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Reconfiguring Species for Immunitary Hybridity

Just as in the case of blood, transplantation is a singularly defining expression of the contemporary biopolitics of immunity. Transplantation represents an immunitary regime, or set of regimes, *par excellence*. These are forms of embodiment and disembodiment that mediate highly charged circuits and circulations of bodily traffic, flow, exchange and transferability. It is here where the defining boundaries within and between bodies are transformed through innovative, plastic and porous immunitary practices. It is also in this context that firm notions of what it means to be human and to have a body that is singular or distinctly ‘ours’ become unsettled. Those disruptions and dislocations are probably nowhere more acute than in the contentious clinical and research domain of transpecies transplantation or xenotransplantation.

Where the previous chapter was primarily concerned with the biopolitics of immunitary circuits between humans, this discussion turns towards our changing biotechnological relationship to other species, other immunitary animals. The chapter revolves around some central fundamental tensions in xenotransplantation, but which resonate with other themes in bioscience innovation, regulation and research including transpecies embryo research, ‘mosaicism’, chimerism and the production of ‘humanised’ and immune-deficient animals for clinical testing (Brown 2009,

2011; Brown et al. 2006; Davies 2012). I also want to locate notions of species and species difference/similarity in wider discourses of race and racism. Just as the last chapter was concerned with the emergence of an immunitary bioeconomy based on race, organ and tissue transplantation too has its roots in a distinctly colonial-racial *dispositif* and history.

One of the more fundamental tensions in xenotransplantation is that which pitches the immunitary interests of the individual against those of whole populations. That is, whilst the approach may well offer a therapeutically life-saving solution for transplant patients facing end stage organ failure, it potentially provides a means of transferring contagious diseases across species barriers. Such zoonotic events can be potentially devastating within a species not immunitarily prepared to cope with exposure to novel non-endogenous pathogens. There is a profoundly troubling contradictory paradox here. The more effort taken to level or reduce immunitary differences between species, in order for such therapies to be possible, the greater the likelihood of transspecies infectivity.

Innovation and international regulatory policy making in this context, stretching back decades, has been preoccupied with a range of fundamental biopolitical questions affecting both animals and humans (Brown and Beynon-Jones 2012; Beynon-Jones and Brown 2011). To what extent is it possible to re-engineer immunitary differences between humans and other species in order to radically increase access to compatible tissues, cells and organs? What measures are considered necessary, and by whom, to restrict and limit the potential for transspecies disease outbreaks? What lifestyle and biosecurity restrictions, including abstinence from unprotected sex, social isolation, can reasonably be placed on the human recipients of animal-based transplant therapies? How might it be possible to produce 'disease free' source animals through practical biosecurity measures including, for example, sterile confinement, sanitary isolation, birth by hysterectomy, and so on? Under what kinds of circumstances does it become possible to declare that another animal's tissues pose no threat, that they are clean, pure and free from contagion? When a non-human tissue is transplanted into a human, what are the implications of assuming that the tissues remain discrete, separate and apart immunitarily from the bodies into which they are transplanted? Or that the boundaries between the human recipient and the animal remain secure? The answers

to these questions are necessarily highly contingent and partial. Nevertheless, as Esposito points out, ‘never before have we had such an accurate perception of this community of bodies... the endless contagion that combines, overlaps, soaks, coagulates, blends and clones them’ (2011, 151).

Cases like this touch upon pressing and urgent biopolitical questions with fundamental implications for understandings of species distinction, kinship and the membership of an interspecies biosocial co-community. This is a site of critical tension. Immunitary theory within STS invites an understanding of immunitary defence where the body is already in a dynamic and plastic biological relationship with other bodies, organisms and animals. The transpecies immunity that emerges here is one characterised by symbioses, parasitics and interdependence. This notion of an open body resonates well with the affirmative biopolitics of immunitary philosophy. It also connects with normative aspirations for the emergence of new kinds of immunitary sociality, interrelationships that defuse the destructiveness of over-protection and illusions of total security.

Both STS and immunitary philosophy invite reassessments of binary immunology, critiquing a politics and biology of dichotomous difference, of purities, of insides and outsides. The chapter that follows explores what these reflections bring to cases like that of xenotransplantation, mobilising tissues between species, whilst also promising to prevent transpecies contagion and pollution. How might STS and immunitary philosophy shed light on the tensions between transpecies transplantation and biosecurity, between attempts to flatten immunitary differences between species, whilst also maintaining biosecurity and the defensive species walls of ‘disease free’ protection?

The chapter explores the tendency for immunitary purification and protection to recoil back upon original designs. As we have seen, for Derrida, autoimmunity is a surplus, the excess that emerges from those measures we institute against risks yet to be realised. It is a belief or a commitment to the very possibility of complete security, protectability, that makes cataclysm more likely, not less. For Derrida, catastrophic events linger on the horizon, in the dystopian imaginary, but guiding actions in the present. Systems of protection, the logics of securitisation, proportionally reflect these imaginaries. So, for example, what might it

mean to place trust in, or have confidence in, biosecurity measures that make the realisation of a threat (pandemics, zoonotic disease outbreaks, etc.) more possible, not less so? To what extent is immunitary innovation, flow and mobility across species boundaries at the centre of a new regulatory politics of biosecurity? To what extent are guarantees of biosecurity premised on beliefs in the workable attainability of pathogen-free purity? And how do the balances between purity and impurity, cleanliness and pollution, play out across the biotechnological re-engineering of species-specific immunological boundaries?

Intrusions in Race and Species

As we have seen, there are a number of occasions where transplantation glances into Esposito's reflections on the affirmative, but also exploitative, potential of the immunitary paradigm. It is, for instance, in the immunitary technology of transplantation that 'flesh needs to be rethought outside of Christian language' he writes (2008a, 168). By this, he means that the negative category of flesh becomes, in biotechnology, 'a non-Christian form of incarnation... a technological transmutation of the human body' (ibid.). What it is that animates matter is no longer classically 'divine' but instead 'the organ of another person; or something that doesn't live, that 'divinely' allows the person to live' (ibid.).

Transplantation is, for Esposito, a way to think through the differing forms taken by the *munus* (see also Tierney 2016), resulting in an ambivalent co-*munus* of bodies. Here, he draws primarily on the overlapping influences of Donna Haraway and Jean-Luc Nancy. He is, for instance, guided by Haraway's observation that it is the very 'heart of biopolitics' which is expressed in the shifting sands of immunology (Esposito 2011, 149). He pays tribute to her attention to the way immunology increasingly fragments the body's parameters. But it is primarily Nancy to whom Esposito is indebted in understanding what is at biopolitical stake in biotechnologies like that of transplantation, regenerative medicine, the reproductive economies, and so on.

Nancy's own autobiographical reflections, in the essay *L'Intrus* or *The Intruder* (2008), stem from his own experience of having first a heart

transplant in the early 1990s and then a stem cell (HSC) transplant several years later. Nancy's experience of 'intrusion' is probably, Esposito writes, 'the most radical and at the same time the most sobering state of awareness regarding the meaning of the technicity of one's body' (2011, 151–2). Nancy is famously unromantic and ambivalent about the sentiments of mutual solidaristic reciprocity that are now somehow supposed to connect him to his donor. He is instead preoccupied with his own loss, with the loaded debt of the recipient. *L'Intrus* is uniquely experienced by the recipient rather than the 'donor'. *Communitas* becomes an intrusion, an incursion into the very corporeal fabric of the recipient's body: 'the whole dubious symbolism of the gift of the other—a secret, ghostly complicity or intimacy between the other and me—wears out very quickly' (2008, 166).

