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DR 1: Can histories of previous technological breakthroughs, drawn from the 20th and 21st centuries and including recent technologies, tell us anything about how identities might change over the next 10 years, and why?

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Contents

1. Executive Summary

The paper opens with an introductory section that explores three key theoretical concepts which are developed and explored in the core sections of the paper.

1. The notion of technological breakthrough. Drawing on the example of the 'invention' of the first computer with stored memory, the paper demonstrates that invention is distributed, collective and on-going. There is often no direct link between a technical breakthrough and the application of a new technology to address specific social needs. Technologists are often focused on solving technical, not social, problems.

2. What is a technology? Here the concept of the assemblage is introduced. Technologies are not stand alone devices. The assemblage refers to the various material and social relations that inhere in any specific technological device and/or system. For example, a domestic artefact such as a washing machine is made out of many component parts (each of which will have emerged over time, often in relation to other technological devices). The machine works in relation to other technical systems such as power, water, drainage, fabrics, washing powders, etc., and in relation to specific aesthetic and moral values, symbolic resonances, aspirations and expectations. In this sense each technology is multiple. It is also unstable in the sense that these diverse aspects of a technology only cohere in specific places and times. They depend on diverse and changing economic and social interests, cultural capacities, knowledges and dispositions. The assemblage is a concept that invites historical analysis to explain how things come to be as they are in any specific time and place, and how and why they change.

3. How do we understand how technology (as assemblage) relates to identity formation? As with technologies, identities are also relational. Following Hall and du Gay 1996, this essay works with the concept of identification, drawing attention to the relational dynamics of identity formation. As with technologies, identities are inherently multiple, fragmented, ambiguous and ultimately unstable. It takes work to keep things stable. Both technology and identity, as processes of assemblage and of identification, are closely linked as modern responses to the uncertainties of life, and carry the promise of order and control. The paper explores the appeal to technology (and to identity) as a 'technical-fix'. Technical fixes can stabilise relations and elicit apparently stable social orderings. The theoretical approach deployed in this essay does not assume such an outcome, but looks instead at how such an outcome is achieved (the specific conjunctural relations that make stabilisation possible), and at how any particular stabilisation transforms over time.

These general perspectives are explored in relation to three areas of technological innovation and identity formation. Computing and information technologies are not explored directly (as these are covered elsewhere in this research programme). They are however discussed with respect to their significance in the chosen areas of study.

4. Energy: Approaching energy systems as assemblages brings into view the material, technical, political, social, economic and affective relations that inhere in the development of specific forms of energy production and circulation. The specific example of the development of nuclear power in France is given as an example to show how the development of nuclear power produced specific modes of identification -

national identities, political identities, economic and social identities. Tensions between identity politics of localised protection, concern for planetary futures, and a growing sense of threat and insecurity are key issues in this field for the coming decade.

5. Domestic Technologies: This section looks at the role of domestic technologies in the shaping of domestic life, with a specific focus on gender, class and kinship. The formation of new markets and the highly mediated and normative image of the average family is a central part of the story of technological innovation in this field. Trends in this field are to greater convenience and greater automation.

6. Genetic Technologies: The final section looks at how the technical ability to grow living cells of complex organisms outside of the body underpin developments in cloning, genetically modified food production and technologies of assisted conception. Biotechnology changes what it is to be biological. Synthetic biology disrupts prior understandings of natural categories with significant effects on modes of identification. The commodification of life (cells are already routinely bought and sold) raises many issues and concerns.

Ten years is a short time frame with respect to technological histories. Those technologies that are going to be most influential over the coming decade will already be well on the way to becoming established.

The following dynamic fields of technological change are likely to be highly influential with respect to changing modes of identification over the coming decade:

- Synthetic chemistry and synthetic biology are producing new materials and new life forms.

- Computing power is now able to produce, store and mobilise huge data sets and information is routinely collected from human transactions and movements.

- Nano technology and remote sensors can incorporate computing power into materials and life forms. These synthetic fields and hybrid products are likely to be influential on identity change over the coming decade.

Issues that are already emerging as significant and which we might expect to take on greater salience in the coming decade: (i) the ownership of data (ii) new forms of property - the patenting of process and a simultaneous call for an expansion of the commons; the commodification of life forms (iii) the development of explicitly hybrid responses to technological change (iv) an increasing tension between a turn to the technical-fix, and a need for close consideration of technology as assemblage.

Technological changes do affect modes of identification but the relationship between technology and identity formation is complex, non-linear and contingent. Specificity is always important. We should always expect mixed responses to new technological configurations. And we should always expect existing modes of relating to be integrated in some way to the new configurations presented by technological change.

When policy makers consider the question of the relationship between ‘technology’ and ‘identity’ it is of central importance to interrogate both these terms. How is the ‘technology’ or the ‘identity’ framed? What aspects of the assemblage or practices of identification are under consideration? What other aspects might be relevant?

2. Can histories of previous technological breakthroughs, drawn from the 20th and 21st centuries and including recent technologies, tell us anything about how identities might change over the next 10 years, and why?

This essay explores the relationship between technological change and identity formation. I begin with a brief reflection on the notion of a 'technological breakthrough', arguing that technological change is more of a process than an event. This focus on process is reflected in contemporary approaches to identity, which are also briefly outlined in this introduction. One of the consequences of presenting both technologies and identities as complex, multiple, dynamic and relational is that any expectation of a straightforward linear connection between technological change and identity change begins to appear very simplistic. However, in the following sections of the essay I discuss in some detail how the analysis of particular technological innovations can shed light on the general issue of how identities are formed.

3. What is a technological breakthrough?

In 1998 Manchester celebrated the fiftieth anniversary of the 'invention' of the first computer with stored memory. The highlight of these celebrations was a re-creation of the moment of technological breakthrough. A team of computer enthusiasts worked closely with the original developers, known as the 'pioneers' to recreate a machine able to run the original programme. Two things of relevance to this essay emerged from my study of this event. Firstly, it was clear that the moment of 'breakthrough' only became significant retrospectively. The achievement of the computer scientists in 1948 was significant, but from their perspective the 'breakthrough' was one small step in an on-going process. They certainly had no sense of an historic event. The first successful run of the programme was for them more of a starting point. Excited by the potential of this machine the developers immediately started work on what became known as the Manchester Mark 1, a more powerful and useable machine. The original machine was soon dismantled – its parts were needed as the scientists continued their work of trying to improve the speed and power of these early computers.

The second point to note is that 50 years after the original programme was first run it was hard to dramatise the breakthrough. The computer itself was certainly impressive, it was huge but its size was an indication of obsolescence not innovation. And what it could actually do was also extremely unimpressive by comparison with what was routinely expected from computers 50 years after the event. Furthermore, it emerged that the Manchester team were not the only ones to have invented the computer. The technological challenge was being worked on in other places as well. Various teams had 'breakthroughs' of a slightly different kind - more or less at the same time. Invention was distributed, collective and on-going (Agar, 1998; Harvey, 2005).

The fact that the sense of 'breakthrough' came somewhat after the event does not diminish the significance of what was achieved. Computer memory and calculative power are of fundamental importance to the ways in which digital technologies have become central to contemporary identity formation. The calculative capacity of contemporary computers lies at the heart of the circulation, storage and convergence of informational forms. Computing has implications for how we think not only about memory, archive, and genealogy, but also about how we attempt to forecast future possibilities. Computers allow us to model future effects and to calculate risk - drawing on ever more detailed and precise information. These predictive possibilities do not deliver a certain world. Nevertheless, the promise of such technological control is a deeply embedded cultural orientation, and the calculative capacities of computing are integral to the ways in which we orient ourselves to emergent and uncertain futures.

