undertake these, but, as with the previous example, this does not show that we are always right to do so, nor does it show why we might be right to. It is worth noting that, if the rescue is undertaken, it may not be justified by the value of the speculative outcome, but by the consequences of the undertaking *regardless of outcome*. For example, in this case, the institution of child-rearing may be negatively affected by parents believing that the state will abandon their children in times of great need, hence the rescue must proceed. At an abstract level, the resources expended in such an endeavour may produce greater benefit if spent elsewhere, say improving public health in third-world countries, or providing vaccinations. However, Roache's example is a practical one, and the rescue team cannot be deployed to third-world countries to work on sanitation systems there. In other words, this example is disanalogous in terms of deciding which speculative possibilities are worth taking seriously in applied ethics and pursuing as a society. Nevertheless, we might adjust the scenario to minimize this problem, by having other children lost in other caves within the rescuer's area. Differences in the nature of the caves and the children make the chances of success finding some more likely than others. There are enough rescuers to undertake some of the rescues immediately, while others must wait. In this situation it is reasonable to undertake those rescues with the greatest chance of success, or at least not to undertake those *known to be highly unlikely* while others wait.

In light of these considerations, Roache's example fails to show that we are wrong to eschew options known to be highly unlikely in favour of other more likely options. But the example does show that highly improbable, but highly valuable possibilities, may still make moral demands on us. However, these are demands that must be weighed among the many demands of other social, scientific and technological options. Roache acknowledges that some projects will be unacceptably speculative and, given resource constraints, more worthwhile options should be pursued in their stead. One could, therefore, think that she endorses the kind of weighting that favours options addressing current or imminent concerns over those that are distant and speculative (other things being equal).

Nevertheless, she argues against this focus on "socially beneficial" outcomes, the judgment of which she says is highly fallible, and influenced by factors such as fads, prejudice, bias, and misconception. We would, therefore, have reason to view such a focus as being shortsighted and misguided. To illustrate this point she uses the example of bacterial antibiotic resistance, which she rightly states could render all antibiotics ineffective against bacterial infection. She argues that this is not a current problem, since

there are still drugs that can treat the relevant diseases. She is right that there are drugs or drug combinations that can be effective in treating antibiotic resistant diseases. She is also correct in asserting that the emergence of bacterial strains that are resistant to *all* antibiotics and their combinations is not a current problem, and therefore could be excluded from a moral focus that privileges current over future problems. However, she is wrong to infer that antibiotic resistance *per se* is not a current problem, and this undermines her example.

A brief examination of *Staphlococcus aureus* is sufficient to reveal this. Penicillin resistant *S. aureus* was a significant comorbidity during the influenza pandemic of 1957 and 1958 (Kunin, 1993; Schoenbaum, 2001), and, more recently, Methicillin-resistant *S. aureus* (MRSA) was reported to increase mortality during the 2003-2004 and 2006-2007 influenza seasons by 33 per cent. Meta-analysis of 31 articles published from 1980-2000 revealed that patients with MRSA infection have significantly greater odds of mortality compared to otherwise similar patients with Methicillin-susceptible *S. aureus* (Cosgrove et al., 2003), despite the fact that at the time, MRSA was uniformly susceptible to treatment with Vancomycin (which is no longer the case (Hiramatsu, 2001)). *S. Aureus* is one of many such bacteria that exhibit rapid development of antibiotic resistance and pose a current problem to successful treatment. Collectively, these findings show that her example fails as an example of a merely future problem. The future development of alternatives to antibiotics is an approach that would be effective for this current problem *as well* as solving the future problem of total antibiotic resistance in pathogenic bacteria. Her example shows that—contrary to her own argument— an emphasis on current or imminent problems can yield solutions that are not shortsighted, but beneficial now and in the probable future.

However, the point Roache is making is that there are serious future problems that we are right to anticipate and devote our efforts towards solving. Although there would be benefits to a cheap alternative to antibiotics now, even if this were not the case, we would be right to devote resources to considering the moral implications of total antibiotic resistance, and making efforts to develop alternatives to antibiotic use. Roache is correct in stating that a position committing one only to considering current and imminent problems may fail to prepare for or avoid some harmful future scenarios. It may also fail to identify beneficial or harmful future scenarios. Despite their improbability, they may still be significant enough to be worth our current attention. However, given the highly contingent nature of many speculative possibilities, a *prima facie* preference towards consideration of current and imminent problems seems reasonable. Roache's arguments against this restriction of scope are only partially successful; she does not challenge the value of current moral problems and she acknowledges that many speculative possibilities are so unlikely that attending to them would be a waste of time (Roache, 2008). We are then left in the middle ground of admitting a legitimate place for speculative possibilities in moral thinking, but requiring that these be weighed against actual or imminent issues.