Nancy recounts the ambivalence arising from the way, in these special circumstances, life must be preserved through the death of another. Put in another way, in most instances of transplantation, the *immunitas* of the few comes to depend upon the *communitas* of the many. The advancing bioeconomies of immune system innovation deepen this dynamic interpenetration of *immunitas* and *communitas*, life and death. As Nancy puts it, 'this type of condition concerns more and more other bodies... the sick, the aged, compromised, handicapped, assisted, pieced-together bodies' (1997, 158).

The folding of death into life, the 'intrusion' of one into the other, is therefore a highly risky opening to potential and actual harms, dilemmas, pollution, infectivity, contagion and inequalities between bodies. But instead of seeking to dispel these risks by pretending their remoteness, Nancy's point is that we must immerse ourselves in the ambivalence arising from the interconnection of *immunitas* and *communitas*, life and death. He goes on to caution against the banishment of death from life: 'Isolating death from life—without leaving one intimately entwined with the other, and each intruding upon the heart of the other—this we must never do' (Nancy 2008, 165). Instead, the role of an affirmative immunitary analysis lies in recovering the intimately entwined intrusion of one upon the other. Tierney (2016) sees here, in Nancy's entreaty, some semblance of Esposito's affirmative aspirations for biopolitics in calling for an 'intense sense of *communitas*' exercised 'no longer over life but of life' (Esposito 2008a, 157).

By way of contrast to Nancy and Esposito's affirmative biopolitics, I now want to shift this discussion by locating transplantation in a history that, as in the previous chapter, goes back to questions of race and indeed species. It is important to do this because of the way transplantation both reconfigures and re-entrenches notions of difference and similarity, of distinction and connection, of opposition and resemblance, of disparity and affinity, of immunity and community. Again, building on the previous chapter, it goes without saying that the modern biopolitics of race is, at the same time, a biopolitics of species and even interspeciesness (Dillon and Lobo-Guerrero 2009). It is against the backcloth of race that I want to outline a biopolitics of transpecies transplantation.

There are of course many historical points at which transplantation punctures its way into the immunitary biopolitics of race, but few epitomise this more than the events of 1967/68. In the tumultuous moment in which Martin Luther King is assassinated, and in which two Olympian medallists stage their black panther protest, apartheid South Africa becomes a flashpoint in culturally transgressive surgical medicine. Christian Bernard performs the first 'successful' heart transplantation in late 1967 and repeated the following year in a far more contentious expression of apartheid racial biopolitics. The recipient, a European Jewish dentist, is transplanted with the heart of Clive Haupt, a legally designated 'coloured' twenty-four-year-old male. It is deeply significant that the white recipient had to give specific consent given that the heart in question was not 'white'. Nor could it be guaranteed that the heart in question was straightforwardly 'human', given that Haupt's ancestry might conceivably be traced to the 'Hottentot'. Hottentot is amongst a number of white colonialist specious inventions or concocted images of primate-related bushmen used to reassuring settlers of their superiority to indigenous natives (van der Schyff 2011).

The event immediately threw into sharp relief the fissures of embodied contradiction and exploitation hierarchically dividing whites from blacks, segregating a politically constituted *bios* from the bare life of *zoe* (Agamben 1998). Politicians to the right of the political spectrum quipped about how Haupt had posthumously violated apartheid legislation, specifically the Group Areas Act of 1950. The Act and related legislation spatially excluded blacks from dominions occupied or frequented by whites. That

structure of laws however went beyond the external control of bodily space, penetrating deep into the body itself through the legislative control of sex and reproduction. The Immorality Amendment Act of 1950 proscribed extramarital intercourse between whites and non-whites taking apartheid into the flesh of its subjects. The transplantation of Haupt's heart across the frontiers of race had constitutionally confounded laws of bodily interpenetration and space. Global news coverage consistently played on these ironies, and especially the inherent contradictions between biomedical facts and biopolitical laws. Headlines read 'The heart that knows no Color Bar' and 'Brothers Under the Skin' (Niewijk 1999, 112; Koretzky 2017).

It is against that legal structure of proscription that a novel transracial biomedicine had now to be justified or defended, whilst at the same time maintaining the categorical separations of apartheid. As a 1968 piece in *Time* magazine put it, apartheid created a 'delicate problem' (Jan 12) for the nascent biotechnology of transplantation. Opondo writes that, 'integrating body parts from people of different races... raised crucial questions about exceptions to apartheid policies, the integrity of bodies and the value of life' (2015, 3). In an edition of *Ebony* magazine, the writer notes that 'Clive Haupt's heart will ride in the uncrowded train coaches marked "For Whites Only" instead of in the crowded ones reserved for blacks ... to hundreds of places where Haupt himself could not go because his skin was a little darker than that of Blaiberg' (10 March 1968, in Opondo 2015, 7). The obvious dynamics of exploitation exacted upon black labouring bodies were now seen to extend into the body itself. The event served as a focal point for morbid suspicions of racially organised medical experimentalism (Scheper-Hughes 2007). Non-white labouring lives were seen to be expendable while their bodies had become 'indispensable to lifesaving and life-extending apparatuses' (Opondo 2015, 8).

The routes to legitimation, if at all possible, depended on a number of discursive strategies. One way through the contradiction lay in championing clinical heroism, articulating the boundless premium placed on lives (or at least some lives) threatened by catastrophic illness. Another strategy lay in levelling or smoothing out the uneven biopolitical terrain created by apartheid. In other words, apartheid applies more to the living

than it does to the dead. The deceased bare life of Haupt's heart, stripped of its racially marked subjecthood, nevertheless remained mechanically functional. A now infamous intervention by a member of the Nationalist Party made just this point: 'The relief of suffering knows no colour bar... The heart is merely a blood-pumping machine and whether it comes from a white, black or coloured man—or a baboon or giraffe, for that matter—has no relevance to the issue of race relations in the political or ideological context. The question of colour is not at issue here' (Malan 1968, 115; see also Imma 2011).

Crucially for our discussion, the statement above advances the position that the levelling of biopolitical difference applies equally to race and species. That is, race and species become one and the same from the point of view of a technical script in which flesh becomes machine and organs become transferable apparatus. It is therefore in the context of race that transplantation overlaps in this way with questions of species. There is also something deeply significant here in the fact that Barnard would briefly, a decade later, experiment with xenotransplantation. In 1977, he reported transplanting a middle-aged male with the heart of a chimpanzee and a young woman with a baboon's heart (Barnard et al. 1977; see also Fox and Swazey 1992, 213; Cooper 2001).

