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Rethinking therapeutic strategies in cancer: wars, fields, anomalies and monsters

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In this article, we argue that the excessive focus on cancer as an insidious living defect that needs to be destroyed has obscured the fact that cancer develops inside human beings. Therefore, in order to contribute to debates about new cancer therapies, we argue that it is important to gain a broader understanding of what cancer is and how it might be otherwise. First, in order to reframe the debate, we utilize Pierre Bourdieu's (2004) field analysis in order to gain a stronger understanding of the structure of the (sub)field of cancer research. In doing so, we are able to see that those in a dominant position in the field, with high levels of scientific capital at their disposal, are in the strongest position to determine the type of research that is carried out and, more significantly, how cancer is perceived. Field analysis enables us to gain a greater understanding of the complex interplay between the field of science (and, more specifically, the subfield of cancer research) and broader sources of power. Second, we draw attention to new possible ways of understanding cancer in its evolutionary context. One of the problems facing cancer research is the narrow time frame within which cancer is perceived: the lives of cancer cells are considered from the moment the cells initially change. In contrast, the approach put forward here requires a different way of thinking: we take a longer view and consider cancer as a living entity, with cancer perceived as anomalous rather than abnormal. Third, we theorize the possibility of therapeutic strategies that might involve the redirection (rather than the eradication) of cancer cells. This approach also necessitates new ways of perceiving cancer.

Fields, subfields and external forces

Bourdieu's notion of field is useful in helping us to understand the complex interplay of forces guiding cancer research. According to Bourdieu (1975, 1993a, 1996, 2003, 2004), the field of science, like other cultural fields, has, over the centuries, developed, in its most autonomous region, its own laws which are at odds with the laws of surrounding fields - such as the field of power. According to Bourdieu (1998: 40), a field is:

> a structured social space, a field of forces, a force field. It contains people who dominate and others who are dominated. Constant, permanent relationships of inequality operate inside this space, which at the same time becomes a space in which the various actors struggle for the transformation or preservation of the field.

The 'rules of the game' that characterize each social field are unique, and so an understanding of external factors alone will not suffice in understanding what occurs therein. However, as a field becomes less autonomous, external forces can come to dominate. Individuals bring to each field resources and competences (forms of capital), which define the position that they are able to take and the strategies they will pursue (Bourdieu, 1986). Actors' social conditions of existence and the forms of capitals they possess are embodied in their habitus, which 'functions as a system of generative schemes, generative strategies which can be objectively consistent with the objective interests of their authors without having been expressly designed to that end' (Bourdieu, 1993a: 76a). The interaction between habitus and field occurs below the level of consciousness, hence Bourdieu's (1993a) reference to *practice* rather than consciously formulated social action. This means that an individual's habitus will

predispose them ‘to select forms of conduct that are most likely to succeed in light of their resources and past experience’ (Swartz, 1997: 106).

Each field has its own rules which sometimes run contrary to the laws of other fields. For example, in the most autonomous region of the field of cultural production, there is an inversion of the rules of the wider field of power: for avant-garde authors, the acceptance of awards bestowed by bourgeois institutions is likely to be an indication of having compromised artistic integrity (Bourdieu, 1996). If these authors do claim success, it is not success that can be measured economically, but in terms of the literary or artistic prestige bestowed by peers in the field. As part of this logic, where ‘the loser wins’, profit, success and popularity with the general public are viewed suspiciously. The author of a bestseller is likely to be accused of ‘selling out’ to a wider audience and sacrificing the ideals of art and creativity (Bourdieu, 1993b). Field-specific cultural power is thus opposed to the economic power that prevails in other fields. This example makes clear the fact that each field has its own specific stakes, interests and properties, though a troubling development in recent years is the incursion of the logic of profit, as an external threat, undermining the hitherto autonomous regions of scientific, literary and artistic fields (Bourdieu, 2003).