The social consequences of ubiquitous computing were not in any way foreseen by the original pioneers, nor were they their focus. The challenges that excited them were primarily technical rather than social. Indeed even in the late 1990s when we were carrying out this study in Manchester, the technologists with whom we were working on the inter-operability of internet applications were anxious for people to tell them how this new technological and communicative potential might be put to good use. The potential users, both the general public and the local authorities, were also uncertain, and expected the technologists to have more of an idea of the possible applications. At the time these difficulties were swiftly glossed as the differences between social and technical worlds. The more general point we can take from this is a reminder that new technologies emerge as problem solving devices, but it is not always clear what kinds of problem they are solving. Many technological innovations are ingenious solutions to technical problems. How such solutions are related to specific social needs or possibilities is an issue to which I return below. However, at this stage it is important to

remember that in technical terms, solutions do not necessarily follow problems in a linear fashion.

4. What is a technology?

The ways in which computers became central to identity formation relates to how they became integrated, over time, into socio-technical systems of increasing complexity. Typically technologies come not in the form of separate, isolate devices but as part of wider systems. Such systems can be thought about in relatively local terms. A washing machine may have programmable electronic components but to work as a domestic technology it has to be integrated into other systems, minimally of electricity, water and drainage, but also extending into the ways in which clothing and other household fabrics are manufactured and labelled, how washing powders and products are developed and marketed, component parts sourced, and repair services set up. In the more detailed discussion of domestic technologies below, I also trace some of the ways in which a domestic artefact, such as the washing machine, incorporates aesthetic and moral values, symbolic resonances, aspirations, and expectations.

In science and technology studies the notion of the ‘assemblage’ is used to refer to the complex relational dynamics of technologies. This concept is important for the way in which it signals the intrinsic heterogeneity of technological devices and/or technical systems. The term refers to the work of thinkers such as Foucault and Deleuze who are interested in the ways in which the assemblage entangles human and material technologies. Technologies from this perspective are approached as unstable gatherings, multiple entities, which are neither tightly organised nor coherent. The instability of the technological is key to understanding why it is that technological effects are always, to some degree uncertain, or non-linear. Technologies draw together heterogeneous materials, skills, and practices that routinely include economic and social interests, cultural capacities, knowledges and dispositions. As we try to understand how technological innovation relates to identity formation it is these complexities and multiplicities that we need to keep in mind. It is here that the histories of technological developments are very useful for thinking about identity formation. Such histories in effect un-pick the assemblages to show what kinds of gatherings occurred in specific cases, and with what effects. They also help us to understand another aspect of technological multiplicity that relates to the specificity of particular technological formations. The Manchester computer described above was not the same as the other devices being developed and deployed in other places at around the same time. These differences were not simply technical but related to the wider question of how and why that particular machine was developed in the way it was. Historical analysis also allows us some critical analytical purchase on this specificity, revealing the social and cultural dispositions, influences and propensities that are crucial to any consideration of possible future configurations.

5. How do we understand how technology (as assemblage) relates to identity formation?

As with technologies, identities are also multiple, complex and in process. Stuart Hall, in the introduction to an influential edited volume on cultural identity (Hall and du Gay, 1996), suggests that 'identification' might be more useful as an analytical concept than 'identity' per se. 'Identification' suggests an on-going process of articulation, rather than a stable and singular state of being, thus drawing attention to the relational dynamics of identity formation. Identification also points towards the fascinating tension in identity formation between the normative (culturally dominant) subject positions which can appear self-evident in some interactional contexts (e.g. man, woman, pensioner, child, urban professional, academic, vagrant, Christian, Muslim, housewife, protester, consumer, citizen, Scot, Glaswegian, etc.), and the hugely varied practices and positions that in other contexts routinely disturb these apparently stable categories. All the terms in this list are relational terms, defined as much in terms of difference (that which they exclude), as in terms of any positive defining features. Identification also suggests an active force of association, pointing out the ways in which identities are both assumed and imposed, projected and responded to. This active, relational approach encourages us to consider from the start how it is that identities are inherently multiple, fragmented, ambiguous and intrinsically unstable.

Zygmund Bauman (1996) reminds us that preoccupations with 'identity' are a relatively recent phenomena, characteristic of the modern subject. The concept of identity was, he argues, a way of addressing the uncertainties of modern life. These uncertainties were themselves technologically driven, in the sense that modernity, modern science, and technology in particular, assumed the possibility and the aspiration to order, control and reason. It was in this respect that 'identity' emerged as a specifically modern problem.

Identity, understood as "something one needs to do something about" (Bauman, 1996: 18-19), thus emerges as a possible solution to the unsettling effects of technological failings or limits, a response to the uncertainties of the modern drive to change. But identity does not undercut the promise of technology, for technology also addresses uncertainty, and is called upon to resolve all those social problems that appear to stem from a failure of identification, and a perceived lack of social cohesion and/or sense of belonging. Identity and technology are thus tightly bound together as problem and as solution. Technologies and identities together perpetuate both the promise of ordered, safe, productive lives, and the sense of threat and precariousness that emerges when such orderings are routinely experienced as partial, as inappropriate or compromised in some way. This problematic relationship surfaces quite routinely in the on-going search for technological solutions to social problems - commonly referred to as the 'technical fix'. 'Technical fixes' are attempts to re-order relations, to control uncertainty and to apply rational approaches to some aspect of life that seems to be going wrong. The problem with 'technical fixes' is that there is often very little attention given to what exactly it is that needs 'fixing'.

As 'technical fixes' are enacted all those complex gatherings that the technological assemblage implies are activated as part and parcel of the technical solution. It is in this sense that some historians of science and technology have argued that all technical solutions are political (Winner, 1980). Robert Moses' design for the public infrastructures of New York City is one

famous example. Moses wanted to keep low-income, Black residents out of the middle-class residential areas that he was designing. He achieved this by strategically building bridges that were too low for public buses, and by forcefully blocking all proposals to extend rail networks. With no public transport, his middle-class enclave did not need to be gated to keep poor people out. Several decades down the line it was very difficult to reverse these decisions. To change things would require not simply the ripping out of established urban infrastructures, but also the disruption of what Moses had successfully created, an area of the city where property values were high, and where people with high incomes felt safe. The technological intervention had bolstered the identities and sense of entitlement of those who had moved into the area and made it their home. The divisions that were created had settled in such a way that it was no longer obvious that these barriers to a more integrated social landscape had been firmly installed to make the categorical social divisions of race and class appear self-evident, prior, durable and beyond question. For many people the arbitrariness and contingency of the divisions created by these infrastructures were always obvious and they fostered a sense of injustice. For others though the notion that social divisions were, in some respects at least, technological effects, only becomes thinkable when social frameworks changed. Stephen Collier's research on Soviet heating systems (Collier, 2011) offers us an example of one such change in the awareness of the relationship between technological assemblages and modes of identification.

In Soviet Russia heating networks were known locally as teploseti. The teploseti carried hot water or steam from state owned industrial boiler complexes to apartments, administrative buildings, schools, hospitals and industrial enterprises in small cities. Through this system, the state ensured the provision of heat to all citizens. Such provision was understood to be a basic state responsibility, and the assumption of this responsibility by the state was folded into the technological assemblage in a quite literal way. However, in recent times the heating systems have produced huge difficulties for local government bodies as they struggle to implement the transition to a market-led economy that fosters private enterprise and consumer choice. The new private owners of the heat generating factories are no longer expected to heat residential properties, and yet the Soviet infrastructure perpetuates a material inter-dependence. As a result, cash-strapped local authorities have had to strike deals with the private enterprises to exchange heat provision for tax credit, thereby perpetuating their inability to meet other local needs. Individual users are expected to pay for the heat they use, but there is no possibility of cutting off supplies for non-payment. In post-Soviet Georgia where the political and social accommodations collapsed, the heating systems were shut off. But these shut-offs led to the destruction of heating systems due to both freezing and widespread looting of pipes and radiators for scrap metal. The example illustrates a case in which the ideological aspirations of a system that was designed to provide cheap heat for all, falters under a different political regime where consumers are expected to choose the levels of heat, the amount of energy consumed, and where the prices fluctuate in accordance with the market. Put another way the technological system was built with no anticipation of a time of privatisation, or market forces and individual responsibility - indeed on the contrary such an option was engineered out as surely as the low bridges of New York kept buses from crossing over into Long Island.