How we weigh up the many current and potential future issues that could be attended to is a difficult question. We suggest that relevant factors include a realistic and scientifically rigorous assessment of the harms and benefits that each issue contains, *and* the likelihood that future aspects might be realized. Roache makes the suggestion that "Reflecting on where our most important values lie, and how we might work to maximise them, is surely an important step towards ensuring that ethical concern, and other valuable resources, are

not squandered" (Roache, 2008, p. 326). This is a good suggestion, which is compatible with the middle-ground arrived at here. It should be noted that multiple values would also have to be balanced against each other, thus prioritizing is inevitable.

Applying this to cryonics, we may decide, upon careful reflection, that one of our most important values entails sustaining individual lives through the pursuit of life-extending technologies such as this. In that case, full-blown cryonics is a live ethical issue, and we should seriously consider taking steps to realize its potential. However, the highly speculative nature of cryonics means that we can only have limited confidence that it is a good means of pursuing that which we value. Moreover, a value that entails life-prolonging technologies such as this would likely entail the promotion of life-prolonging possibilities elsewhere. Maximization of this value would arguably require a much greater focus on more reliable or likely means for prolonging life, such as public health measures in third-world countries. Revisiting our modification of Roache's analogy of rescuing the trapped child may be useful here. In cryonics, there may be a possibility that the frozen cryonics patients can be 'rescued' by future medicine. However, this is a rescue effort of highly unlikely success, whereas there are other efforts in which success is vastly more likely. To pursue the unlikely alternative at the expense of those that are so vastly more likely would amount to irresponsible allocation of resources.

8. Conclusion

The degree to which ethics as a discipline should engage with highly speculative possibilities is a significant matter at a time when science fact and fiction are becoming increasingly difficult to disentangle (Jones, 2006). Cryonics has been used as a paradigmatic example, the extreme nature of which highlights the issues involved for bioethicists. We have argued that considerable caution is required when approaching all speculative situations; the more extreme the situation the more cautious the response should be. Even if it is conceded that speculation can be a useful tool for ethical reasoning, and that the pursuit of speculative possibilities may in principle be justifiable, it is far from clear that the highly speculative, like cryonics, offers sufficient likelihood of benefit to warrant consideration, let alone prioritization ahead of more likely and beneficial future possibilities. Tempting as it may be for bioethicists to be swept away by the apparently exciting and enticing possibilities rampant in the literature, moves in the direction of speculative ethics ought to be made with extreme caution.

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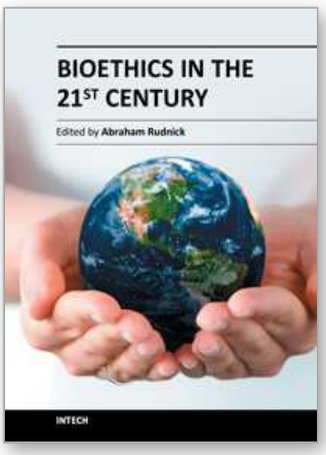
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Bioethics in the 21st Century
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Bioethics is primarily an applied ethics of health related issues. It is considered an important guide for health care and its discourses and practices. Health related technology, such as information technology, is changing rapidly. Bioethics should arguably address such change as well as continue to address more established areas of health care and emerging areas of social concern such as climate change and its relation to health. This book illustrates the range of bioethics in the 21st century. The book is intentionally not comprehensive but rather illustrative of established, emerging and speculative bioethics, such as ethics of mental health care, ethics of nano-technology in health care, and ethics of cryogenics, respectively. Hopefully the book will motivate readers to reflect on health care as a work in progress that requires continuous ethical deliberation and guidance.

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InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
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InTech China
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No.65, Yan An Road (West), Shanghai, 200040, China
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Phone: +86-21-62489820
Fax: +86-21-62489821

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