Individuals, with varying competencies and abilities, possessing capitals – such as, for example, economic capital (money, property, shares) or cultural capital (cultural competences, resources) – of varying volume and structure, compete in accordance with the field-specific rules in their bid to obtain the profits at stake. The entry requirements that enable one to play the game in each field vary considerably. In the field of cultural production, high levels of cultural capital and the ability to perceive the world aesthetically

are required. In the field of scientific production, possession of scientific capital is essential. This form of capital is:

> a particular kind of symbolic capital, a capital based on knowledge and recognition. It is a power which functions as a form of credit, presupposing the trust or belief of those who undergo it because they are disposed (by their training and by the very fact of their belonging to the field) to give credit, belief (Bourdieu, 2004: 34).

Scientific capital is embodied in the habitus of individual scientists so that their scientific practice is more of a practical mastery than a consciously formulated logical procedure (Bourdieu, 1975, 2004). According to Bourdieu (2004: 41), the scientist 'is a scientific field made flesh'; science is a 'craft', communicated through the doing (and observing the doing) of science, 'a practical sense of the problems to be dealt with, the appropriate ways of dealing with them, etc.' (Bourdieu, 2004: 38). Entry to the field is not possible for everyone: in the twenty-first century, for example, entry to the scientific field requires the practical mastery of several centuries of research relating to a particular sub-field and an awareness of the current state of play in the field (Bourdieu, 2004: 51). Bourdieu's field perspective on science enables him to reject two arguments: first, macro-level approaches arguing there is a homogenous scientific community that operates in accordance with consensus; second, micro-level approaches that make the claim that individual scientists deploy various strategies in order to construct their findings as truths while disregarding contrary evidence. Let us consider Bourdieu's critique of the first these two perspectives with reference to Merton's (1957) work. Merton (1957: 642) makes the argument that science, as an institution, operates and advances effectively because of its emphasis on originality, innovation and new discoveries and, corresponding to this, 'an elaborate system for

allocating rewards for those who variously live up to its norms'. According to Bourdieu (2004: 45), this '"communitarian" vision fails to grasp the very foundation of the scientific world as a universe of competition for the "monopoly of the legitimate handling" of scientific goods'. Those in possession of large volumes of scientific capital have power over others in the field and they are more likely to have the authority to set the rules of the game and maintain their pre-eminence in the face of competition from newcomers. Those with high volumes of scientific capital are thus more likely to pursue conservation strategies in the field: they are suspicious of approaches that challenge the current state of play and their own dominant position. Newcomers, in contrast, have nothing to lose and everything to gain: their role is to contest the taken-for-granted assumptions in the field and to break through its entry barriers (Bourdieu, 1993a). Lacking scientific capital, they rely on strategies – semi-consciously pursued – that are rooted in heterodoxy. In Bourdieu's model, change is accounted for in this struggle between the old guard and the newcomers. However, it is worth noting that when revolutions take place in the field, they are only *partial revolutions* because for the game to continue at all, all parties, from the defenders of orthodoxy to the newcomers, share a belief in its value and its all-consuming importance (Bourdieu, 1993a: 74). As for the second perspective, Bourdieu (2004) is critical of constructivist micro-level laboratory studies approaches that provide a more individualistic account of scientific practice, drawing attention to the self-serving strategies, linguistic, rhetorical, and political, deployed by scientists as they present their findings as self-evident workings of nature and ignore unfavourable results as aberrations (Gilbert and Mulkay, 1984; Latour and Woolgar, 1979). According to Bourdieu, scientists are not consciously Machiavellian, but in order to 'play the game', they respond and adjust their practices and position-taking – often semi-consciously – in accordance with requirements of the field. The autonomy of the scientific field has been won gradually, over the centuries, stage by stage, starting with the Copernican revolution and

finally being achieved with the institutionalization of science by the seventeenth century (Bourdieu, 2004: 49-50).