But the point to take from the Haupt event is the way processes of socio-cultural othering and distancing paradoxically make way for immunitary entanglement and interpenetration. The biopolitical event of Haupt's transplantation across the racial bar marks a moment of paradox. But it is also an event made possible and legitimised because of the way social community and biological immunity are made to depart from one another. The former sustains a striation of biopolitical difference unequally segregating and demarcating members of the community. The latter, biological immunity, introduces a new register of sameness. This cleaving apart of politics from biology occurs in such a way that the immunitary similarity of transplantation comes to depend upon the biopolitical segmentation of community. For Opondo, the Haupt event is expressed through a complex 'dialectics' between otherwise opposed dimensions of sameness and difference, between immunity and community, between the indispensable and the expendable:

the imperative to save specific human lives and the recognition of the entanglement of human lives erases certain bodily boundaries while enabling forms of bodily fragmentation, appropriation, and commodification that create a “sense of ontological insecurity” for those whose bodies are considered a reservoir of spare parts or a depository or conduit for trial drugs. (2015, 9)

It is then, in these terms, that immunitary life becomes and makes possible an interlocking dynamics of utility and even exploitability within the new economies of tissue transplantation. Scheper-Hughes (2002) makes much of the emergence of a ‘medical apartheid’ that globally differentiates between structurally and racially located bodies, some of whom become a ‘source’ for tissue beneficiaries. Organ trafficking and transplant tourism globally extends the way biologically defined immunitary wholes come to depend on segmented communitary parts. One expresses an immunitary universalism cutting across socially and economically entrenched racial divisions. The other articulates the communitary segmentation separating North from South and advantage from disadvantage. In the highly polarised economies of advanced global capitalism, very few are positioned to take advantage of the differences of value to which the majority are oppressively subject.

Over forty years after the Haupt event, South Africa would again become a flashpoint in the biopolitical collision between race and transplantation. In 2010, one of South Africa’s largest healthcare providers, Netcare Ltd, was prosecuted on over a hundred counts of medical malpractice involving the illegal purchase and transplantation of kidneys supplied to largely Israeli ‘customers’ during the early 2000s (Gunnerson and Lundin 2015). The ‘price’ paid varied between 1200 and 1600 US dollars for kidneys bought for a mere fraction of that value from mainly Romanian and Brazilian nationals. It goes almost without saying that the case expresses many of the undercurrents of what Scheper-Hughes chooses to call gourmet ‘neo-cannibalism’. Now however, the original racial framing of cannibalism, in which barbarous ‘primitives’ threaten to ingest their ‘colonialists’, is now reversed. Here, biomedical colonialists threaten to consume global capital’s post-colonial poor.

There are a number of points to take from these and other events in which race, species and the bioscience of transplantation have become enmeshed. But the crucial point for this analysis of immunitary life is to better understand the pragmatic separation of immunity from community, the biomedical from the biopolitical. It is also critical to understand the way in which this separation is subsequently redeployed in the advancement of sometimes culturally troubling immunitary biosciences. Immunological innovation in transplantation and related fields is one fundamentally characterised by, within certain limits, a qualified erasure of difference, the creation of a kind of questionable commonness. Transplantation is continually cited as illustrative of this blurring of immunitary boundaries between bodies and across species. When Tauber (1998) writes of the ascendancy of a more dynamic and permeable perspective on the immune system in immunology, he rightly cites the influence of 1970s and 1980s transplant ‘pioneers’ like Tom Starzl amongst others. Fittingly for the discussion that follows below, Starzl played a leading early role in championing the promise and potential of xenotransplantation using non-human primates, pigs and other species. The idea that ‘we’ now share a new inter-humanness or interspeciesness is a pervasive, but not unproblematic, trope in the immunitary biosciences and in biopolitical scholarship. That levelling rips its way through, for example, metric discourse in genomics in which other species are said to share x-number of genes or mutations or whatever with humans (see Marks 2003; Holmberg 2005; Brown 2009).

It is however a mistake to extrapolate a rationale of sameness found in immunology or genomics to the cultural and biopolitical. The use of Haupt’s heart to extend the life of Blaiberg should not, Imma (2011, 143) warns us, ‘be read as the dramatic demise of scientific racism’, as some had optimistically suggested. Rather than shaking the very foundations of apartheid, it arguably made the unthinkable more possible. Of the Haupt event, Opondo (2015) usefully points to Esposito’s reflections on a modern immunitary paradigm which ultimately dehumanises through the fusion of the human and with other species. We might usefully think of this as a process of biopolitical ‘beasting’ (Brown 2009) or ‘bestialising’ (Esposito 2011, 81) in which *immunitas* plays a role in reducing life to its bareness, to raw matter (Agamben 1998). As besting

progresses, '*humanitas*' becomes the untainted remnant or exclusive residual purity left over once the vast majority of the world has been designated impure:

Nazism itself never renounced the category *humanitas* ... more than 'bestializing' man, as is commonly thought, it 'anthropologized' the animal enlarging the definition of anthropos to the point where it comprised animals of inferior species. He who was the subject of persecution and extreme violence wasn't simply an animal ... but was an animal-man: man in the animal and the animal in man. (Esposito 2008a, 111 in Opondo 2015, 10)

The traffic in tissues between bodies and between species clearly incites hybrid anxieties in which categorical differences collide in newly embodied realities. That potential for pollution becomes more acutely profound in the shift from allotransplantation (between the human) to xenotransplantation (between humans and non-humans). But the point being made in much of the critical sociological commentary is that there are strong cross-currents between racism and speciesism in the political and moral economies through which transplantation has developed.

In what follows I focus more explicitly on the way in which biotechnological innovation in immunology has become implicated in reconfiguring species boundaries. In so doing, I want to extend the discussion above about the patterning of similarity and difference, and the relationship of that patterning to *communitas* and *immunitas*, to culture and science, the 'social' and 'natural'. This patterning of 'sameness and difference' in the context of xenotransplantation was a focus for much of my work on biopolitics throughout the late 1990s and into 2000s (Brown 1999a, b; Brown and Michael 2001; Michael and Brown 2005). Questions of sameness and difference, for me, articulate themselves most strongly in debates about which source species would be more appropriate than another for transplantation into humans. What I called the 'which species debate' in the science and policy of xenotransplantation focused, at various times, on a number of closely or distantly related species including varieties of primates, pigs and other species. Themes of species desirability and undesirability remain enduring biopolitical issues in the still advancing fields of transpecies biomedicine (Cook 2013). It is here, in

questions about species selection for transplantation, that we can glimpse into some of the more profound ways in which biotechnology reconfigures immunitary life.

Primate Un/Desirabilities

Xenotransplantation sits historically alongside a number of developments in the biosciences that have called into question the boundaries separating one species from another. These perturbations, as I note above, stem from insights into genomics but also the creation of transpecies hybrid embryos for research and other areas of biotechnology including genetic engineering in addition to immunological insights into species symbiosis and beneficial parasitism, and so on. Xenotransplantation also extends and focuses long-standing controversies about the use of animals as model proxies for humans in medical research, let alone as novel sources of immunologically ‘humanised’ cells, organs, tissues and biodevices. In historical terms, dating back centuries even, humans have been the recipients of blood and tissues from an eclectic menagerie of animals including other primates and ‘higher’ simians (apes, baboons, macaques, rhesus monkeys, chimpanzees, etc.) and ‘domesticated’ animals (guinea pigs, dogs, rabbits, goats, sheep, cows and pigs, etc.).