The material effects of technological systems are not necessarily planned as they were in both these cases. However, if we think of politics more generally in terms of specific arrangements of power and authority, then it is arguable that all technical systems have political dimensions. Likewise, all technical systems both require and elicit social arrangements. Some systems are more intractable than others, some are flexible and relatively open-ended. The two previous examples show how a technological assemblage can come to appear stable, self-evident or normalised. These stable assemblages seem to contradict the theoretical understanding of an

assemblage as an uncertain and unpredictable 'gathering' of material and social forces. However, the Soviet example reminds us that however stable an assemblage might appear at a particular point in time, such stability has to be actively produced. The material and social relations that sustain an assemblage are constantly in need of renewal if they are to produce this sense of stability. The pipes of the Soviet heating systems had to stay warm to prevent them breaking up, and the social relations that sustained the political system appeared equally fragile once the transformation to a market economy was underway.

In the following sections of this essay I look in more detail at three fields of technological change outlining how technological innovation reconfigured or reinforced normative understandings of identity. I have chosen three very different arenas of technological innovation, deliberately avoiding any direct focus on computing and information technologies as these are covered in detail by other contributors to this research initiative. I start with energy, as perhaps the most fundamental field of technological innovation on which all the other technologies depend and one which also raises issues of national identity, political and economic identities, protest movements and contested understandings of well-being. I then move to a consideration of domestic technologies and the changing dynamics of family life, and particularly of mediated understandings of how to live well. I end with a consideration of biotechnologies and the ways in which innovations in genetic technologies have raised questions about human biology, family connections and individual personhood.

5.1 Energy

Many fundamental assumptions about the quality of everyday life relate to expectations and aspirations concerning mundane activities - the ways we eat, travel, house ourselves, and consume goods and services - and these activities in turn are closely linked to specific modes of energy consumption, fossil fuels (coal, oil and gas), nuclear fuels, or traditional energy sources - the wind, the sun, the tides. The organisation of flows and concentrations of energy are fundamental to human political and social life and to basic understandings of what constitutes a grounded sense of well-being. The recent outage in India left an estimated 700 million people without electricity (Burke, 2012). The vast majority of those were quite used to an unstable supply and temporary back-up systems and habituation to a lack of power helped people through. But the event, which made headlines across the world, signalled just how important power supplies have become to the basic sense of prosperity and well-being to which India's population are now laying claim.

In this section I follow the pioneering work of the historian of technology, Thomas Hughes (1971, 1979), who studied the ways in which power networks (specifically the electricity system in the USA) were central to the formation of the US economy, and by extension to the emergent and changing relations between technical experts, systems managers, financiers, citizens and state administration. Hughes' account considers how in the early years, when the systems for the delivery of light and power began to emerge as a possibility at the end of the nineteenth century, it was inventor-entrepreneurs who dominated the decision making process. These men were focused on solving specific technical problems, but also had a keen eye on ensuring that their inventions were patented and folded into their own manufacturing companies through which they could control the systems that they brought into being. Their key challenge was to find ways to address the need for flexible systems that could interconnect despite the diverse levels of charge required for different purposes at different times. Standardisation was the means to achieve the goal of networked connectivity and energy flow. By the first decade of the twentieth century this technical challenge had been addressed, and while there were always technical issues to be considered, new figures appeared on the scene,

namely the manager-entrepreneurs, who became the key problem solvers, focused more directly on the challenge of creating new markets for electricity, and new organisational structures to deliver power to a growing number of consumers. By the 1930s regional networks were firmly established and power flows managed through regional utility companies. Given the central significance of these energy providers to the economies and daily lives of the majority of citizens, there were further changes in the organisational structures of the power companies, which had become major political, economic and social institutions run by financier-entrepreneurs with strong negotiating skills and considerable political influence. The key point to draw out here is that these power systems evolved over time, and as they evolved they gathered complex histories, politics, material infrastructures and connections not simply between energy sources and power networks, but also between consumers and providers, corporations, public bodies and citizens. The systems in this respect were always political.

The political history of the oil industry has been traced by Timothy Mitchell (2011). He describes some of the ways in which energy politics has dramatic consequences for specific communities of practice. To render his account in terms of changing technological assemblages, he was interested in how the assemblage of the coal industry gave way to the assemblage of the oil industry. Miners were a highly skilled labour force, and tight knit communities were fostered by the working environment in which the workers had considerable political power, but were nevertheless very vulnerable as the work was also dangerous. Strong communities of mutual support were the strength of the industry, and its weakness as the miners were able to make demands that their political rulers felt powerless to refuse. As Mitchell notes: “the development of cheap and abundant energy from oil, most notably from the Middle East, offered a means to reduce this vulnerability of ruling elites to democratic pressures. The abundance of oil made it possible for the first time in history to reorganize political life around the management of something now called ‘the economy’ and the promise of infinite growth. The politics of the West became dependent on an undemocratic Middle East (Mitchell, 2011).

But it is the nuclear industry which has been the most controversial energy sector. The history of nuclear science and the relationship of this science to the development of nuclear technologies has been central to twentieth century geo-politics, to the framings of national economies and to the development of strong communities of interest that emerged in relation to the deeply controversial and political arrangements with respect to the development of nuclear power. The centrality of the Second World War to this story - with the attendant sense of threat, of secrecy, and espionage - inflects the terms in which this potential energy source has been developed, as too does the daunting challenge of the lethal toxicity of certain radio-active products with a half-life of hundreds of thousands to millions of years. This high-level nuclear waste posits a temporal horizon that exceeds human experience. And yet nuclear energy is also supported, as a cleaner option to carbon fuels, offering more efficient and cheaper energy sources. The debate around the promise and the limitations of this energy source certainly exemplify the uncertainties that characterise all energy systems. Nuclear energy - as with electricity, coal and oil - is also the result of a plethora of technological innovations which can be traced back to the discovery of uranium in the eighteenth century, and the subsequent exploration of the chemical and physical qualities of this material.

Accounts of the defining ‘breakthrough’ moment in the history of nuclear energy tend to focus on the late 1930s in the build up to the Second World War, when the possibilities of atomic fission were established. The timing was significant, for by the 1940s nuclear research was firmly associated with warfare. The complex collaborations of international science were orchestrated to the command structures of war, investments were high but focused on this

specific, destructive application. Subsequently the initiatives in the 1950s, such as Eisenhower's 'Atoms for Peace' programme, worked to harness nuclear energy for the generation of electricity but the context of the Cold War, and the close connections between these programmes and their military uses (for powering submarines and aircraft carriers) was an important element of the social arrangements surrounding nuclear power. The building of nuclear plants marked a specific kind of post-war settlement that shaped the geo-political landscape of the twentieth century, but by the 1970s there was deep uncertainty over nuclear futures.