The 'war on cancer' and the subfield of cancer research as heteronomous

Bourdieu's notion of the scientific field enables us to problematize the notion of a scientific community working collaboratively, in the name of progress, in search of a cure for cancer. Within the subfield of cancer research, we can see that the *type* of cancer research that will be conducted is at stake in the field, as are the rewards and profits associated with this research. Furthermore, in the scientific field and the subfield of cancer research, there remains a lot of 'undone science': promising research projects that do not meet the (funding) criteria associated with the dominant research agenda (Frickel, 2009). As we will see below, cancer research is still entrenched in the 'war on cancer' and its temporal perspective is limited. Moreover, it is constrained by views ingrained in the structure of the field. Since the signing of the National Cancer Act by the US President Richard Nixon (in the early 1970s), thought by many as the first move triggering what would become the 'war on cancer', the orthodox position in cancer research has been to find ways of destroying cancer cells. This impulse has led to great scientific achievements in the field, including the human genome project with the hope of understanding what goes wrong in cancer at the molecular level. Medical advances have made welcome gains in improving the life expectancy associated with cancer, but the numerous painful side effects of chemotherapies are often overlooked (Pjevic et al., 2004), leading patients to drop second line treatments and, in some instances, look for physician-assisted suicide (Hicks, 2006). Tumours that have been attacked by violent therapeutic intervention typically relapse after a year or less and when they do so, they are more obstinate than before (Huang, 2014: 1). Furthermore, the cells that survive the initial intervention

experience a ‘phenotype switch to a more primitive and resilient state’ (Huang, 2014: 2). Cancer consists of a heterogeneous population of cells and the lethal force of chemotherapy serves only to eradicate the drug-sensitive cells on the periphery of tumours. When these cells are gone, the vacuum is filled by the chemo-resistant subpopulations which tend to reside in the inner regions of the tumour and which are able to multiply at the expense of the drug-sensitive cells (Oronsky et al., 2015).

The ‘war on cancer’ approach is the prevalent way of viewing the problem of cancer in the (sub)field. As Bourdieu observes, each field institutionalizes a particular viewpoint; it has its own *doxa*: ‘a set of inseparably cognitive and evaluative presuppositions whose acceptance is implied in membership itself’ (Bourdieu, 2000: 100). The habitus of the scientist, which must be closely aligned with the demands of the field (in terms of the requisite scientific, cultural and technical competences), must be ‘amenable to restructuring’ so that the scientist acquires a tacit sense of what is thinkable or unthinkable and a practical sense of what questions can or cannot be asked (Bourdieu, 2000: 100). Inevitably, this produces a degree of conformity, a degree of ‘group think’ which is reinforced by the fact that many of those entering the scientific field hail from similar backgrounds: As Bourdieu (1984, 2000) has pointed out, the ability to assume a ‘disinterested’ intellectual stance is made possible by a social power over time and a life relatively free from economic necessity. What, then, are the consequences of this ‘group think’? Amidst the battles that rage between, for example, competing schools of thought, between the established order and the newcomers, between orthodox and heterodox positions, the arguments of those attempting to take up an *unforeseen position* in the field are excluded as ‘absurd, eclectic or unthinkable’ (Bourdieu, 2000: 101) and ‘the right way to do science’ is imposed, thus discrediting all other ways (Bourdieu, 2004: 63). Along these lines, then, the ‘war on cancer’ retains its dominance, though this is perhaps as much due to the

lack of hope in feasible alternatives as it is an expression of the doxic attitudes prevalent in the field.

However, matters are further complicated because the 'game' of cancer research extends into other fields and well beyond the confines of the scientific field. The subfield of research into anticancer treatment is heteronomous. Therefore, economic, political and institutional pressures and influences from other fields need to be considered in the analysis of dominant modes of cancer treatment. Consider, for example, the model of anti-cancer treatment in the United States of America where an insurance-based, market-oriented model of healthcare prevails. Here, cancer treatments are inseparably linked to the practices of 'big pharma'. It is estimated that the costs associated with treatment per individual amount to nearly half of the average annual income (Kantarjian et al., 2014, p. 208). Drugs such as imatinib – which is used to treat chronic myeloid leukaemia – costs $95,000 per year (as compared to $46,000 in Canada, $29,000 in Mexico) (Kantarjian et al., 2014: 209). The costs of the drugs are high because the pharmaceutical and health care industry has considerable influence. In the US in particular its lobbying power is significant: in 2012, for example, it had around 2,500 lobbyists and spent $306 million. This figure 'far exceeds the lobbying spending of the defence, aerospace, and the gas and oil industries' (Kantarjian et al., 2014: 209). Decisions affecting the type of anti-cancer treatments available in societies such as the UK, which have stronger welfare state traditions, are informed by complex political and institutional factors as health spending comes under pressure in the post-financial crisis economic climate (Harvey, 2010) and the relatively weak structural position of health and welfare departments makes them vulnerable to budget reductions (Gray, 2007). For instance, in the aftermath of the crisis, the Conservative-led coalition government introduced a Cancer Drugs Fund (2010) in order to increase access to anti-cancer treatments that would otherwise be unavailable on a routine basis in the NHS. However, by 2015, the costs associated with this Fund were