The question of species desirability in xenotransplantation has operated in relation to a rich and complex number of socio-cultural, scientific and physiological factors. These include, but are not limited to, the conventional use of some animals as ‘meat’ in the human food chain; or conversely the breeding of some species as ‘companion animals’ and pets; whether a species is understood to be a ‘wild type’ and subject to certain kinds of international protections; the amenability of some animals to rapid reproduction and therefore accelerated cycles of bespoke breeding programmes; the extent to which certain species are known to harbour, or not, various pathogens, parasites and viruses; the relative physiological size of a source species; the different responses of species to genetic engineering for immunological adaptation; the impact of sterile biosecurity measures upon the welfare of different species, and so on. The immunitary biopolitics of xenotransplantation are therefore rife with dilemmas

and contradictions which pitch differing species as either desirable or undesirable sources for tissues and organs. Reconciling these scientific and cultural contradictions is far from straightforward for the technical script of xenotransplantation.

It goes almost without saying that a source species, as in conventional transplantation, must or should be ‘closely matched’ immunologically to the recipient human species, and indeed the individual recipient themselves. In other words, the source species needs to be sufficiently similar or even ‘closely related’ to their prospective human hosts. This fundamental requirement for sameness relies on certain relations of species affinity, possibly even some kind of ancestral resemblance and ‘kinship’ amongst relatively distant or proximal evolutionary ‘cousins’. And yet, it is that very requirement for similarity and sameness that brings xenotransplantation into conflict with cultural norms forbidding the ‘exploitation’ of animals ‘like us’ or animals which are ‘human-like’. What often makes animals ‘useful’ or usable are those attributes that are seen to distance them from ‘us’, animals whose anthropomorphic status is less secure. The contradiction which defines xenotransplantation is that in which a biological (immunitary) anthropomorphisation comes into conflict with a cultural (kinship) anthropomorphism.

For much of the recent history of xenotransplantation from around the 1960s, clinical research tended to focus on the use of ‘concordant’ non-human primate species, largely chimpanzees and baboons (Brown and Michael 2001; Cook 2013). Chimpanzees were used in a number of kidney transplants in 1963 performed by Hitchcock and Reemtsma, and in the very first heart transplantation performed in 1964 by Hardy. With poor evidence of therapeutic efficacy, xenotransplantation procedures dropped away considerably from the late 1960s and into the early 1980s. It is however important not to lose sight of the extent to which the politics of race continues to define xenotransplantation throughout this period (see Opondo 2015; Kierans 2015). With parallels to Barnard’s work in South Africa, much of the early work on xenotransplantation takes place in the Southern states of the US especially Virginia, Mississippi and Louisiana. Reemtsma’s early clinical transplantation work was conducted at Tulane in Louisiana where it could be argued both primates (chimpanzees) and black patients were seen to share an

adjacent cultural locus as experimental objects. Implicit in a number of programmes was the idea that therapeutic success would be more likely between non-whites and primates than with Caucasoids. As Sharp points out, 'vulnerable Blacks apparently served at key moments as human species proxies during the provisional and transitional testing of inter-species kinship. If a chimp's heart or kidneys could function in a black body, perhaps these organs might function in the bodies of any human being' (Sharp 2011, 26). Reemtsma was also institutionally located at a charity hospital where there was a much greater likelihood of treating deprived black populations.

In an event that highlights questions of species difference and similarity, the baboon figured as the preferred organ source for the surgeon Leonard Bailey in the infamous 1984 'Baby Fae' case in which a fourteen-day-old neonate received a heart transplant. The controversy became a harrowing media spectacle before and after her death twenty-one days later. Bailey defended his actions with reference to a growing body of literature in immunology pointing to the 'naïve' or 'immature' immunity of the neonate. Tolerance to 'foreign tissue' would therefore be more likely amongst infants than adults. This echoes the developing understanding of the immune system as dynamic and plastic, the embodiment of immunitary learning and adaptation over time (Martin 1994).

Bailey was, however, taken to task for not appreciating the specific aspects of the immune system responsible for the rejection of unmatched tissues, elements of which, it has been argued, are 'fully mature at birth' (Stoller 1990). Bailey was criticised for his mistaken view of the immune system as singular rather than multiple and heterogeneous. Nor, according to many critics, had Bailey taken sufficient account of immunological and evolutionary differences between baboons and humans. It was pointed out that baboons, unlike chimpanzees, have no antigens in common with humans (*ibid.*). Bailey's hope that 'some degree of homology between baboon and human lymphocyte antigens must exist' (Bailey et al. 1985) was roundly condemned as 'wishful thinking' (Jonasson and Hardy 1985).

Famously, when Bailey was asked why he had not chosen an evolutionarily more closely related primate he countered, 'I find that difficult to answer. You see, I don't believe in evolution' (Gould 1988). For the

evolutionary biologist Stephen J. Gould, Bailey's 'chilling' remark highlighted profound confusion in what it means to be evolutionarily 'homologous' or merely 'similar'. For Gould, the very idea of homology fell between at least two meanings. For biochemists, it meant sharing similar sequences of DNA. But for evolutionary biologists, it meant descent from a common ancestor. It is, he writes, the 'quality of relationships based on evolutionary descent' that should be taken as the measure of our relationships to other species (*ibid.*, 30). Genetic homology was not, he argued, the same as evolutionary homology. Bailey, Gould suggested, had confused mere 'similarity' with 'homology', mistakenly placing trust in genetics over that of evolution. More polemically, Gould pointed out that just because 'birds, bats, and pterodactyls all bear wings with common aerodynamic properties', it does not follow that they share an ancestry (*ibid.*). More obviously, 'the greater the evolutionary distance between two species' he wrote, 'the less the hope that a xenograft can survive rejection' (*ibid.*).

The point made by Gould and others at the time is that Bailey's mistake lay in deviating too far from the horizons of immunological and evolutionary similarity that connect humans to some, but not all, other simians. The relative degrees of difference separating the baboon from the chimpanzee, it was argued, made all the difference in the outcome of Bailey's 'experiment'. Success would come to depend, it was argued, on the closest possible immunitary and evolutionary homology between source and recipient species. It is this naturalised biological affinity which makes other simians so compelling in the twentieth century scientific imaginary (Haraway 1989). Simians are thus positioned, in the physiological and behavioural disciplines, as proxies *par excellence* for humans. The very legitimacy and success of those enterprises comes to rest equally upon the erasure of difference and the assertion of sameness. It is that very same 'proximal imaginary' in the wider natural sciences that guides and structures the simian species preferences of xenotransplantation into the 1980s.

But close species proximity also brings other primates into collision with a cultural register of affinity, a sense of shared social identification and connection. When Christian Barnard explains his shift away from direct involvement with xenotransplantation in the late 1970s, he states

that he had become ‘too attached to the chimpanzees’ (Cooper 2001, 606). I want to explore this further below, but this sense of being too close is not at all confined to cultural or moral transgression. One of the key developments that negatively defines the use of other primates in xenotransplantation arises in response to increasing knowledge of the etiological origins of AIDS/HIV. It is, arguably, in the context of origin stories about AIDS/HIV that anxieties about ‘zoonosis’ (transpecies infectivity) give way to anxieties about ‘xenozoonosis’ (transplant-related transpecies infectivity).