Gabrielle Hecht has elaborated on the specific case of the development of nuclear power in France - and the entanglements of these developments with issues of French national identity post WWII, when the nuclear reactors came to embody a particular vision of the French state (Hecht 1994, 1998). After WWII, France was suffering from economic and infrastructural collapse, and the humiliation of the German occupation. There was huge determination to reconstruct both the economy and public morale, and modernisation was assumed as a central goal by people of all political persuasions. With respect to the French nuclear programme however, two quite distinctive techno-political regimes emerged in the 1950s with quite different priorities. The first of these emerged in relation to the newly formed state utility, Electricité de France (EDF). Electricity, coal and gas utilities were nationalised in support of a determination that the new economy would serve the French people and not private interests. Their priority was to produce reliable, cheap and abundant electricity. The other was associated with the Commisariat a l'Enérgie Atomique (CEA) the atomic energy commission, that associated French prestige with military capacity, and which worked to create consortia of private companies to develop nuclear capacity. The agencies fostered quite different responses to the question of how to conceive of the role of nuclear energy as integral to a French national project.

In this context, plans for the kinds of nuclear reactors that were to be built emerged as somewhat ambiguous. Decisions were taken that hedged bets over the future uses of nuclear power. While publicly there was a strong rhetoric of the necessity of developing nuclear power in relation to the energy needed for economic development - there was also a sense of the importance of not losing sight of the as yet unspecific possible future need for weapons-grade plutonium. The excitement and the prestige associated with the development of enhanced uranium, and the urgency of solving problems related to the dangerous instability of plutonium, led to a concentration of resources and research attention on the production of plutonium over the production of electricity. However, at no point in the 1950s did the French government make an explicit commitment to the generation of nuclear weapons. The post-war commitment to produce as much power as possible as soon as possible had launched a series of energy investments that had not been scrutinised in terms of the economic viability, and by the mid-1950s criticisms of these programmes had begun to emerge, alongside open competition between energy sectors (the hydro-plants, thermal plants and the nuclear plants). The nuclear reactors, however, had support in terms of national identity, and exemplify the complex ways in which technology and nationalism are entangled - the technologies were shaped by a desire to re-establish France as a global superpower, and that desire itself was taking shape around France's emergent nuclear capacity.

The fudging of the distinction between military and economic interests had everything to do with the complexity both of the nuclear plants themselves as technical assemblages with many component functions and differentiated modes of expertise, and the ways in which some aspects of the plant were given priority over others. As Hecht points out, there was no single best way to build the reactors, as with all technological systems, the specific ways in which the

plants emerged was closely related to the priorities deemed most important, the particular social problems that they were addressing, and the resources available to confront those problems. The French case offers a clear example of how these priorities, perceived problems, and available resources were themselves unstable factors, subject to internal fluctuations and external pressures. When the first French nuclear bomb was produced in the 1960s it was clearly, for many, a source of great national pride, and the media of the day heralded the event as a breakthrough for French industry. We also know that the French determination to carry out nuclear tests in the Algerian Sahara and in Polynesia between 1960 and 1996 generated considerable international protest, notably from the Campaign for Nuclear Disarmament, an organisation founded in 1957, and particularly active in mounting protests against the French nuclear testing in the Pacific. The French nuclear programme produced many intersecting forms of identification - a bolstered national pride, a community of technocratic experts, a cohesive international protest movement, a growing sense of threat and the subsequent and parallel sense of need for high levels of security.

Without wanting to suggest that particular forms of energy determine correlate modes of politics, it does seem fair to follow Mitchell's suggestion that "energy is a field of technical uncertainty rather than determinism, and the building of solutions to future energy needs is also the building of new forms of collective life" (Mitchell 2011:238). In the second half of the twentieth century protests against nuclear plants strengthened. The oil industry also actively campaigned against nuclear fuels, drawing attention to the hidden costs of nuclear waste disposal. In the twenty-first century new uncertainties surround oil, particularly the on-going social and political instabilities in oil producing nations that are exacerbated by the inequalities and interdependencies of both the huge global desire for oil, and the threat of the ecological consequences of the continued demand for life-styles that depend on carbon fuels. In terms of energy systems it thus seems likely that the coming decade will be marked by the drive to establish alternative energy systems. Our understandings of how such systems will affect processes of identification should be informed by how previous systems have emerged. The push to ensure widespread networked provision makes it likely that for the coming decade at least new energy sources will be delivered through existing networks; it is also likely that the political and economic resources associated with energy provision will be both centralised and politically controversial. This is particularly likely with respect to the appropriation of energy sources widely perceived as 'commons' - such as is the case with solar, wind, and tidal energy.

5.2 Domestic Technologies

The changes to domestic life in Europe and the USA in the mid twentieth century were profound. Working people, and women in particular, were moving from domestic service to factory labour and new domestic technologies were transforming what domestic labour entailed (Cowan, 1983). This section looks at the role that domestic technologies played in the shaping of domestic life in the twentieth century and points towards changes that are emerging in the twenty-first. Domestic technologies had a central role to play in bolstering growth in national economies in the post-war years and they were, and are, key to the rise of the consumer society in Europe and the USA. In what follows I trace the relations that are folded into these appliances - paying particular attention to their design and marketing, to the skills and practices associated with their use, and to the desires and expectations which constitute their specific transformational promise. The histories of fridges, freezers and microwaves offer important insights into the entanglements of economic growth, family values, and processes of class and of gender differentiation.

I start with the case of the refrigerator. Over the course of the 1930s domestic refrigeration moved from being an expensive luxury, sold exclusively to upper-class customers - that is to people who did not usually cook for themselves and who purchased the appliance for its novelty value - to becoming an 'affordable, labour saving, food preservation device for a broad market of "servantless housewives" (Nickles, 2002). In her study of domestic refrigeration, Nickles (2002) explores how the market for these goods was created. The technologies incorporated into these household items went far beyond the science and engineering of compact, domestic refrigeration. They also involved the new techniques of an emergent mass advertising sector that began to develop methods of market research using interviews and survey data, gathered from the target groups whom they aimed to reach and transform into their primary purchasers. In other words, the transformation of industrial technologies for domestic use required the creation of the consumer, for whom the goods would be produced. For the first time this consumer was not taken to be the wealthiest in society (with the assumption that others would follow via a trickle down effect). On the contrary the advertising industry set out to create a generic mass market, focused on the desires and needs of the 'average consumer'. At the heart of this model were white, middle-class, hetero-sexual couples, living in single family homes, the men working in white-collar jobs, the women caring for the home and for the children. These so-called 'average families' came to stand for domestic harmony and solid social values as depicted in the images that the advertising agencies were creating for the sale of these new products. The values of the 'average family' were actively promoted as efficient and hygienic. In this normative framing, the good housewife upheld these aesthetic and moral values by providing a clean, safe environment for her family. The new domestic appliances were her modern, sleek allies and "the streamlined kitchen became a measure of progress - progress in the house-hold toward middle-class status, and progress in the nation toward a mass, middle-class society" (Nickles, 2002: 726).

