Remembering Epimetheus: Biotechnologies and the market

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Abstract

We all remember Prometheus (forethought, projection), but he makes little sense without his counterpart and brother Epimetheus (afterthought, reflection). Our stance towards biotechnology has all too often been compared with Frankenstein's handling of the creature he gave life to. Indeed it is no coincidence that Mary Shelley's book Frankenstein was subtitled 'The Modern Prometheus'. Marketers, like scientists, have tended to project *their* vision of a technology's interaction with society and the natural world – and time and time again the hiatus between vision and reality has manifest as a yawing fissure. In this paper, we take an Epimethian approach to the interaction of biotechnology and the market; specifically, we reflect upon the intentional and emergent trajectories that biotechnology can trace within the marketplace using a model developed by Berthon *et al.* We argue that such reflections can help scientists and marketers better understand the complex dynamics of biotechnology and the market: we remember Epimetheus to ameliorate our Promethean suffering.

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INTRODUCTION

In ancient Greek mythology Epimetheus is the figure of forgetfulness, yet ironically it is we – modern men and women – who forget both Epimetheus and his message; and we do so at our peril. We all remember Prometheus (from the Greek Προμηθεν´ζ, forethought or projection), but he makes little sense without his counterpart and brother Epimetheus (from the Greek 'Επιμηθεν´ζ, afterthought or reflection). No more important is this

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forgetting than in the domain of technology; no more pertinent than in the realm of biotechnology.

The philosopher Stiegler points out that the forgetting of Epimetheus is a striking omission in the philosophy of technology. This is surprising because the Titan brothers Epimetheus and Prometheus are not only the progenitors of technology, they yield the major elements of the structure of temporality: *prometheia*, anticipation, worry in advance, as well as *epimetheia*, wisdom, arriving after the event – together, these constitute reflection, reflection in time. Moreover, this ceaseless process of différance is constituted *through* technicity – the pursuit of life by means other than life. For Stiegler[1] it is not a matter of technics in time, but rather of technics as time, as the constitution of time.

Today's stance towards biotechnology has all too often been compared with Frankenstein's relationship with the 'monster' he created. Indeed it is no coincidence that Mary Shelley's novel 'Frankenstein' (1831/2000) was subtitled 'The Modern Prometheus'.[2] Marketers, like their scientist counterparts, have tended to project their vision of a technology's interaction with society and the natural world – and time and time again the hiatus between vision and reality has manifested in a yawing gulf.

In this paper, we take an Epimethian approach to the interaction of biotechnology and the market; specifically, we reflect upon the emergent trajectories that biotechnology has traced within the marketplace using the framework developed by Berthon *et al.*[3] We suggest that such reflections can help both scientists and markets become a little wiser: we remember Epimetheus to ameliorate our Promethean suffering.

BIOTECHNOLOGY AND THE MARKET: UNEASY BEDFELLOWS

In February 2004, newspapers around the world carried a story from the annual meeting of the American Association for the Advancement of Science. A scientific study showed that a virus carrying the gene for a growth hormone called IGF-1 injected into mammals could produce a 15–30 per cent gain in muscle size and strength, in comparison with a control group of untreated animals.[4] It was hoped that a gene therapy programme might be developed for humans suffering from muscle-wasting diseases. The overwhelming market interest, however, came not from sufferers of diseases such as muscular dystrophy but rather from athletes. Why? Because the growth hormone did not enter the bloodstream and was therefore undetectable by sports anti-doping authorities.[5]

In April 2006 more than 70 Indian shepherds reported that a quarter of their flocks died within a few days of consuming genetically modified (GM) (Bt) cotton plants. When harvesting the cotton pickers had to be hospitalised, and during processing labourers had to take antihistamines to suppress allergic reactions. Moreover, the GM cottonseed's growth proved highly erratic, with plants producing stunted roots and other unexpected deformities. Following widespread crop failures, thousands of indebted Bt cotton farmers committed suicide. Indeed in Vidarbha, in north-east Maharashtra, from June to August 2006, farmers committed suicide at a rate of about one every eight hours.[6]