In the early 1990s, Thomas Starzl receives permission to undertake up to four baboon-liver-to-human transplants at the University of Pittsburgh. In the first of these, an immune-suppressed AIDS Hepatitis patient received a baboon liver and died seventy days later (Starzl et al. 1993). In 1995, the AIDS patient Jeff Getty is transplanted with the bone marrow cells of a baboon in an attempt to reinvigorate his failing immune system. Putting aside the pejorative references to ‘baboon boy’ in the press (Cooper and Lanza 2000, 201), baboon haematopoietic stem cells were known to be resistant to HIV infection. In other words, what made the approach conceivably possible were the very same homological differences that had made Bailey’s baboon transplant impossible. Both events sparked increasing awareness amongst virologists beyond the worlds of clinical transplantation that xenografting might in fact replicate the very same species intimacies that had given rise to HIV in the first place. As one of the key virologists in the debate put it: ‘simian immunodeficiency viruses (SIV) appear to have low if any pathogenicity in their natural African primate hosts, but lead to fatal acquired immune deficiency syndrome (AIDS) in Asian macaques and, sadly, after adaptation to become HIV in humans’ (Weiss et al. 2000).

Zoonotic transpecies infectivity has, since the late 1980s, become indelibly wedded to a contemporary biopolitical imaginary of immune system vulnerability and global biosecurity. Taken together, HIV/AIDS, CJD, SARS, ‘Swine Flu’, Ebola, and so on all mediate a dystopian pandemia whose points of origin lie in real and imagined anxieties about other species, other regions, other dietary practices and husbandry intimacies, and now transpecies surgical innovation. It is in the context of HIV/AIDS—and arguments about its traceability to Simian

Immunodeficiency Syndrome in Sub-Saharan African wild chimpanzees (SIVcpz)—that concerns about the biosecurity risks of xenotransplantation take their original shape. It is difficult here to disentangle a science of zoonotic aetiology from an implicit politics of race and post-colonialism. Routed through origin stories about AIDS, Africa is positioned as the ‘dark continent’ of ‘our’ prehuman origins (Sontag 2001), and the locus of more recent inter-simian proximities which prove fertile breeding grounds for devastating globalised infections.

Just to recap, what makes non-human primates a compelling species of choice for xenotransplantation (closeness) makes them all the more threatening in terms of xenozoonotic disease (too close). That is, the nearer we are evolutionarily, the more likely it is that we share the same mutual vulnerabilities to similar kinds of pathogens. This is the contradictory double-bind that runs through the logics of xenotransplantation, a collision between being adequately and excessively close. By 1999, the US FDA had taken steps to put in place a de facto ban on the use of non-human primates in clinical trials of xenotransplantation arguing that ‘recipients, their close contacts, and the public at large would be exposed to significant infectious disease risk’ with one FDA director stating that non-human primates specifically ‘are a potential hazard’ (Butler 1999, 549). In relative terms, the view taken by the late 1990s was that other primates were likely to pose greater disease transmission risks than more distantly related species.

But one of the objections to the steps taken by the FDA and other regulatory authorities at the time was that their caution did not go far enough. Many argued that the ban on primates implied that other species might be viewed as safe, simply because of their dissimilarity to humans. As one key scientist put it: ‘It’s not unlikely that non-human primates are more dangerous in terms of disease transmission than pigs’ but ‘we know nothing about how dangerous it would be to use pigs... how can the FDA now suggest a moratorium on non-human primate donors but maintain a policy potentially allowing pigs as donors?’ (ibid.). As we will see below, in the face of shared viral vulnerability between humans and their proximal ‘close cousins’, the more distal porcine species promised a degree of, possibly false, biosecurity.

Before taking up the question of porcine un/desirability, I want to reflect a little more on this question of cultural affinity, a distribution of species identification between humans and other primates in debates about xenotransplantation. As I note above, it is critical to understand the way in which fascination about other primates in twentieth century natural history and behavioural sciences is that which also makes them so obviously both attractive and problematic as experimental objects and sources of tissues and organs. Apes and monkeys embody the rehearsal of humanness itself in both popular and expert representation (Strum and Latour 1987; Haraway 1989; Schubert and Masters 1991). Indeed, primate imaginaries, as Haraway notes, routinely involve the rehearsal of cultural concerns surrounding race, segregation, class, gender and social taboo. Much of the biomedical discourse surrounding the problematic use of other primates in xenotransplantation refers to their rich emotional lives, their complex sociality, and so on. One of the first influential advisory reports on xenotransplantation makes the point that other primates share many of 'the features qualifying human beings for personhood... including self-awareness, complex social relationships and many of the other characteristics that have often been supposed to make human beings unique' (Nuffield 1996, 39). It is in this sense that the field becomes associated with the taboo of cannibalistic threat (Scheper-Hughes 1998) and interspecies incestuousness (Sharp 2011).

In these terms then, other primates are narrated as 'close' to us. Too close. By the late 1990s, a growing number of regulatory authorities were placing greater restrictions on the use of other primates in biomedicine. However, debates about species desirability are also shaped by the fact that other primates are also unfamiliar and seldom encountered directly. Very rarely do they become companions, pets or sources of meat. Instead, our 'closest cousins' occupy a distantly remote mythical space in our interspecies imaginary. For this reason, the Nuffield report (1996) drew a distinction between 'relatedness' and 'relationship'. In other words, relationships or affinity with other species does not necessarily follow from being related or evolutionarily linked to them. The moral *communitas* of the human might be expected to apply more directly to other baboons and chimpanzees. But, the report pointed out, we may instead 'be more ready to include familiar, domestic animals than unfamiliar primates,

even though the latter are much closer to human beings in a biological sense' (ibid., 42). The patterning of closeness is always therefore situated and context-dependent upon relationships in which it is conceivable that some animals, like pets, 'or indeed farm animals such as pigs, may well seem more person-like than baboons or chimpanzees' (ibid.). Having explored this patterning of sameness and difference in the context of humans and other simians, I now want to pursue the field as it turns towards pigs as a potentially desirable tissue source.

Porcine Un/Desirabilities

By the mid-1980s and into the 1990s, developments in 'gene transfer', 'gene knockout' and later mammalian cloning lay the foundations for a far reaching reorientation of species and interspecies relationships. The biotechnological imaginary, it has been argued, repositions other species as objects of 'technoscientific bespoking' (Michael 2001), the potential of 'making to order' of 'off the peg' or 'designer' transpecies 'productions' (ibid.; Franklin 2001). For the field of xenotransplantation, a new suite of transgenic techniques held out the promise and potential of creating what we might call 'designer immunities', approaches with which to 'humanise' the immune systems of other species. It is the pig which, over the last few decades, has come to occupy the centre ground in the discursive and material world of xenografting. That is not to suggest that non-human primates slip from view. Just the contrary. They continue to figure ubiquitously as proxy surrogate hosts for humans in pre-clinical trials of porcine organs and tissues.

As above, I want to offer here an overview of the way pigs become points of articulation for expressing relative species qualities and properties, advantages and disadvantages, similarities and differences. What is fascinating here is the constant rehearsal of the case for pigs, the incessant need to explain, justify, rationalise and defend. It is this uninterrupted rearticulation that is at once a witness to deeper ambivalence about the place of pigs as ongoing sites of cultural and scientific risk. In what follows, it becomes possible to see into the intense material and discursive work still required to diffuse or normalise those risks. Again, what is most

significant is the creation of a particular contrasting patterning of sameness and difference constructed between pigs and humans. In the first place, a shared *immunitas*, or sameness-making, between source and recipient species has come to depend on a natural/scientific/functional repertoire. But at the same time, a cultural, social or moral repertoire of difference-making is intended to exile the pig from the *communitas* of the human.