However, the transformation of domestic labour did not improve women's quality of life in any straightforward way (Cowan, 1983). The various labour saving devices (washing machines, vacuum cleaners, electric irons, ovens and refrigerators) and the routine provision of hot water and indoor bathrooms, came with changing standards of cleanliness. Specific tasks may have become less arduous but the domestic worker used the time to do more housework, under greater moral pressure to emulate the ideal home. Self-sufficient with her new machines, women often felt isolated in the home, and dissatisfied and demoralized by work that expanded to meet the time available. The story of the microwave oven illustrates how the new appliances often consolidated narrow and confining images of women

In the 1950s and 1960s, the micro-wave was not really a 'domestic' technology at all. Marketing was directed at young single men, with no time or inclination for cooking. It was sold as a high-tech gadget in electronics stores alongside the hi-fi equipment. However, once this market was saturated there was a change in marketing strategy and the micro-wave was domesticated. The design was changed to simplify the interface, and the appliance moved from the electronics stores to sit alongside the refrigerators and washing machines as another basic household appliance. Feminist theorists of technology have analysed how the marketing strategies of all these domestic appliances reinforced gender stereotypes, particularly women's technical incompetence, and their moral duty to provide a clean and efficiently run family home. The dramatic changes in domestic technologies thus reconfigured but did not necessarily transcend existing modes of inequality (Cowan, 1983; Cockburn and Furst-Dilic 1994). However, the microwave oven did foster a change in eating habits and in cooking habits, opening up new possibilities for how food was prepared and consumed in the home. It continued to offer greater autonomy to those who did not want to cook, but the ease with which food could be re-heated also removed the need for everybody to eat at the same time. The

microwave thus had the potential to radically alter that central ritual of family life, the meal-time. However, the microwave was not a lone appliance. It was intrinsically connected to other domestic devices, particularly the home freezer to which I now turn.

In the 1970s only 3% of the UK population owned a freezer. By 1995 96% of households had one or more (Shove and Southerton 2000: 301). The story of the domestic freezer is a story of a technology that moved from its original industrial setting, to domestic outhouses (typically the garage) in the 1960s and 1970s, until by the 1980s it had become definitively embedded in the kitchen as an integral part of 'normal' systems of food provisioning. As with other domestic technologies the freezer was originally sold as a novelty device, a symbol of technological progress. By the early 1970s the price of freezers was coming down, with the change from absorption to compression technology. Refrigerators were also beginning to incorporate small freezer boxes, and of course the microwave was making its way out of the bachelor pad and into the family kitchen. This was also the time when the first specialist frozen stores appeared to supply this emergent market. The first Iceland store opened in the UK in 1970. By the mid-1970s the freezer was integral to meal planning - and the running of an efficient home - bulk buying saved money, reserve stocks saved time, and fast-food (pizzas, burgers, ice-cream) were introduced. This was also the time when the kitchen itself became a commodity, the stylish space of contemporary living. The freezer was no longer relegated to the garage but was incorporated as an intrinsic part of the new modern 'fitted' kitchens. The adoption of the domestic freezer was thus encouraged by other devices and infrastructures.

Domestic technologies were always marketed as devices that could save time and increase efficiency. In the process they transformed normative images of the home, and ideals of how families should live, offering new possibilities for how people live together, altering the rhythms of family living and essentially offering more autonomy (and therefore less inter-dependence) within the home. As with previous examples it is noteworthy that these changes did not equate in any straightforward way to improvements in 'well being' or 'quality of life'. Studies show that the devices did not save time with respect to the maintenance of an 'ideal (or average) home'. Gender inequalities remained significant. The technologies were primarily designed by men and aimed at women and it often took time for a notion of technological efficiency in the abstract to become an appliance that women actually found helpful in practice. Domestic technologies are first and foremost consumer items. They need customers, people who want to own them, to adopt them, and pay for them. One of the greatest 'changes' introduced alongside domestic technologies has thus been this charged image of the ideal family. This image tends to erase a more general awareness of the diversity of family practices, the complex employment patterns, shifting gender relations, and inter-generational dependencies. It also erases the significant tensions and disjunction between advertising campaign and consumer desire.

Advertisers are highly skilled in the work of creating 'needs' which have been systematically equated with the promise of 'well-being' and 'social cohesion'. But consumers are not empty canvases waiting to be imprinted by whatever the advertisers put their way. In fact the care that went into advertising campaigns in the 1960s was precisely about making informed judgements of how to create new needs and desires out of existing ones. It is worth noting that the campaigns did not always work. Parr, for example, analysed Canadian women's rejection of the automatic washing machine, in favour of a more labour intensive wringer washer. She argues that this rejection stemmed from strong ideas about the moral economy of domestic life that combined the drive for greater cleanliness with a keen ecological awareness that was reflected and reinforced in national economic policies of the 1950s. These prevalent Canadian

values thus generated a quite different response to the marketing of domestic technologies than was the case in the USA.

Changes in domestic technologies in the coming decade seem likely to grow from the contemporary interest in ecological devices that are energy efficient, devices that have in-built connectivity such as fridges that order replacement food items, sensors that register and even anticipate potential hazards, and further development of robotic devices (Bell et al., 2005). All these innovations continue the drive for time-saving and efficiency but they also incorporate a sense of individualised or customised attention. The smart home is the home that responds to specific needs. The 'average family' is no longer as important as the image of the individual (or individual family) whose needs can be met by a customised service.

Smart homes compile data from mundane domestic activities (whether this is energy use, food consumption patterns, or any pattern of normal behaviour that can trigger a response from a programmed system). The data that is used to construct and subsequently meet consumer 'needs' has already become a new commodity. The short history of domestic technologies presented here shows how the commodification of domestic life raises important issues of identity, desire and behaviour. The new informational devices that are now entering our homes also foster ambiguities, raising questions about how we expect to balance the possibilities for more efficiency (savings of money, time, space and labour) with the sense of individuality that arises not from our 'normal' behaviour, but from our quirky, ambiguous and unresolved ideas about who we are, what we want, and how we behave. It thus also seems likely that while these new technologies will continue to enchant and seduce, they will be shadowed by other practices that foster a human rather than a machinic rhythm (such as the slow food movement). The new connectivity, such as the potential for your refrigerator to place an order with your local food warehouse, might increase isolation for people, just as the new domestic appliances trapped housewives in efficient but lonely homes in the 1950s and 60s. It also seems likely that there will be further investment in technologies that register the environmental and human costs of the commodification of individual desires (such as in the move to alternative energy, the reintroduction of cycles to city centres, the opposition to supermarkets, the labelling of food miles, the insistence on fair trade, etc.). There is already recognition in some quarters that there is a need for culturally rich design, a move away from standardisation and efficiency, and breaking of the connection between consumption and technology. (Bell et al., 2005) An example here would be the installation of smart meters that explicitly work against growth models, encouraging consumers to use less energy. These ambiguities and the strong link to the social limitations of a model of individual demand are central issues in the final set of technologies discussed here, the biotechnologies that play such a prominent role in contemporary identity formation.

5.3 Biotechnology

Biotechnologies relate to human identity in ways that are fundamental to our understanding of the particularity of our species, the specificity of our families, and also the potential mutability of our genetic make-up. The problems that the life sciences have always sought to address are the problems of life itself, the reproduction and transformation of living matter. As with the other technologies we have discussed in this essay, these scientific problems are an expression of social preoccupations. But the scope of biotechnologies connects fundamental questions of what it is to be human to concerns over intra-species differentiation and the heritability of genetic traits, to desires to find ways to treat congenital conditions, and identify populations at risk, and to the possibility of intervening in the reproductive cycles and potentials of humans, plants and animals. Historically there have been many significant breakthroughs: Darwin's

understanding that species are not immutable; Mendel's discovery that traits can be inherited; McClintock's finding that genomes are highly dynamic. Every field and sub-field would offer us further examples. Anthropologist and historian of science and technology, Hannah Landecker notes, however, that the fundamental skills and techniques on which contemporary biotechnologies depend, particularly the practice of growing living cells of complex organisms outside of the body (in vitro) offer us a more tangible and specific history from which to consider some of the implications for human identity of cloning, genetically modified foods, and the technologies of assisted conception, each of which I consider briefly below (Landecker, 2007).