Meanwhile, some oenologists argue that those working on transgenic vines have failed to heed the lessons of earlier GM-food missteps. The biotechnology companies are creating what the producers want – disease and pesticide-resistant vines – rather than making wines that appeal to consumers. Indeed some oenologists are calling for transgenic wines that are reliable in colour, smell and taste, or novel in flavour or in combination with food: Pinot Noir with Swiss Gruyere. Others call for genetic modifications to boost the levels of wine's beneficial ingredients: resveratrol, quercetin

and ellagic acid to help improve cardiovascular health, enhancing the benefits of drinking red wine.[7]

These three news stories illustrate the convoluted and troubled relationship that biotechnology has with the market. Understandably this has resulted in predictions ranging from apocalyptic to redemptive; a catatonic vision of rampaging chimera, synthetic life and bio-weapon war is set against an idyllic picture of a world free of disease, hunger and suffering; where limitless green energy fuels humanity's ascent to the stars. It is glib to say that the truth lies somewhere between these two visions. Moreover, it is unhelpful, nay unwise, to take refuge in the instrumental view: that the technology is neither good nor bad, but depends on how we use it. Why unwise? Because as Stiegler[1] points out, *différance* (difference in both space *and* time) is constituted through technicity; or as Heidegger[8] argues *techne* is a 'bringing forth', a 'revealing' – a touch cane reveals a world to the blind, a blindfold brings forth another world to the sighted. Through our use of technology new worlds emerge.

TECHNO-REVELATIONS

The naive view is that technologies comprise objective artefacts: technology exists 'out there' in the physical world. Heidegger, however, argues that the essence of technology is not physical, but conceptual. He proposes that technology is a 'frame of mind', a way of viewing the world: technology is a way of seeing. Heidegger[8] uses the German word gestell in this context, which is best translated as *enframing*. Thus, for example, to the person with a video camera, everything looks like an image; to the person with a gun, everything looks like a target; and to the person with a blog, everything looks like it is in need of an opinion – preferably theirs. Taking Heidegger's lead we see that technology has both a physical and a conceptual dimension. Thus, a pair of spectacles allows us to 'see' both literally (physically) and conceptually (enframing).

THE MODEL: TRACING TECHNOLOGIES

In this section, we review the model of technological trajectories developed by Berthon *et al*.[3] The model is an attempt to map the instrumental and emergent trajectories that technologies trace once they are released into the environment. Although the wider environment comprises the natural world, human society and the marketplace, in this paper we chose to focus primarily on biotechnology's interaction with the market; although the market manifestly intersects with society and nature, as it is *subsumed* by them. Building on Heidegger's notion that technology is more than a 'means', it is a 'bringing forth', Berthon *et al.* propose that most technological artefacts are typically created from an instrumental perspective. That is, they are created as 'means to ends': the means of fulfilling some need. This is called extension: a technology is consciously extended to meet some goal or solve some problem. Once 'released' into the market, however, a technology can be subject to a number of forces or processes that change its trajectory in new and surprising directions. Thus, over time a technology and the market evolve in an emergent dialectic and the 'cone' of possible trajectories expands.

The processes or mechanisms by which a technology and the market co-evolve comprise two categories: *intentional* and *unintentional*. Intentional processes are where the market changes the technology; unintentional processes are where technology changes market.

Intentional processes can be broken down into three main groups: further *extension* by the initial creator of the technology, *subversion* by the consumer and *diversion* by some third party. Further extension is a trajectory with which most marketers would be familiar – typically it is the 'new and improved'

approach to product development, and enhances an existing design or concept by making it better. Subversion occurs when a consumer or third party changes or adapts the technology so as to use it in a manner quite at odds from that for which it was originally intended: the original use is subverted. Diversion occurs when a consumer, group or some other third party (firm, government, regulatory agent) or combination of these seek to affect changes in the technology and/or restrictions in the use of the technology through social, legal or political means. The original use of technology is delimited or diverted.

Unintentional processes can be broken down into two main groups: *emersion* and *aspersion*. Emersion is where the technology has a primary, change effect on people, such that there is a positive feedback loop between society and technology, and where the technology and society then assume a very different trajectory. The interaction of technology and society proceed in an unforeseen, creative and emergent manner. Aspersion, in contrast, is where the technology produces secondary effects ('side-effects' to the main effect) on people and society, which are typically managed in a negative feedback loop so as to be balanced or minimised: The interaction of society and technology produce unforeseen, pleiotropic aspersions, which then have to be managed.