Within the register of *immunitas*, pigs are said to possess any number of attributes which make them the 'obvious' species of choice for xenotransplantation. In both material and discursive terms, pigs have been bred and domesticated over millennia to have a considerable body mass making them anatomically not dissimilar to humans. They are represented therefore as 'about the right size morphologically' and 'physiologically' in comparison to the smaller anatomies of baboons and chimpanzees. Processes of rapid reproductive domestication have resulted in frequent cycles of breeding with large litters. They therefore lend themselves to biotechnology's requirements for an accelerated accumulation of 'breed-wealth' (Franklin 1997) over relatively short generational durations. That accumulation extends to the creation of particular 'designer' immunities, the 'humanisation' of a 'generation' of chimera human-porcine bodies. It even becomes theoretically possible to breed litters to exhibit particular patient-specific immune system characteristics, and so on. Pigs have more recently been positioned as 'ideal incubators' for 'essentially human organs' in tissue-specific gene 'transfer' and 'editing' programmes. The following illustrates just some of the ways in which this sameness-making has been publicly rehearsed:

The pig's organs are approximately the same size as human organs both in infancy and adulthood. Additionally, pigs have been domesticated for many centuries. They breed relatively quickly with large litters, so a large number of life-saving organs could potentially be generated quickly when necessary. (Imutran press release, 14 August 1994)

[Geneticist, Steve Jones:] There is a transgenic pig, perhaps the first of many, which contains some of the human genes for cell surface variation. The pig looks, of course, just like a pig. But to our immune system its tissues—heart

or kidney, say, which are about the right size for transplantation—are more acceptable to a human patient than they otherwise would be. (*Red Pepper*, January 1995)

Although baboons are genetically closer to humans than pigs, their hearts and lungs are too small to transplant into adults. While pigs' organs are of similar size to those of humans, the problem previously has been to make them “friendly” to the immune system. (*Sunday Times*, 5 July 1992)

... professor in the department of neurosurgery, University of Minnesota, said pigs were an ideal “biological incubator” for growing human organs, and could potentially be used to create not just a pancreas but hearts, livers, kidneys, lungs and corneas. He said if the iPS [induced Pluripotent] cells were taken from a patient needing a transplant then these could be injected in a pig embryo which had the key genes deleted for creating the required organ, such as the liver: “The organ would be an exact genetic copy of your liver but a much younger and healthier version and you would not need to take immunosuppressive drugs which carry side-effects.” (BBC June 2016)

In effect, clinical effectiveness depends upon the capacity of porcine xenografts to go ‘unrecognized’ by the host immune system. Recognition of a ‘discordant species’ as ‘foreign’ results in the adherence of host antibodies to the graft’s antigens triggering ‘complement cascade’, a chain reaction in which blood proteins (complement) ‘puncture’ the cells of a transplanted graft. Most of the techniques employed over the course of several decades seek to achieve a degree of immune system ‘invisibility’, or ‘concordance’, by genetically substituting porcine complement with human complement. The first transgenic pig developed for xenotransplantation was announced as a ‘breakthrough’ (Brown 2000) in the early 1990s. Named Astrid, she was biotechnologically engineered with the gene for human decay-accelerating factor (hDAF).

Manufacturing sameness has included the production of, from the late 1990s, ‘Gal knockout’ pigs and their progeny lacking one of the enzymes responsible for hyper-acute rejection. Other more recent approaches, mentioned above, have focused around the injection of human tissue-specific induced pluripotent (iPS) cells into developing pig foetuses. The xenograft vision also assumes new advances and improvements on an

older generation of immunosuppressive agents like cyclosporine first introduced in the 1980s. Other approaches seek to ‘condition’ the human immune system prior to xenografting. This includes, ‘induced chimerism’, the bone marrow ‘ablation’ of host immunity and then reconstitution with a hybrid immune system. It is then, in these terms, that pigs and humans become mutually enfolded within a shared biomedical *immunitas*.

That biomedical *immunitas* depends, however, on the moral estrangement of the porcine from the *communitas* of the human. Inclusion comes to rest on exclusion. An otherwise incestuous taboo is dissipated by moral othering. That which is so like us, which has evolved alongside us, because of us, is nevertheless not our kin. Much of the discourse around pigs in this context centres on their use as meat, their instrumentalisation as a source of food to be ingested, to be embodied nutritionally. As one of the prominent UK advocates expressed it early in the debate: ‘How can you criticise the use of pig tissue for therapeutic procedures that save lives while at the same time accepting the existence of a ham sandwich?’ (Imutran director; *Sunday Times*, 5 July 1992). And yet, ‘meat’ itself evinces so many disparate and contested meanings, not least in the context of a metaphor in which ingestion is awkwardly likened to the living surgical embodiment of another species (Michael and Brown 2004). Anthropological work has elicited and demonstrated a profound problematisation of the meat metaphor. Young participants in one of the many focus group discussions I convened on xenotransplantation put it like this:

- A: Well the idea of putting anybody else’s ... you know the idea of an operation and taking out a major organ makes you feel queasy. It’s not a nice thing. And then putting in something ... I mean, pigs. Dirty, horrible farmyard animals, is how they’re classically seen. And then putting something like that inside you. It’s not a very nice idea but ... it’s worth it, I reckon! [Laughs]
- C: It depends where you look at it from. ... we’re looking at it physically. It’s a food that’s got protein and it’s got energy, that’s why we eat it. It doesn’t really matter where it comes from to me. It’s like my personal opinion is that it’s my intestine and what I eat is separate from the rest of my body because it’s sort of got like a shield between.
- B: It’s still technically outside of you even though it’s inside. If you think of yourself as a donut shape.

Much of our research elicited similar complex sentiments of ambivalence and unease, visceral responses of cultural pollution alongside materialist registers of contagion. The prospect of a porcine xenograft puts ‘matter out of place’ (Douglas 1966) in a way which meat does not, at least not always (Brown 1999a, b). As C and B put it above, the intestinal wall is seen to keep meat in its place, ‘outside’ the body, whilst also ‘within’. Meat ‘passes through’ the gut of the body, but without entering it. It is rapidly broken down into something else from which can be derived nutrition before leaving the body as excreted faecal waste. Contact with meat is transitionally time-bound, an impermanent state of affairs. Many of the respondents in our study distinguished between the use of pigs as food and xenografts in exactly these terms (Michael and Brown 2004). The body’s genuinely internal space remains therefore a zone of acute risk in the politics of xenotransplantation. Incipient threats are seen to come from an othered immunity without (Martin 1994), but in truly entering the body the xenograft becomes united with the body in a way that food does not.

