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Tissue-Fragments

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Matter from bodies *becomes* tissue, rather than this being an ontological given. Practices and heterogeneous collectives of actors, including histological study, organ donation, biopsies, hospital waste collection, and therapeutic uses of tissue products imbue tissues with complex social and cultural lives. These tissue lives are contradictory, producing tissue as an intelligible and acceptable object as well as a contested and unstable one. I argue that tissues represent a duality of fragmentation and wholeness, sometimes metonymically standing in for the body in which they originated (e.g. biopsies), sometimes associated solely with a "laboratory life" (e.g. tissue cultures), and sometimes becoming a new part of an existing body (e.g. transplants). While these processes have been elaborated in the literature, we lack a terminology that captures and accounts for them. As such, in this paper I propose the notion of the "tissue-fragment" as a way to conceptualize these entities more fully in their biotechnological and embodied existence.

The explosion of biotechnological innovation in the last few decades has drawn the attention of many scholars who trace the circulation of tissues in the laboratories, bodies, institutions and politics they inhabit (see Landecker 2007; Waldby 2002a, 2002b; Waldby and Mitchell 2006; Lock 2001; Kent et al. 2006; Dixon-Woods et al. 2006). How are tissues conceptualized in this work? In their book *Tissue Economies* (2006), scholars Cathy Waldby and Robert Mitchell use the term "tissue" in a "generic sense, to include blood, organs, and any other kind of living matter taken from the body" (Waldby and Mitchell 2006:4), a definition implicit in much of the literature. Yet does this fully account for the variegated entities that we understand as tissue or the sometimes-contradictory applications of this term?

In this paper, I show that behind this simple definition are a range of iterations of tissue that need be accounted for if the term can be usefully and critically employed in sociology of health, the body, medicine, and science. Employing a relational materialist approach (Latour 2005, 1999, 1992, 1988, 1987; Latour and Woolgar 1979; Law 1986; Law and Hassard 1999), I argue that bits of flesh become tissue by virtue of their interaction with and contribution to the heterogeneous, collective terrains of matter, practice, knowledge, and politics that comprise histology, tissue procurement, tissue economies,

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and therapeutic tissue products. I argue that within these collectives, tissues persist unstably between fragmentation and wholeness, sometimes functioning metonymically for the body in which they originated (e.g. biopsies), sometimes associated solely with a "laboratory life" as an object unto itself (e.g. tissue cultures), and sometimes becoming a new part of an existing body by replacing or repairing parts (e.g. allografts). This resonates with Mol's concept of the *body multiple*: [1] that is, the pluralizing practices of health and illness (in Mol's study, atherosclerosis) that comprise the entity we call "the body."

> These are practices in which some entity is being sliced, colored, probed, talked about, measured, counted, cut out, countered by walking, or prevented. Which entity? A slightly different one each time. Attending to enactment rather than knowledge has an important effect: what we think of as a single object may appear to be more than one. (2002: vii)

Based on these discussions, I propose the notion of the "tissue-fragment" as a way to conceptualize these entities more fully in their biotechnological and embodied existence.

Encountering Tissue

There is no "original state" of tissue before the intervention of science. The same bits of flesh that serve as tissues in that context serve as something entirely different in others. For example, placentas are deeply ambiguous entities that can be wastes, tissues, or sacred objects—even food (Jones and Kay 2003; Ober 1979; Helsel and Mochel 2002; Davidson 1985). Or consider animal flesh, which in a laboratory setting may be considered tissue, but on your plate is "meat." "Tissueness" is not an intrinsic quality, but rather articulates flesh taken from the body within medical and scientific contexts. Basic physiology textbooks suggest that tissues are the "fabric" of the body, distinguished by morphology and function (Solomon 2003:32; the "fabric analogy" has also been made by Junqueira and Carneiro, 2003: vii). In *Basic Histology*,[2] Junqueira and Carneiro note that "Tissues are made of cells and extracellular matrix, two components that were formerly considered separate entities" (Junqueira and Carneiro 2003:1)—suggesting that tissues have not only a morphological and physiological reality, but a historical one too (see Appadurai 1986). Based on these understandings, tissues are "parts" of the body, but not organs or limbs which are commonly understood to be made of various tissues. Tissues occupy a middle space between cell and organ, and the breadth and location of this space has changed through time.