Within the field of biotechnology these techniques are not particularly remarkable. On-going experimentation with freezing technologies and cell-cycle interventions, and the development of concepts which allows for effective communication across diverse branches of the life sciences are now embedded and normalised. Cell lines can be maintained continuously as indefinitely self-reproducing populations as long as they are incubated and kept in nutrient media, or frozen at cold enough temperatures. All those working in the field of biotechnology, from whatever field, would routinely assume that living cells can be stopped and started, suspended and accelerated. These possibilities underpin the more explorative investigations into the plasticity of living matter, the possibilities for trans-genic mutations, and the on-going research into what new organisms can be created. The work is the work of hybridisation. And the 'new' entities we create in this way routinely confound established understandings of our human possibilities and responsibilities. As Landecker remarks: "It is not simply that biotechnology changes what it is to be human - biotechnology changes what it is to be biological" (Landecker, 2010). In the cases discussed below, the evolving technological possibilities offer solutions to specific problems of plant and animal health, growth and reproduction, but the hybridsing techniques, and the temporal suspensions and accelerations that they involve produce new problems which are not open to technological solutions. These concern the disputed legal status of new hybrid entities, the ethical and moral concerns raised by the procedures, the concerns over the uncertain consequences of such interventions, and the confusions generated by the emergent commodification of life itself as living matter becomes the subject of sponsorship, ownership and controlled circulation (Rose, 1996).

5.3.1 Cloning

The techniques for the freezing of cells were not much remarked upon when the experiment that led to the cloning of Dolly the sheep was carried out, but this experiment was utterly dependent on these techniques as Dolly was cloned from tissue taken from the udder of a pregnant ewe that had been frozen since 1995. The excitement of technological innovation in the case of Dolly was the demonstration that the nucleus of an adult differentiated cell could be used to clone a whole new individual. However, the crucial scientific proof required to demonstrate that Dolly was genetically identical to the adult ewe from which the transferred nucleus had come was dependent on the continued existence of those original cells, which were duly brought out of the freezer and compared. These procedures challenge normative assumptions and understandings of life, and of what it is to be a biological entity. They show how it is that cellular life is routinely (rather than in any way exceptionally) suspendable, interruptible, and partible. The technological novelty that surrounded these cloning experiments concerned the advances in the techniques of getting cells to live outside the body, the ability to fully control the media in which cells live, and the growing understanding of cell synchrony and cell cycles. But these technical advances were neither the story nor the preoccupation in Dolly's case. This is because the technological assemblage that was given the name 'Dolly' was a complex social, economic and scientific ordering that drew together more than cell chains. The hybrid formation was one outcome of long term histories of human differentiation,

of sexual and racial politics, of nation states and colonisation, of attempts by modern science to control nature, and of capital to create and control new commodities and foster new markets. (Franklin, 2007). The specific ways in which cell technologies are integral to these forces of global political economy is also highly pertinent to the debates and controversies surrounding genetically modified plants.

5.3.2 Genetically Modified Plants

Experimentation on gene transfer across species has been on-going since the late 1940s when the techniques were first developed in laboratory conditions. The first genetically modified plants were produced in 1983, but GM technologies came to public attention when the techniques were directly applied to foods for human consumption, as opposed to animal feeds, fibres, or plants used to produce non-edible oils. These GM foods were developed primarily to address problems facing large-scale agriculture. For example, GM tomatoes were developed to delay the ripening process and thereby facilitate long-distance transport. The techniques were subsequently widely applied to increase yields in maize and soya, and to displace the use of fertilizers and pesticides. The greatest public controversies have surrounded the direct production of genetically modified food crops. The media has tended to portray a strongly dichotomised public stance in relation to the use of GM (Campbell, 2009; Degnen, 2009). The Pro-GM lobby promote the advantages of GM to address issues of global food security. The anti-GM lobby argues that there are other, safer alternatives and most importantly that it is more important to consider political and social solutions to inequalities in food distribution than to address the problem of food scarcity via the technical fix of GM which primarily benefits large-scale producers. There are also fears that the use of proprietorial GM seed (and the colonization of non-GM plants by GM crops) will disenfranchise poor farmers and lead to the loss of local skills in plant selection and breeding. However, studies also show that many people are open-minded, somewhat uncertain but willing to consider the various arguments and to think about GM in relation to specific needs and possibilities rather than in relation to the somewhat abstract and apocalyptic challenge of how to feed a world population of over ten billion in 2050 (Public Understanding of Genetics).

Ethnographic research in this field confirms that in relation to identity formation, GM foods are significant primarily because of the relationship between food, feeding and personhood. Anthropologists have documented the importance of food for the building of relationships within families and local communities. Food sharing is a basic mode of human identification and across the world people pay close attention to the ways in which basic consumption habits express relations not only of care and concern, but also of power and social difference. Food production, preparation and consumption expresses class, gender, ethnic and generational differences and for many people it is also overtly constitutive of such differences. Those who refuse to eat with you or to share what you eat are refusing a basic human mutuality.

Concerns around GM thus extend well beyond the mass production of cheap food. There are fears about whether such food can foster healthy bodies, and whether its mode of production fosters healthy communities. GM foods became the subject of explicit debate in the context of severe health scares that were connected to uncertainties surrounding industrial models of agricultural production. In the UK the strong resistance to GM crops was linked to the outbreak of bovine spongiform encephalopathy (BSE), commonly known as ‘mad cow disease’. The uncertainties and dangers, and the devastating consequences for farming communities, were carried forward into growing ecological concerns over other effects of industrialised agriculture, particularly in relation to fears that intensive agriculture was at best unsustainable, at worst destructive of biodiversity and a threat to human life. These debates made explicit the connections between the food we produce and eat, and the health of individual and social

bodies. The potential of biotechnologies in this field was thus counterbalanced by the uncertainties and fears concerning the increasing commodification of life forms and the sense that the technologies might reduce choice by limiting diversity. There was also the fear that the corporations that were sponsoring the production of GM crops were not accountable. This lack of accountability in a field where effects were potentially irreversible were also a cause of public concern.

5.3.3 New Reproductive Technologies

If healthy bodies, and communities of practice (producers and consumers of foods) are central to the GM debates, it is the field of kinship and cultural understandings of relatedness that underpin discussions of what became known as the new reproductive technologies. In 1978 Louise Browne was born in Oldham in Lancashire. She was the first child resulting from in vitro fertilization. Her birth provoked excitement and unease in terms that were not dissimilar from the debates around cloning, or GM crops. The new reproductive technologies, however, were less clearly led by commercial and corporate interests or scientific fascination into the possibilities of trans-genic mutation. These technologies were immediately understood in the more mundane terms of human relations, of kinship and ultimately of a person's right to have children. The technologies offered a 'technical fix' to the inequalities of human reproductive capacities. There were deep-seated expectations of how to be a proper person at issue here, and the sense that adult relations were completed and consolidated in and through the conception and birth of a child. And yet the technologies disrupted equally deep-seated convictions with respect to the sanctity of life, the role of the state, the structure of families, the institution of marriage, and ultimately extended to questions of how notions of ownership extended to persons.

In the UK these issues were extensively discussed and analysed. From 1982-1984 the ethical legal scholar Mary Warnock chaired the Committee of Inquiry into Human Fertilisation and Embryology which led to Human Fertilisation and Embryology Bill of 1990. Research on human embryos more than fourteen days old was banned, and in vitro fertilisation made subject to state regulation. Across Europe these procedures were also discussed and regulated, although it is important to emphasise that different countries took quite different approaches to how these technological re-orderings of human kinship should be regulated. Debates over the sanctity of human life drew on long-established and highly differentiated traditions, reflected in terms of religious conviction, of personal rights to one's own reproductive body, and of state responsibility for regulative frameworks. The question of who is ultimately responsible for human life is answered in many different ways. The technologies posed this problem rather than resolved it (Shore, 1992).