The risks of immunity intimacy are nowhere quite so powerful as they are in debates about ‘invading’ zoonotic infections. The xenograft imaginary, even in pursuing the more distant porcine route, remains locked into the logical contradictions of risk arising from interspecies closeness. Immunosuppression of the host, together with efforts to level immunity differences between humans and pigs, replicates the same disease risks that seem to have ruled non-human primates out as a source of tissues. However, in the case of pigs, much of the debate has centred on the presence of, and likely pathogenicity of, Porcine Endogenous Retrovirus (PERVs). Evolutionarily familiar, and folded into the genome of all mammals over the course of millennia, such pathogens are harmless unless reactivated in ideal conditions of intimacy with other species. One of our interviewees, a leading virologist in the debate puts it like this:

if you’ve got a closed barrier herd of pigs specially derived.. screening them, you could argue they should be a damn site cleaner than the average human ... it’s those few pig viruses and microbes that we don’t know about still lurking there, or we can’t get rid of, like PERVs. ... however many times you deliver piglets by caesarean section and raise them behind filters and things where they can’t pick up infections from their mothers or the field, they’ve inherited these viruses. (V1 2001)

By 1997, a number of leading researchers in virology had begun to publically voice their concerns about PERV transmission. Patience et al. (1997) published their findings empirically demonstrating *in vitro* transmission of two porcine retroviruses to human cell lines. Their findings were then replicated by an FDA study (Wilson et al. 1998). The following year, one of the main US researchers leading the programme at Harvard, Fritz Bach, had announced a self-imposed moratorium on his porcine research citing the risks of PERVs. That prompted the FDA to look more closely at zoonotic risk resulting in their formal statement in 1999 ruling out the use of other primates (see above). Their position, reflected by a number of national regulatory agencies around the world, was taken as a gravely discouraging sign for the porcine route too. The terms of debate were by now seen to have largely shifted radically from questions of clinical potential to biosecurity risk.

One of the major commercial investors in xenotransplantation responded to these concerns by publishing a study based on the examination of samples from 160 patients previously exposed to living pig tissues (Paradis et al. 1999). The study argued that none of the patients had been infected with PERVs, including patients who had been immunosuppressed. However, twenty-three patients had porcine DNA circulating in their blood ('microchimerism') and four showed a PERV-stimulated antibody response. Here then, advocates for xenotransplantation were seen to manage this evident contradiction by creating a division in the disciplinary basis of the scientific debate about porcine infectivity, a division between immunology and virology. Through this disciplinary 'boundary work' (Gieryn 1983), it conceivably became possible to advance claims to immunological similarity (the argument for therapeutic efficacy) whilst also drawing on virological evidence of dissimilarity (the argument against pathogenic risk).

Unsurprisingly, interpretations of the Paradis study varied considerably with some questioning the adequacy and sensitivity of the antibody-based assays used to detect viruses and whether the study ignored viruses harboured elsewhere in the human body (Hopkins 1999). One virologist we interviewed at the time explained that the Paradis study was like randomly shooting an arrow and then drawing your target around where the arrow fell. In other words, there might be lots of viral targets that current

knowledge is entirely unaware of, but which pose unknowable future risks of equally unknowable proportions. One virologist memorably wrote at the time that ‘no evidence of risk’ should not be mistaken for ‘evidence of no risk’ (Weiss 1999, 1222).

What makes these conflicts all the more paradoxical is the clinical requirement to suppress (immunosuppress) recipient immunity after transplantation. Esposito frames the state of immunity as one of the not being ‘or the “not-having” anything in common’ (2008a, 51). To suppress immunity is, therefore, to make possible the having of something in common. In this case, the ‘in common’ is the space of the body and, with it, the greater likelihood of shared exposure to zoonotic disease. That commonness is focused upon the graft itself but also extends to the possibility of exposing and preconditioning the recipient human immune system in advance of surgery through prior chimerism (Shildrick 2015). To embody commonness by relying upon the suspension of immunity in this way ushers in an enduring and precarious state of co-immunity.

It is therefore in these terms that the field of xenotransplantation has come to represent a direct contradictory collision between the ambitions of the clinic and the worst fears of public health authorities; or between the *immunitas* of the individual and that of the *communitas*. Here, efforts to protect, enhance and improve individual lives are seen to occur at the potential expense and endangerment of a wider universe of non-beneficiaries. It is, as myself and colleagues have put it, ‘through this unique combination of private benefit vs. public risk’ that xenotransplantation can be seen to ‘exemplify deeper political tensions between neoliberalism (individualised free choice, health care consumption, etc.) on the one hand and risk-averse public health-oriented governance on the other’ (Brown et al. 2010, 6). There is therefore something particular to our times and politics in the profound contradiction centred on the ascendant immunity protections of the individual, of self-determination and autonomy.

The threat to biosecurity arising from the xenotransplantation imaginary is also spatially expressed in anxieties about the capacities of national state regulators to geographically ‘contain’ risk across globally fluid territory. Indeed, national regulatory borders have been seen to offer insufficient protections in the prevention of simultaneously transnational and

transpecies infections. Early in the xenozoonotic debate, concerns had been expressed that global variation in biosecurity measures would naturally lead to pockets or ‘havens for the performance of less regulated, and therefore more dangerous, xenotransplantation procedures’ (Collingnon 1998, 519). That prospect has since been borne out. In the early 2000s, news began to emerge of xeno-trials undertaken in Mexico City. Rafael Valdes Gonzalez had, together with collaborators in New Zealand and Canada, implanted porcine pancreatic islet xenografts into children with Type 1 diabetes.

The disclosure of the Mexico City trial became the focus of intense international criticism and subsequent sanction by Mexican medical authorities (Cook et al. 2011). This and similar events have been taken as expressions of contrasting biopolitical conditions distributed between ‘core’ and ‘peripheral’ regulatory spaces. The Montreal-based International Xenotransplantation Association was vocal in taking the opportunity to endorse its own standards of biosecurity, whilst censuring those of others: ‘Without organised international cooperation, the best efforts at minimizing these risks in countries with appropriate regulatory oversight may be thwarted by the free travel of individuals undergoing unmonitored XTP in countries lacking such regulation’ (Sykes et al. 2004, 119). The episode also drew attention to the disproportionate exploitability of different racial and economic populations. Disadvantaged children whose families, it was argued, found it difficult to pay for insulin had been recruited to the study (Persson and Welin 2008). It also highlighted the iniquitous dimensions of ‘xenotourism’ between rich and poor countries already touched upon above. A number of those treated had travelled and paid considerable sums for inclusion in a trial which was seen to put individual privilege above population protection. In this way, xenografting operates through an uneven and exploitable ‘spatiality of biopoliticised flesh’ as Esposito puts it (2008a, 160), resulting in the production of highly unstable ‘pathogenic spaces’ (Bewell 2003). Whereas *communitas* implies a certain distributed boundlessness, an undifferentiated vulnerability, the immunity exemptions found in xenotransplantation threaten to negate the protection of the *communitas*.

Insecure Securities

One of the more striking dimensions of the XTP debate is that centred upon the surveillance, monitoring, even containment and segregation of recipient xenograft bodies. In this context, risks to wider populations are seen to extend across the lengthy legacy periods of the lifecourse or even transgenerationally into remote futures. A number of national and international regulatory measures have evolved to explicitly require the life-long surveillance of xenograft recipients. Not without precedent, biosecurity here comes into conflict with established conventions protecting civil liberties including the right to withdraw from clinical trials enshrined in the Declaration of Helsinki. US Guidelines on xenozoonotic infectious diseases mandate recipient compliance with 'lifelong surveillance necessitating routine physical evaluations and the archiving of tissue and/or body fluid specimens for public health purposes even if the experiment fails and the xenotransplantation product is rejected or removed' (FDA 2001, 21). Arrangements would need to be made for the archiving of such specimens for a minimum, it is stated, of fifty years. Recipients would be further required to consent to 'the responsibility to educate his/her close contacts regarding the possibility of xenogeneic infections' (*ibid.*). 'Close contacts' are defined as those with whom a recipient may, as a matter of routine, share intimate contact resulting in the exchange of bodily fluids. They would therefore be obliged not to engage in 'unsafe' sexual practices and be subject to the same criminal liabilities that apply in some cases of HIV transmission. Clinical trial sponsors would be forced to document the identities of sexual contacts and immediate intimates for the purposes of subsequent tracing and monitoring. Monitoring would extend beyond death to include the compulsory autopsy of recipients. In these and other intricate respects, the FDA's guidelines are very detailed in the minutiae measures involved in the containment of an otherwise boundless pathogenic riskiness.