deemed to be unsustainable, and after a review, a number of the anti-cancer drugs were removed from the list of available treatments (National Audit Office, 2015). These trends need to be considered in a wider context. Across Europe, the neoliberal trend continues towards the involution of the social state in response to a perceived crisis in the welfare state model (Bourdieu, 1998; Gray, 2007; Harvey, 2005, 2010), and threatens the public provision of healthcare, including access to anti-cancer treatments. However, at the same time, research recently conducted on attitudes to social spending in Australia, Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Italy, Japan, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland and the USA, demonstrates that attempts to marketize the social state, though popular with political elites, are only weakly supported by ordinary citizens (Lindh, 2014:904). Moreover, members of the public in countries with stronger welfare state traditions (i.e. most European countries) are particularly resistant to funding reductions (Lindh, 2014: 904). The complex nature of these trends indicates the heteronomy of the subfield of cancer research. It is by no means a 'pure' zone of disinterested scholarly activity and scientific discovery.

Innovations from heterodox positions

Bourdieu's field analysis enables us to understand how change in any given field occurs while the overall structure of the field remains largely in tact. According to Bourdieu (1993a), fields are characterized by struggle between those seeking to conserve the existing order and those trying to break through the entry barrier. He argues that 'constant, permanent relationships of inequality operate inside this space, which at the same time becomes a space in which the various actors struggle for the transformation or preservation of the field' (Bourdieu, 1998: 40). While newcomers still believe in the *illusio* of 'the game' of science,

they response to and react against what has happened before in this field. Ultimately, in their attempts to break through the field's entry barriers, they are forced to innovate and to introduce new ways of seeing and thinking. We can see this happening in the subfield of cancer research. With the limitations of the 'war on cancer' in mind, a common agreement is emerging that considers cancer as a chronic disease (Gatenby, 2009; Oronsky et al., 2015). This is an important step on the way to envisaging alternative ways of approaching cancer. As Thomas S. Kuhn argued in relation to paradigm change, 'the scientist's perception of his environment must be re-educated – in some familiar situations he must learn to see a new gestalt' (Kuhn, 2012: 112). This ability to see a new gestalt requires a different way of thinking about cancer. Occupying a heterodox position in the field, oncologists and biologists are forging links and working to persuade governmental authorities and the pharmaceutical industry to change their practices. Sometimes these strategies are ignored; sometimes they are successful. For example, in 2009 a meeting of oncologists and cancer scientists (organized by Salvador Harguindey, in Madrid) aimed at generating enough momentum to persuade the EU governments and industries to fund research into drug chemicals that are known to work against cancer cells but cannot be patented. This meeting initiated by allowed not only the creation of a new society – the ISPDC (International Society for Proton Dynamics in Cancer), which subsequently became the IScAM (International Society for Cancer Metabolism) but also paved the way for new perspectives, ideas and strategies that aim to better understand, and perhaps, one day, circumvent cancer. A number of chemicals that are used to treat other conditions have shown promising results in the field of cancer. These chemicals can be divided in two groups known as: (i) proton pump inhibitors and, (ii) pH-buffers (Harguindey et al., 2013; De Milito et al., 2012; Spugnini et al., 2015; Fais et al., 2014). In (i) one finds (i-a) amiloride-derivatives that are potassium-sparing diuretic agents usually used to treat congestive heart failure and hypertension; (i-b) omeprazole-derivatives used to treat gastric

acid reflux. In (ii) one finds bicarbonate of soda and its derivatives. These chemicals have no patents attached to them and as a result are cheap and readily available. While (i) contains chemicals that affect the transport of protons across the membrane of cells, (ii) affects cancer slightly differently as it does not target a specific biological element but normalizes the extratumoral acidity generated by cancer cells instead.