But the possibilities for some of giving birth to children to whom they had no genetic connection, as in the case of surrogate motherhood, also raised questions about the structure of parenthood and of families more generally. Who had the rights to be a parent? The technologies produced new possibilities for gay couples, for infertile couples, and for single people. The changes in what was understood by biology were thus directly related to the possibilities that ascribed identities might have become elective. The issues explored in relation to new reproductive technologies thus had implications for adoption, for marriage, and ultimately for the ways in which individuals understood the relationship between private life and public concern. Normative understandings of the 'average family' were certainly challenged. Kinship was revealed as something that had to be made to happen (whether or not the genetic technologies were deployed).

But the reproductive technologies were also dependent on specialist knowledge, and on the genetic techniques described above. As cells were routinely kept alive outside the body it became less clear who they belonged to. The Baby M controversy in 1986 made this dilemma explicit. The case involved a surrogacy arrangement in which the surrogate or birth mother changed her mind and refused to deliver the baby to the commissioning couple, and more importantly in law, to the male sperm donor. The courts subsequently awarded custody of the child to the father, but the process by which this decision was reached had involved deliberation over the ownership of cells, the negotiability of parent-child relations, the markets in body parts.

Over the past twenty five years genetics has created a new language for talking about kinship - people are familiar with notions of sperm donors, gestational surrogates, birth mothers - and the contrasting notion of 'real parents', those responsible for the upbringing and well-being of children. The complex interplay between biological (genetic and gestational) and social connections are the subject of constant consideration as individuals, families, communities and regulatory bodies try to keep up with the new possibilities that the technologies of assisted conception offer. However it is interesting to note that the new conditions of possibility do not necessarily change the ways in which people express their connections to others. Researchers have found that old idioms of kinship are remarkably resilient (Edwards and Salazar, 2009), and that the notion of a malleable connection through diverging and mixing blood lines, is more common than any notion of fixed genetic essentialism (Carsten, 2011). Nevertheless the exclusionary modes of identification associated with blood lines, is also carried forward into contemporary modes of relational thinking where upbringing and biology are combined in ideas about how people relate to each other and establish a sense of belonging (and/or a sense of exclusion). Thus overall while genetics has produced new idioms of relatedness, it does not, as yet, seem to have created a new way of thinking about human differences. People still think in terms of ancestry, of blood and an open and undefined sense of biological/cultural mix - the coming together of history, language, religious practices, and family life. And unfortunately the genetic technologies do not seem to have substantially altered racialised thinking despite the fact that genetic science has definitively shown that genetic origins are significant only as species origins, human beings sharing 99% of their genetic material. The variations that the 1% produces are not understood by scientists to correspond to racial - and still less to ethnic or national categories - but phenotype is routinely assumed to signal other profound and systematic differences in human make-up.

6. Conclusions: What should we take into account in thinking about how identities might change over the next 10 years?

Firstly it is clear that ten years is a short time frame with respect to technological histories. In all the examples explored here several decades passed by before technological breakthroughs had translated into stable assemblages that had reached a point of normalisation. The changes that will be noticeable over the next decade are thus likely to already be well on the way to becoming established. It thus seems logical to look, in the first instance, to areas of excitement and interest with respect to existing technologies.

In most general terms the key issues, in terms of the technologies are the emergence of synthetics/hybrids (with synthetic chemistry and synthetic biology leading the way in the production of new materials, and new life forms) and the move to the informational (as ubiquitous computing renders real time data and the use of huge data sets a mundane reality). Furthermore, these two fields of technological innovation are increasingly inter-connected as technological devices are no longer primarily conceived of as stand alone artefacts or even as parts of networked systems. Technological devices now routinely accumulate and redirect data. Our transactions are tracked, as are our credit cards and our bio data. Our running shoes can already register exercise patterns and prompt responses and suggestions from an on-line coach, while the autonomous circulation of data and the configuring power of algorithms have had more sinister effects in contemporary financial markets. We have also seen how specific techniques for the handling of living matter allow that matter to be reconfigured. Cells can be stored, moved, and transformed. At the same time it seems clear that the basic trends of mechanisation (in which I would include robotics), and integration through powerful cybernetic systems will continue to develop and influence the ways we live. We thus urgently need to interrogate and understand technologies as complex assemblages with implications for the kinds of collectives we are building for ourselves to live in and with.

With respect to the three technological domains that I have considered in this essay there are specific trends that can be identified. With domestic technologies the trend to greater ‘convenience’ is already configured as informational (as smart devices ‘learn’ to anticipate needs) and as automation (continuing the trend to labour saving). In bio-technologies the commodification of ‘life’ emerges as a major trend as the possibilities for the disaggregation of living matter and its re-configuration are developed and extended. Cells can now be bought and sold. However, the commodification of life generates new communities of practice and of protest and there is also likely to be considerable research effort into developing ‘alternative technologies’ with a focus on what has become known as general resource security (the ambition to secure middle-class life-styles for a growing population), and an acute challenge particularly in relation to food, energy and water. The challenge here will be to think beyond the ‘technical-fix’ and to find ways to articulate the specific problems that different communities face in relation to resources.

Commitment to growth models is also likely to foster increased concern about security in a more political sense - with anticipation of growing inequalities - and struggles over how future planetary life is imagined, particularly with respect to energy production and circulation. The key fractures in this regard are already clearly visible in terms of identity politics of localised protection (national, regional, community identities articulated as exclusionary and under

threat). The mobilisation of a sense of threat or pervasive insecurity is also likely to increase the use of informational devices (and bio data) to track and anticipate potential sources of threat, and the use of predictive modelling is becoming more widespread. The 'technical fix' is likely to remain the option of choice, rather than the more complex and time-consuming task of trying to work out the prior conditions of specific problems, and the possibilities of partial, open solutions that people can understand and relate to. This latter option returns us to the notion of the assemblage and the reminder that technical fixes are never the straightforward application of a (singular) technology to a specific problem. Both the technology and the problem have complex histories, both are the outcome of specific choices, of paths not taken, of differentiations that are made and made to stick. Even an algorithm has a history, and emerges from a whole range of competing possibilities, carrying forward not just mathematical choices but a range of social and cultural values that motivated how it was developed and tested.

In this field of emergent technologies, conjunctural factors will be significant and require us to think about what salient social dynamics will be of greatest significance over the next ten years. The pervasive trends here point decisively to at least a decade of precarious living for many people, in relation to many fields of life. The coming decade is likely to be shaped by concerns over climate change (particularly with respect to the threat of floods and of drought); energy sources (as discussed above); financial insecurity on a global scale (a problem intimately connected to automated networked systems that undermine the capacity of national, regional and local economies to fend for themselves); increased criminality around financial dealings also seems highly likely alongside new alliances and technologies designed to tackle financial crime; beyond the issues of bio-technology discussed above, the significance of nano-technologies is also likely to develop, particularly with respect to new smart materials, pharmaceuticals and medical devices; it seems likely that the deeply embedded propensity to turn to the 'technical fix' will produce new experimental life forms and new senses of risk; developments in robotics and artificial intelligence will continue to transform labour identities and the move towards increased automatic and human/machine configurations driven by an enduring drive for greater economic efficiency in industry, but with a social cost, generating further potential for a deepening sense of widespread social alienation. All forms of alienation present security risks, and again the most likely 'technical-fixes' in this area are already underway with the increased use of bio-data, linked to predictive modelling, particularly in relation to a growing sense of anticipated threat; this sense of threat will also play through efforts to strengthen democracy through initiatives to increase participation and networked information technologies will continue to play a central role here; these networks will also support issue politics, and the capacity for flash protest and new associational forms that work to circumvent dominant interests (and controls); increased attempts to criminalise such protest seems likely to foster pessimism and disengagement; finally there is little sign of any political will to move away from growth models despite concerns over resource depletion; consumer choice, enhanced by customised marketing, increases corporate power at the expense of political institutions.