The processes outlined above are reciprocally interlinked such that they feedback into each other over time. Thus, a technology created through extension may be modified through subversion and produce 'aspersive' side effects, which are then in turn managed through further extension. Moreover, the five trajectories are not necessarily mutually exclusive – a technology may have 'co-trajectories': that is co-existing, parallel trajectories. The trajectories and their relationships are summarised in Figure 1.

In the following section, we apply the model to biotechnology and the environment, with specific focus on the market. We first look at technology as 'means', then at the various 'emergent' processes that shape a technology's trajectory.

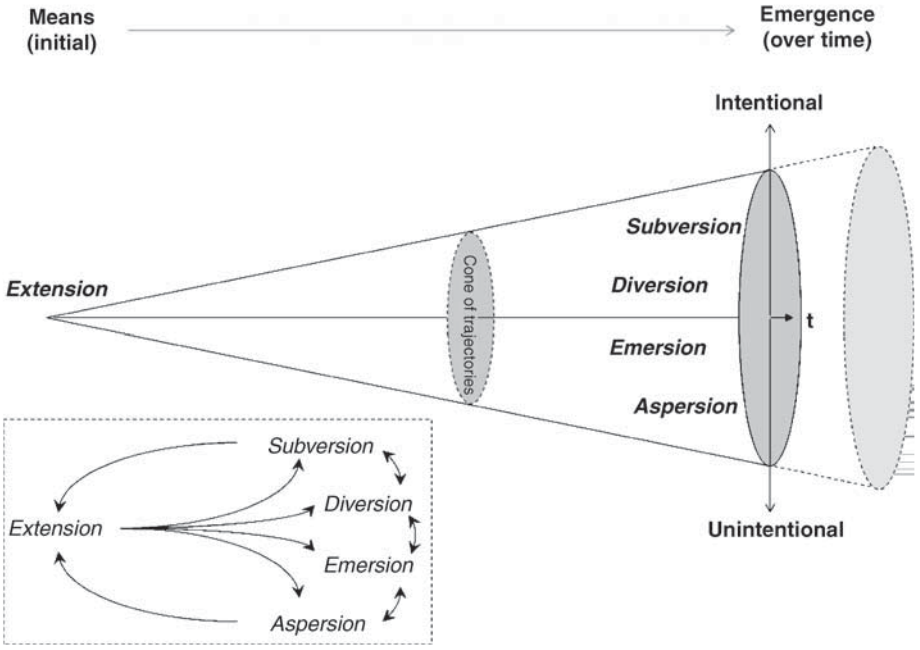

Figure 1: Technological trajectories (Adapted from Berthon *et al.*[3])

APPLICATION: BIOTECHNOLOGY AND THE MARKET

Intentional means: *Extension*

This is the traditional domain of marketing and technology. Here a biotechnology has the effect intended by scientists and marketers, and is used by consumers in ways consistent with marketers' intentions. For example, sequencing of the human genome (3 billion nucleotide base pairs in our genome that encode 30,000 different genes) yielded a host of diagnostic tests that have helped with pre-symptom medical intervention, individualised disease screening and personalised treatment. Clinical examples include tests for various genetically inherited cancers, cystic fibrosis, Huntington's disease and sickle cell anaemia.[9] Nonclinical examples include paternity testing and various forms of forensics. In the area of agriculture, biotechnology is being used to engineer disease resistant and pest protected plants, plants with enhanced nutrition, environmental stress tolerance (eg drought resistant rice), as well as plants yielding biopharmaceuticals. More recently there has been an explosion of research and development into genetically engineered bio-fuels – plants that yield high levels of ethanol and other fuels.[10]

Importantly, biotechnology is created in the physical world by scientists, and then recreated in the subjective and inter-subjective (social) worlds through marketing. Thus, even the 'best' of biotechnologies can fail commercially because of poor extension in the subjective and inter-subjective worlds. A classic example of this is the ongoing ban in Europe (in the face of a World Trade Organization ruling) on most GM foods. Despite overwhelming *scientific* evidence that GM soya beans and the like are safe for human consumptions, marketers have done little to win over a sceptical media and public. The scientific case has been won, the marketing case lost.