Although not all cells in our body rely on a transfer of protons across their membrane to work adequately, proton transport is fundamental in cancer as cancer cells rely on fermentation to generate energy they can re-use in order to function. This biological characteristic is known as the 'Warburg effect' named after the scientist who discovered the fermentation process in cancer. Fermentation is an ancestral process involved in the metabolism of very simple organisms such as yeast or bacteria. In mammals, a side effect of fermentation is the creation of an excess of protons that need to be expelled from cells in order to avoid cell death. Therefore, the rationale behind using proton transporter inhibitors is to block the export of protons from cancer cells and trigger cell death this way (Harguindey et al., 2013; De Milito et al., 2012; Spugnini et al., 2015). The rationale for using bicarbonate of soda derives from a different strategy: extratumoral acidity is essential for tumors to spread to other organs (metastasis) and triggers the pain associated with some cancer. This is because the acidity sensitizes specific neurons to pain sensation. So, by normalizing the extratumoral pH, one can, in theory, control the spreading of cancer cells across the body (Fais et al., 2014). Though these two strategies differ considerably, their implementation requires a new way of thinking about cancer as a disease. There have been a number of phase one studies (i.e. cell studies) using both types of chemicals. The conclusions are that pH/shuttling of protons across the cell membrane when controlled can impact very strongly on cancer cells (Spugnini et al., 2011, 2014). To date, phase two clinical trials (i.e. animal studies) have only been

performed using omeprazole and derivatives and results have shown that cancer can be treated with those chemicals prolonging the life of animals (Spugnini et al., 2011, 2014; Walsh et al., 2015). While these chemical treatments do not cure cancer, they at least open up alterative strategies for alleviating its side effects and inhibiting the growth of tumours.

Anomalies and the temporal dimension of cancer

In the autonomous regions of the cancer subfield, there has also been a shift in perspective among researchers which results from re-considering the cancer cell and the resulting tumour as a living entity of its own (Gatenby, 2009) arising stochastically in accordance with the history of the tumour and not necessarily deriving from specific gene mutations. A possible way forward, then, is to consider the independent life of the tumour, thus reframing cancer within an evolutionary perspective. In this evolutionary context, the 'history' of the cancer cell (and resulting tumour) becomes important. We often consider cancer cells as abnormal: they are perceived to be cells that are not behaving as they should behave. However, when a tumor grows it can only spread to other organs using biological processes and strategies already present in living bodies. For example, in a flask (i.e. outside our body), spheroid tumors can be formed but these die after a certain time because they have reached a critical mass and nutrients are not able to reach their centre. In living bodies, in contrast, the tumor is able to use body functions to divert the endogenous vascular system to create new vessel networks – in a process known as angiogenesis – and this enables the conveyance of nutrients to the tumor (Tseng et al., 2015). Moreover, it is instructive to note that tumors develop in a similar way to embryos formed within the womb: from a single cell they grow and construct a symbiotic space within an ecosystem that is not necessarily favourable to them from the outset (Aiello et al., 2016).

Perceived as a disease, cancer has, in the main, been considered in relation to gene malfunctions (i.e. mutation). This assertion is in line with the notion that genes control cell functions (Hanahan et al., 2011). Cancer cells, in order to grow, need to be relatively independent from the host, and so it was assumed that several gene malfunctions were needed for cancer cells to flourish. However, research into these genetic impairments did not produce the conclusions that were expected: the findings show that one or several gene mutations do not necessarily trigger cancer but merely increase the probability that cancer will develop. So, today we talk of predisposition to cancer (Julian-Reynier, 2011; American Society of Clinical Oncology, 2003). Although cancer predisposition theory states the importance of uncertainties in cancer, it has a significant impact on attitudes to cancer. A prominent and much publicized example of this was when the actress Angelina Jolie decided to undergo a mastectomy knowing the mutation she was carrying *might* lead to breast cancer. However, while cancer predisposition theory highlights the possibility of the occurrence of cancer, the theory also highlights a degree of uncertainty. Therefore, with no certainty whether gene mutations will or will not trigger cancer it is apparent that cancer needs to be considered as anomalous rather than an abnormal. Let us consider this further with reference to the temporal dimension of cancer growth.