This is not an optimistic picture, but there are four areas in which possibilities for change appear to be both open and vibrant. If we return to the notion of technological innovations as world building practices, we can continue to pose the question of what kinds of social identities we would hope that our technological assemblages might work to foster.

The first assemblage is the data set. There are many fascinating questions about how data is accumulated, stored and transformed and it is an area in which social and technical forces are clearly in play. The ownership of data is a particularly contentious issue and an area which relates to crime, extremism, social-cohesion and well-being. All data sources have potential

commercial value, but are also sites of contested control. One of the emergent problems with informational systems is that they convert human beings into data sources. Where this data has commercial value there is likely to be controversy and settlements are likely to vary according to local conditions. For example, in some US states data capture is banned on privacy grounds, while in other states giving data is mandatory in many situations. These issues are not yet fixed and it is an area in which new kinds of localism (localisms that don't necessarily demand co-presence) are likely to remain important and could be fostered, if people are encouraged to work together to figure out how to get their specific problems addressed, potentially in opposition to broader financial goals of large corporations, or homogenizing tendencies of national and regional governments. Struggles are likely to be most acute where there is a perception that technological changes are irreversible.

The second assemblage refers to new forms of property where technological capacity and social arrangements are clearly in flux. The relationship between law and new forms of property (e.g. patenting of process, algorithms, etc.) are areas of public concern where regulation and clear policy could enhance accountability and foster social cohesion through, for example, a commitment to ensuring protection of various forms of commons. Protection and criminality are likely to flourish alongside each other in this field as economic drivers become more visible and increasingly replace other forms of moral value in the ordering of human relationships (whether at the level of the corporation, the public sector organisation, or even individual instrumentality).

The third assemblage refers to hybrid technologies - where the notion of holding or bringing together what was previously differentiated is still explicit. In the early stages of adoption most technologies are experienced as hybrids, as new technologies are always adopted in relation to existing ideas. The notion of hybrid knowledges links to a contemporary understanding of identities as multiple and discontinuous (non-coherent). Hybrid responses should be anticipated and understood as a likelihood rather than an anomaly. Early adopters of new technologies may well mix and match the possibilities that different technological assemblages afford. A recent study of the reasons people give for buying electric cars shows that many people run 'hybrid households' running two cars, with different functions in the household economy, effectively combining the possibilities of electric and diesel powered models (Bell et al., n/d).

Finally as suggested above, predictive technologies such as the widespread use of data modelling and the ever more available possibilities of identifying propensities before 'it' ever happens, do not diminish a sense of insecurity, any more than the domestic technologies of the 1950s diminished the time spent on domestic tasks. There are important lessons to be learnt here from technological histories which return us to the question of how specific technological assemblages manage the relationship between generic and specific problems. In many of our examples history has shown that it is easy to lose sight of the ways in which problems get configured. Technological responses, particularly those that tend to standardisation routinely erase the richness and complexity of the social constituency that they supposedly address. This situation speaks to the need to continually re-examine the specific shape of the problem that is being addressed, and making the effort to understand technologies and identities as complex assemblages rather than assuming that the technologies and identities in question are either singular or self-evident.

References

Agar, J. (1998) 'Digital Patina: Text, Spirit and the First Computer'. History and Technology, 15, pp.121-35.

Bauman, Z. (1996) 'From Pilgrim to Tourist - or a Short History of Identity' in Questions of Cultural Identity. London: Sage. pp.18-36.

Bell, G., M. Blythe and P. Sengers (2005) - Making by Making Strange: Defamiliarization and the Design of Domestic Technologies in ACM Transactions on Computer-Human Interaction, vol 12, no. 2, 149-173.

Bell, S., B. Campbell and J. Brady (n/d) "All you need is a 13 amp plug: a household level study among early adopters of Battery Operated Electric Vehicles in the United Kingdom".

Burke, J. (2012) "India: the dark reality behind the west's idea of the sub-continent's success" in The Observer, Sunday 5th August.

Campbell, B. (2009). "Fields of Post-Human Kinship" in Edwards and Salazar (eds) European Kinship in the Age of Biotechnology, Oxford: Berghahn. pp.162-178.

Carsten, J. (2011) 'Substance and Relationality: Blood in Contexts' in Annual Review of Anthropology, 40:19-35.

Cockburn, C. and R. Furst-Dilic (eds.) (1994) Bringing Technology Home: Gender and Technology in a Changing Europe

Collier, S. 2011. 'The Intransigence of Things' in Post-Soviet Social: Neoliberalism, Social Modernity, Biopolitics pp.202-244.

Cowan, R.S. (1983) More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave. New York: Basic Books.

Degnen, C. (2009). "Eating Genes and Raising People: Kinship Thinking and Genetically Modified Food in the North of England" in Edwards and Salazar (eds) European Kinship in the Age of Biotechnology, Oxford: Berghahn. pp.45-63.

Edwards, J. and C. Salazar (eds) (2009) European Kinship in the Age of Biotechnology, Oxford: Berghahn.

Franklin, S. (2007) Dolly Mixtures: The Remaking of Genealogy. Duke University Press.

Hall, S. and P. du Gay (eds) (1996) 'Introduction: Who Needs Identity? in Questions of Cultural Identity. London: Sage. pp. 1-17.

Harvey, P. (2005) Memorialising the Future - The Museum of Science and Industry in Manchester, in M. Bouquet and N. Porto (eds) Science, Magic and Religion: the ritual process of museum magic, Oxford: Berghahn, pp. 29-50

Hecht, G. (1994) Political Designs: Nuclear Reactors and National Policy in Post-War France, in Technology and Culture, Vol.35, No. 4, 657-685.

Hecht, G. (1998) The Radiance of France: Nuclear Power and National Identity after World War II. Cambridge, Mass.: MIT Press.

Hughes, T. (1979) 'The Electrification of America: the System-Builders', in Technology and Culture, 20, 125-39.

Landecker, H. (2007). Culturing Life: How Cells Became Technologies. Cambridge, MA: Harvard University Press.

Landecker, H. (2010) "Living Differently in Time: Plasticity, Temporality and Cellular Biotechnologies" in Edwards, Harvey and Wade (eds) Technologized Images: Technologized Bodies. Oxford: Berghahn Books. pp. 211-236.

Mitchell, T. (2011) Carbon Democracy: Political Power in the Age of Oil, London: Verso

Nickles, S. (2002) "Preserving Women": Refrigerator Design as Social Process in the 1930s in Technology and Culture, vol 43, no.4, 693-727

Public Understanding of Genetics (PUG): a cross-cultural and ethnographic study of the 'new genetics' and social identity, European Commission Fifth framework Programme. PUG and Governance in Europe, PUG and Family in Europe, PUG and food in Europe, PUG and race in Europe. http://www.socialsciences.manchester.ac.uk/pug/Barcelona.htm

Rose, N. (1996) 'Identities, Genealogy, History'. in Questions of Cultural Identity. London: Sage. pp.128-150.

Shore, C. (1992) 'Virgin Births and Sterile Debates: Anthropology and the New Reproductive Technologies' in Current Anthropology, vol 33:3, 295-314.

Shove, E. and D. Southerton (2000) Defrosting the Freezer: From Novelty to Convenience: A Narrative of Normalization, in Journal of Material Culture, 5:301-319.

Winner, L. (1980) 'Do Artefacts have Politics?' in Daedalus, vol 109:1.

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