Moreover, even the best of extensions in the subjective and inter-subjective worlds can never in the long run make up for poor extension in the physical domain. This is demonstrated by the recent moratorium on certain GM crops in South Africa after the products failed to meet expectations generated by the producers Monsanto.[11]

Intentional emergence: *Subversion*

Subversion, the process of intentional change of technological artefacts by social actors, can range from incremental translation to radical transformation.

We have already mentioned the use of gene therapies developed to help people with muscular dystrophy being subverted by athletes to gain a competitive advantage – indeed the World Anti-Doping Agency is concerned that gene doped athletes may have already triumphed in the endurance bicycle races, such as the Tour de France.[12] Although this has gained much press attention, it is really only the tip of the subversive iceberg. Other subversions of gene therapy include use by criminals to avoid DNA matching – gene therapy can be used to change the specific DNA markers known to be used in criminal DNA tests. Others include the creation of cheap designer drugs, and the modification of brain chemistry to enhance intelligence, attention and memory. For example, the drug modafinil was created to treat narcolepsy and neurological fatigue experienced by people with diseases such as multiple sclerosis, yet has been subverted by students, competitors and even soldiers who use it as a 'smart drug' to significantly enhance cognitive performance.[13]

What is interesting to observe in this latter case is the fact that consumers did not change the physical artefact itself, but rather the use and meaning of the drug. Thus, while no dramatic change was wrought in the material world (the drug remained the same), there was dramatic change in the subjective and social words (ie what the drug meant and how it was used by the individual consumer and society).

Intentional emergence: *Diversion*

In this situation, a third party (eg an individual, a pressure group, competitor or government) changes the intended use of a technology through political, social or legal intervention. This can range from the modifying or delimiting of a technology to its outright ban.

The biotechnology industry has faced a long history of diversion, from governments to companies and individuals. Although now a major grower of GM crops, Canada initially resisted the introduction of GM seed, and continues to heed the call of farmers and consumers to block the approval of Roundup Ready wheat.[14] Meanwhile in Germany, rather than ban GM crops, the government used more subtle diversionary tactics. Under the country's Gene Technology Act, farmers growing GM crops in a particular area are jointly held liable for *any* (even less than 1 per cent) contamination of a crop contracted to be GM free. Consequently, farmers willing to grow GM crops are denied insurance as the risks cannot be calculated. The result is that GM crops are essentially dead in the ground in Germany.[15]

In parts of Asia, farmers and business have fought the introduction of Golden Rice – a genetically engineered rice with 23 times the normal amounts of pro-vitamin A (beta carotene) aimed at countering malnutrition in developing countries – for commercial and ideological reasons. While in Africa, so successful has the diversion of GM technology been that a number of countries including Zimbabwe, Mozambique and Zambia have rejected donations of GM maize at times of acute drought-induced famine.[15]

Unintentional emergence: *Emersion*

This category describes the emersion or revealing of emergent phenomena. Here technology changes the way in which consumers and society behave in often radical and profound ways: it creates new ways of being for consumers. In the case of biotechnology, gene expression can be highly complex, many effects being cumulative and interactive of multiple genes, this epistatic and pleiotropic uncertainly is magnified once a particular technology reaches the market. For example, it has recently been discovered that genetic factors may play an important role in the accuracy and sensitivity of testosterone doping tests. This has implications not only for androgen doping in sports, but also for a wider use of the steroid hormone in society. Simply, the tests for testosterone doping used in professional and amateur sports may routinely be confounded by a common genetic variation.[16] Thus, gold medal winners at the next Olympics may not be the most dedicated or adept sports people, but rather individuals possessing a rather different genetic talent.

DNA testing has transformed both the legal and policing systems in many countries. Whereas evidence used to be primarily testament and physical, it is increasingly biological and genetic. Today many inmates on death row are there because of genetic evidence, and a smaller number have been freed due to the same technology. The widespread use of DNA evidence has highlighted a further problem – that of most jurors meagre knowledge of statistics. Whereas most juries can reasonably weigh up testimony and physical evidence, the complexities of statistical DNA random matching has lead to widespread concern in some quarters. Indeed what is termed the prosecutor's fallacy (the faulty interpretation of statistics about DNA and blood group evidence) has led some countries to rewrite parts of their legal system.[17,18] That said, so effective has DNA testing been, some countries are considering genetically registering their entire populations.[19]