An evolutionary perspective has the benefit of enhancing our temporal understanding of cancer. Deterministic thought links the cause to the effect chronologically and as a result it considers only the passage of time between two events. For that reason, the notion of time used in the science of cancer research has no relation to the broader sweep of history: it traces everything back to the moment that the cell changes, and seeks to understand the specific reasons for that change in order to envisage the death of cancer and a return to the moment

before the change occurred. This has some benefits such as identifying lifestyle, environmental or other causal factors leading to cancer. However, this deterministic thinking leads to a number of misleading assumptions: (i) cancer can be *controlled* at will or *eradicated* provided the adequate thread – leading to the original gene pool – is followed, and (ii) cancer is abnormal with regard to body functions. Moreover, in the deterministic approach, only the narrow frame of 'time' (as opposed to the broader evolutionary 'history') is considered when understanding the changes in the kinetic reaction rates (e.g. multiplication, proliferation, growth of cells and so on...). Note here that time, considered in this way, simply reflects the simultaneity or chronology of events. By contrast, an approach that considers the broader 'culture' of cancer pays close attention to the broader sweep of history that is the making of things. Instead of asking *how* cancer develops we should be asking *why* it exists. Here, again, it is useful to think about cancer cells as anomalous. Anomaly is related to the lower probability of occurrences and therefore probability theory provides a way of understanding heterogeneities (including cancer cells as anomalies) in a given population. Probability theory, and in particular the central limit theorem, shows that whatever the underlying determinism involved in a given process, a population will always display anomalies (events with very low occurrence probability), i.e. unexpected results or variations (Shindell, 1963). Therefore, to understand cancer as anomalous, we need to rethink cancer at a population level and not at a single cell level. This means that instead of merely tracing the journey from a single, normal cell (physiology) to when it becomes a 'diseased cell' by contraposition (pathophysiology), we can consider, at a macro-level, with a broader temporal approach, that anomalous cell developments are part of the wider evolutionary process by which life develops (Haeno and Michor, 2010). Understanding the sweep of time in terms of what has already happened provides only limited insight. It is like looking back on a race, or a game, or a battle, or a historical event with hindsight and seeing the actual

course of action and turn of events as the only possible one that could have unfolded. This restricted temporal approach fails to consider the potentiality of the moment: the numerous possibilities that might possibly unfold at any given time and the probability of each possible course of action occurring.

Anomalies and monsters

Evolution deals with ‘novelty’ and if we are to consider a broader evolutionary approach, it is necessary to refer to the notion of ‘monstrosity’ if we assume that the monstrous is something that: (i) has no common measure with existing objects (i.e. is an abnormality) and, as a result (ii) cannot be fully represented (Foucault, 1966). The etymology of the word monstrous is from the Latin *monstrare* meaning ‘to show’ that in turn demonstrates a lack of adequate word(s) and thus representation(s): a monster cannot be spoken or thought about but only shown. We need, therefore, to think about evolution from a perspective that allows us to envisage the monster. Let us deploy a metaphor here: From the present understanding, thinking about evolution requires us to trace all the different living species back from branches to the common trunk. When viewed this way, the ‘monster’ is not needed. However, if we take the journey in the opposite direction and start from the trunk, the only feasible way for a branch to grow is via the generation of a bud that has not yet been realised; in its nascent state, however, the bud is yet to take shape and thus has no common measure with existing life. The bud, then, is then the monster. Thinking in this way enables us to understand novelty. However, we live in a world that does not always have room for novelty or ‘monstrosity’.