Immunitary protection of the community is here premised on fixing or arresting xenograft bodies in time and space, recording and documenting any instance of their more inevitable tendency towards fluidity, leakiness, mobility and intimacy. That protection, or the fragile appearance of

it at least, necessitates a retreat, a form of custody or capture within the bureaucratic administrative apparatus of surveillant traceability. The illimitability of flesh and the unruliness of its microbiological intimacies are in this way catalogued, recorded and archived. In denying the right to withdraw from the clinical trial, the recipient becomes permanently fixed within it. And yet it does not take a great leap of imagination to appreciate the practical contingencies upon which this brittle security depends. Much has to be taken on trust including 'compliance' with containment, with restrictions of movement, sex, intimacy and scrutiny. To what extent is this immunitary framework capable of forever guaranteeing against subsequent violation, regret, refusal, withdrawal from confinement, intended or unintended intimacies? Esposito conceives of such limits as the end of sovereignty, the point at which biopolitics is pushed beyond the bounds of its self-defined capacities for containment and control (2008a, b). He aptly recalls Foucault's prescient thoughts on the paradoxical tension between the will towards the innovative management of life, which finally subverts control and manageability:

The excess of biopower appears when it becomes technically and politically possible... not only to manage life but to make it proliferate, to create living matter, to build the monster, and ultimately, to build viruses that cannot be controlled and that are universally destructive. This formidable extension of biopower, unlike ... atomic power, will put it beyond all human sovereignty. (Foucault, in Esposito 2008a, 42)

Here, we are presented with the logical contradictory collision between the *immunitas* of the individual and that of the *communitas*, the population. So profound is this paradoxical collision, it could be argued, that neither becomes possible and both are negated. The biomedical protection of an individual life, the xenograft recipient, cannot be achieved without, at the same time, its biopolitical denial. In Derrida's terms, we are able to see into the deconstructive undoing of competing immunitary mandates, principally that of the individual in conflict with that of the population. Clinical benefit comes to depend on the sacrifice of other protections including the imaginary of the sovereign self enshrined in codes of 'consent', 'autonomy' and 'self-determination'.

Nor can the protection of the *communitas* be achieved without the likely possibility of its endangerment, the reassertion of individual entitlements resulting in the haunting threat of microbial leakiness. In this way, the FDA guidelines read like the outcome of a very rich, but ultimately self-defeating, thought experiment in biosecuritisation.

It is in these terms that I return inevitably to the dialectics of autoimmunitary negation and the collapsing thresholds of inner and outer risk. In thinking through the limits of affirmative and negating immunity, Esposito writes of the collapsing fate of the inner and outer body. Immunity risks the negation of life when it 'increases to the point' such that it passes a 'threshold' turning into 'its opposite'. In xenozoonosis, it could be argued, 'the negative protection of life will end up destroying, along with the enemy outside, its own body' (Esposito 2012, 64). Esposito and Derrida have in mind the way inner protections destroy themselves in the process of destroying that which lies in an outer beyond. Here, however, it is the selective preservation of life 'within' which indiscriminately now threatens the 'without'. There is therefore something deeply poignant in Esposito's scepticism of life immunised against death. As he puts it, 'the only way for life to defer death isn't to preserve it as such (perhaps in the immunitary form of negative protection) but rather to be reborn continually in different guises' (2008a, b, 181). The object of critique here is that tendency in immunitary life towards the extremes of frozen self-preservation, of life immunised against death. Clearly immunitary technologies like that of xenotransplantation are premised on profound immunitary plasticity and innovation across species boundaries. But they also come to depend on negating and contradictory stances towards newly embodied interspecies intimacies.

The roots of that negation lie, in Derrida's terms, in the chimera of protection itself, in the sometimes improbable assurance of fortification against contamination and contagion. Conceivably, in this case it is an over-determined bureaucratic biosecurity that makes possible couplings which jeopardise biosecurity itself. As we have seen, for Derrida, it is the denial and repression of threat through immunity which makes those threats all the more dangerous. Immunitary protections eviscerate the enemy from awareness, without ever really overcoming the underlying fretful anxiety of danger. The denied other is already within and literally

so in the case of the xenograft. The sequestration of the recipient, their fixing within immunitary space, can never be wholly guaranteed. Instead, the measures outlined by the FDA above may be taken as an unwelcome reminder of a recurring dread, of a dangerous recoiling excess returning to unravel protection. In these kinds of terms, Derrida reminds us of our need for protection from self-protection, or as Rottenberg has put it 'protection beyond self-protection' (Rottenberg 2006, 13). In deconstructive autoimmunity, there are opportunities for critical re-examination, for more productive and potentially affirmative openings. In this case, critical reflection on possibly naïve biosecurity measures may potentially make way for re-examined acknowledgement of limits and contingencies.

It is worth recalling here Latour's (1993, 2004) reflections on the hazardousness of the 'modern constitution', the divisions between 'politics' and 'nature'. For Latour, rapidly reproducing and systemic hybrids can be dangerous, even catastrophic (climate change, BSE, nanoparticles, recombinant organisms, etc.) and are evidence of the underlying hidden connections between humans and non-humans, and especially false separations between 'objective' science and 'subjective' politics. Here, sometimes dangerous hybrids proliferate in the disconnected spaces between politics (institutions, bureaucracies, administrations, etc.) and science (biotechnologies, natures, life, etc.). The boundaries of the modern constitution are premised upon forms of purification and cleansing in which lines, boundaries, limits and borders are drawn. Laws, guidelines and institutions may seek to regulate the movement of risky agents, capricious microbes and unruly practitioners. And yet it is the very act of purification itself that leads to the confounding and disruptive proliferation of a whole universe of complex hybrids and novel risks. Purification provides its own subversion. Purity begets translation and therefore hybridity. Such monsters are dissident creatures expressing the unsettled irreducibility of things. Hybrids may, sometimes, hold positive potential in forcing we moderns to recognise the contradictions of our modern constitutional arrangements. For example, those contradictions embodied in post-xenograft biosecurity arrangements. Hybridity in turn negates purity. But on the other hand, hybrids evidently harbour profound risks in terms of damage, violence, rejection and contagion. Xenografts have the potential to come apart both

biologically and therefore also institutionally and constitutionally. Given these and other dystopic prospects, Latour calls for a slowing down of the proliferation of hybrids, a deceleration whereby space is created for hybrids to be acknowledged and represented ‘officially’ within the ‘parliament of things’, in regulatory process and deliberation (1993, 12). These themes of pathogenicity and our efforts to fix, arrest and contain the threat are taken forward in the next chapter on antimicrobial resistance (AMR). There, I locate AMR as both evidence of, and the need for, new and more imaginative constitutional arrangements with the microbial.

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