Moreover, GM seed has radically changed agricultural practice. Traditionally, farmers used to reseed their land with a portion of the seeds harvested from the previous year's crop. With the introduction of GM seeds with terminator genes, farmers have to buy new seed every year, and are thus bound to

the seed provider in perpetuity. While this works for large, intensive farming, the small farmer living on narrow margins faces a magnified risk profile. This has led to a worldwide acceleration in the intensification of agriculture and the consolidation of land into ever larger farming units; simply GM technology is moving farming away from 'a way of life' towards an industrial model where economies of scale predominate.[20] This in turn is fuelling the migration of people to the cities. Thus, one emergent effect of GM technology is the urbanisation of the planet with concomitant social and economic changes.

Unintentional emergence: *Aspersion*

Aspersion comprises the myriad of unintended, often pleiotropic (ie producing many effects), consequences of technology on consumers, society and the environment. These consequences are the unanticipated side effects of the interaction of the technology and society. The aspersive effects of biotechnology's interaction with the market are legion. On the personal front they include: the invasion of an individual's privacy when their genetic profile becomes public, and the concomitant targeting of undesirable traits linked to certain genes; social stratification based on genetic traits; social stigmatisation and exclusion based on genetic markers; the emotional costs of knowing that one carries a particularly pernicious gene. On the agricultural front, genetic modifications can result in unintended toxicity to other organisms, and enhanced genetic selection and evolutionary pressures on plants and animals, as well as the possibility of unstable plant hybrids and animal chimera. At the intersection of the personal and the agricultural, we have the suicides of Indian farmers discussed at the beginning of this paper. Let us explore three examples in a little more detail.

As more and more acres of GM 'Roundup Ready' crops are planted in the USA and elsewhere, the use of the pesticide has increased. This has produced a Darwinian selection pressure cooker, resulting in a number of 'superweeds', which are resistant to glyphosate – the active chemical in Roundup.[21] Ironically, the manufacturer Monsanto has benefited – through ever increasing sales of the herbicide. A positive feedback cycle is in place where increased resistance to the chemical results is in increasing demand. The fear is that just as society is facing a medical crisis over 'MRSA' (methicillin-resistant *Staphylococcus aureus*), it may soon face another over superweeds.

Furthermore, there is increasing evidence of cross-pollination between GM crops and their naturally evolved counterparts. Husbandry strategies designed to prevent hybrids developing have proved only partly successful. Consequently the genie is out of the bottle – parts of planet are infected with GM modified plants that are starting to have an impact on the ecosystem. For example, a German study has shown the toxic nature of Monsanto's Triple Hybrid GM corn on bees, and some speculate that the current bee colony collapse syndrome may in part be due to GM crops. Other studies have liked GM crops with the decline in the monarch butterfly and other important pollinating insects.[22]

Finally, the wide spread availability of DNA tests on unborn children to determine gender have lead to an increase in abortions in countries such as India and China. Indeed, the spectre of future gender imbalance – skewing of sex ratios – and the societal implications therein has led some countries such as Australia to propose banning the technology entirely.[23]

CONCLUSION

The quote McLuhan[24] (p. 248) the 'unconsciousness of the effect of any force is a disaster'. Biotechnology holds tremendous promise for humanity and the planet, however like any powerful technology it can evolve in unplanned and uncontrollable ways once it enters the market. Scientists and marketers need to have a robust range of

conceptual tools to make sense of the past and become aware of the possible trajectories that the technology may take in the future. In this paper, we show that the model developed by Berthon *et al*. can help deepen our understating of the complex interaction of biotechnology and the market. Epimetheus' sin was of forgetting, but his gift was that of reflection. The making of the mistake is transformed into a gift *if* we learn from it – lest we realise the sobering vision of progress that the sociologist Walter Benjamin conjured.

> 'This is how one pictures the angel of history. His face is turned toward the past. Where we perceive a chain of events, he sees one single catastrophe which keeps piling wreckage upon wreckage and hurls it in front of his feet. The angel would like to stay, awaken the dead, and make whole what has been smashed. But a storm is blowing from Paradise; it has got caught in his wings with such violence that the angel can no longer close them. This storm irresistibly propels him into the future to which his back is turned, while the pile of debris before him grows skyward. This storm is what we call progress.'
> Walter Benjamin, 'On the Concept of History'

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