If we utilize an alternative perspective that considers cancer in relation to biological evolution, what directions can future research take? One possibility is that instead of trying to eradicate cancer by deploying the indiscriminate weaponry associated with the 'war on cancer', it could be possible to redirect cancer on its course. For example, it is not extravagant to think about transforming a breast tumour into a neutral piece of bone. Transforming organisms or enhancing their functions is central to the 'biotech' arena. Over the past twenty years there have been an important number of studies trying to better understand the molecular involvements to control and (re-)programme cells (Ohnuki and Takahashi, 2015). In the field of embryology it was suggested as early as 1953 that a molecular program takes place involving specific molecules known today as 'morphogenes' that guide and shape the future offspring, i.e. from a single undifferentiated cell (fertilized egg) to the generation of all the different cell lineages in our body (Turing, 1990[1953]). This, in turn, has paved the way for what we know today as stem cell theory (Evans and Kaufman, 1981). This theory postulates that it is possible to manipulate stem cells or transform normal cells into stem cells in order to control the generation of new tissues or repair damaged ones (Takahashi et al., 2006; Kim, 2014). Developments in stem cell theory raise possibility of cancer cell manipulation and the imposition of morphogenetic fields similar to those present during the early stages of embryo development. While this field of research is still in its infancy, it has been demonstrated nevertheless that the morphogene BMP2 (Bone Morphgenetic Protein 2) required for mesoderm formation and for the development and patterning of many different organ systems in embryos (Hogan, 1996), can block the proliferation of gastric cancer and can destroy these cells (Zhang et al., 2012). It is therefore possible to envisage morphogenesis working in relation to cancer, transforming (for example) breast cancer into a piece of bone. Bioengineering, inspired by embryology, is now at a point where transforming and creating new tissues from cells is possible. Many active

molecules found in cancer are also found in embryos while they develop and it is hoped that in the future, cancer can be re-programmed by chemicals derived from active molecules involved during embryogenesis (Levin, 2012; Mintz and Illmensee, 1975; Schulze, 2012; Spike et al., 2012). Furthermore, it has been suggested that a dynamic change in the interactions between cells and tissues may result in a dysregulation of the body routine. This hypothesis – i.e. a lack of tight connections between cells and surrounding tissues – has been suggested to be a cause for tumour growth (Sonnenschein and Soto, 1999). With this in mind, it is essential to envisage cancer not as an outsider disease, but as a condition evolving in the specific environment that is the body. This means that cancer cannot be envisaged as external to the body; it belongs to it in its own right and this can be seen in its ability to survive.

The field study of imperfections in embryology and development that is caused by a disorganisation of cells/tissues interactions is known as teratology (or study of monsters) (Tort, 1998). As is the case in many 'hard science' fields, teratology uses the philosophy of determinism to frame or classify 'monsters' as necessary defects. Doing so the field of teratology has the job of promoting the death (or *mise à mort*) of what could be seen as a novelty (Tort, 1998). As a result, the field of teratology tries to promote the notion of abnormality but does not provide any insight into the *anomalies* that could account for the origin of those events. The existence of anomalies signifies the lack of total control that permits evolution and revolutions to happen. We can make an analogy with an area of human production: the car industry, when making its calculations, knows too well that even if all steps to build a car are identical, a fraction of the cars produced will be lost due to unpredictable imperfections. Perhaps teratology (and molecular biology/Omics and the science of Big Data) can learn from the car industry's calculations: instead of trying to do the impossible by attempting to annihilate anomalies, it is instructive to take them into account.

Anomalies are an integral part of biological evolution and, if we consider them in relation to Darwin's (2016[1887]) formulation, can be seen as part of the process through which new species (anomalies) emerge:

> I happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which everywhere goes on …it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The results of this would be the formation of a new species. Here, then I had at last got a theory by which to work (Darwin, 2016[1887]).

So, instead of re-programing cancer cells in the manner associated with the usual curative aims, we can consider the possibility that the redirecting of cancer cells might be simpler and more effective. The constraints issued from re-programing (seeking to go back to the norm, to the state that the cell was in before it changed) are necessarily much stronger than those associated with redirecting the course of flexible cell development, which would involve embracing anomalies, novelties and 'monsters' instead of strictly defined norms. If cancer cells are redirected rather than eradicated, the shape they take, even as they are made benign, will not be 'normal' in any sense of the word. They will be new. They will be monstrous. But as Derrida (1995: 386) points out, a monster shows itself but cannot be spoken of because it 'appears for the first time and, consequently, is not yet recognized'. The monster is a species that captures the present and has yet to acquire a name.

As part of engaging with these debates, we also need to rethink the aesthetics of cancer. In recent years, there has been a resurgence of interest in aesthetics in the social sciences. This research has focused on, for example, the aestheticization of everyday life (Featherstone, 2007); social aesthetics (Highmore, 2010); beauty (Hickey, 2009; Wolff, 2008); the

evaluation of cultural objects (Harrington, 2004; Stewart, 2013, 2014); and the aesthetic dimensions of social forms (De La Fuente, 2008). Scholars in the sociology of health and illness have also made this 'aesthetic turn'. For example, Radley and Bell (2011: 219) have drawn attention to the significance of artworks in giving 'shape and form' to illness experiences. Radley (1999, p. 791) has argued that the significance of illness accounts extends beyond their value as the mere recounting of suffering or survival. Far from being confined to the modes of appreciation associated with a privileged aesthetic disposition (Bourdieu, 1984), these narratives are existential and become 'exemplars of a way of being in the world'. Along similar lines, pictorial images of illness 'transform what was previously a private experience of the patient to being a shared comprehension of illness by the group' (Radley, 2002: 21). Henriksen et al. (2011) have focused on aesthetic practices, both visual and verbal, deployed by individuals making sense of their illness in everyday life through representations and narratives. In their analysis of a case study, which examines the book montages produced by the Danish breast-cancer survivor, Sara Bro, Henriksen et al. (2011) argue that Bro has produced objects that invite the reader to engage in a dynamic form of aesthetic practice that reconfigures our understanding of cancer suffering. They argue that 'the excessive traits of the montage and its multi-layered qualities create a room for co-contribution of the reader' (Henriksen et al., 2011: 283). The reader is able to find a 'third meaning' beyond the primary, denotative meaning and the secondary, symbolic and connotative meanings. The 'third meaning' (a notion derived from Barthes' work) transcends the first two meanings, and is '"a poetical grasp" … conceived as an excessive trait of the image in itself and as the individual interpretive response performed by the beholder of the image' (Henriksen et al., 2011: 283). The effect the third meaning in Sara Bro's montages is to destabilize the meaning of the 'sick patient' identity as well as the meaning of cancer. What is significant about this body of work is that it enables us to find the aesthetic in the

most unlikely places: in images or accounts of sickness and suffering (Radley, 1999: 780). It is our contention that a new aesthetic approach is required in order to destabilize the meaning of cancer.

Conclusion

Instead of trying to fit cancer into pre-existing scientific, social and medical frames, it is important to consider cancer in its evolutionary context by utilizing a broader temporal framework. Cancer is anomalous rather than abnormal; it develops in the specific environment that is the body, and tumors develop in a similar way to embryos: they construct a symbiotic space within an ecosystem that does not necessarily favour them (Aiello et al., 2016). In order to extend the reach of debates in the subfield of cancer research, we have theorized new possibilities in cell-redirection inspired by recent advances in the field of bioengineering. If we are to consider the redirection of cancer cells as a feasible strategy, there are, of course, many questions that will need to be addressed. For example, in which parts of the body would the redirection of cancer cells be most effective? What would be the limits of this approach? What risks and dangers might ensue? Bourdieu's notion of field provides a useful framework within which to understand how the possible fate of new approaches and how they might challenge the prevalent orthodoxy in a given field. New approaches are resisted, partly because they are unproven, partly because their advocates lack the scientific capital that will enable their arguments to gain wider legitimacy, and partly because new modes of thought are deemed 'unthinkable' in the terms of the prevalent ways of doing science (Bourdieu, 2000). Nevertheless, new modes of thinking such as those outlined above continue to emerge out of struggles between scientists and other agents active within the subfield of cancer research, and these struggles ensure 'the production of

difference' as newcomers challenge orthodoxies while holding on to their fundamental belief in the value of the game (Bourdieu and Wacquant, 1992: 100).

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