We may begin with initial and "rudimentary"—though they are by no means simple—encounters with matter in the context of scientific practice to begin to elucidate how bits of flesh become tissue, following Latour's lead in *Pandora's Hope* (1999). Latour explains the transformations that take place when entities such as a small clump of soil or a plant sample are removed from the earth and placed within simple scientific apparatuses that permit different organizations of the samples and cross-comparisons. By removing the sample from the earth, both gains and losses occur: while the samples no longer retain

[1] I would like to thank one anonymous reviewer for reminding me of this reference.
[2] Histology is the study of the microscopic characteristics of tissue.

their context, they gain scientific relevance, rendering morphological or other kinds of classification possible. Further transformations and associations occur because of hypotheses, theories, models, scientific papers, grants, institutes, and scientists themselves, which simultaneously both enrich and reduce the significance of the sample. This comprises a "chain" of associations and transformations which can be traced back to the original sample, which becomes what Latour calls a "circulating reference."

Tissue is a circulating reference. Flesh becomes tissue by gaining specific kinds of significance through examination, classification, experiment, and trials in scientific settings. Like Latour's samples, tissue samples are extracted from the body (such as through biopsy) and placed in arrangements that enable cross-comparison and classification. Tissues have come to be classified in four categories. *Epithelial tissue* "protects the body" by covering its outer surface and lining the body's cavities. These tissues can secrete substances (like sweat) or absorb substances (like nutrients in the digestive tract) (Soloman 2009:32). *Connective tissue* joins other tissues together, providing a framework or structure. This type includes cartilage, bone, and blood. *Muscle tissues* contract and shorten to move body parts, and included skeletal (attached to the skeleton) muscles and cardiac muscle (Solomon 2003:37). Finally, *nervous tissue* "receives and transmits messages, allowing various parts of the body to communicate with one another" (Solomon 2003:37), and is composed of neurons and glial cells, which support and nourish neurons. These classifications as well as knowledge about their cellular constitution are possible because of the advent of microscopy and the preparatory techniques and tools required to create slides.

Through a Latourian framework, we understand these classifications as being coproduced by the scientist, the paraffin, the dyes, the slides, the microscope, other tools required in histology, as well as the "things-in-themselves"—the bits of flesh—which seem to more or less "cooperate" with the will of the scientist. Certainly, there is "nonhuman agency" involved in these processes. For example, the necessity for different kinds of dyes to result in the desired accentuation of specific tissue characteristics points to the constraints imposed on scientists by tissue itself. Junqueira and Carneiro also note that "artifacts, distortions, and loss of components due to the preparation process are almost always present" in tissue slides (Junqueira and Carneiro 2003:1). Artifacts do not necessarily take away from the validity of the slides as testament to the "truth" about tissue, nor should they be interpreted as evidence for the "social construction" of scientific knowledge. Junqueira and Carneiro, scientists themselves, suggest that "A key point to be remembered in studying and interpreting stained tissue sections in microscope preparations is that the observed product is the end result of a series of processes that being with fixation and finish with the staining of the section" (Junqueira and Carneiro 2003:18). In other words, scientists are not "naïve realists" about these processes: they conduct their practice such that these intrusions can be both accounted for and mitigated, and make their conclusions with the limitations in mind. With enough trials, one can become more confident in distinguishing which actions are associated with which actors in the apparatus, and develop a statement about the nature of the tissue.

Procuring Tissue

Since the earliest studies of histology, the interest in tissues has been bound up with concerns over health and pathology, the study and diagnosis of disease. Moskaluk (2005) writes,

> The analysis of whole human tissue has been primarily the providence of anatomic pathology... Gross dissection allowed for the basic understanding of the "plumbing" of the human body, and the subdivision of the organs into organ systems of distinct function... During the Renaissance in Italy, autopsies became standard practice in the investigation of human disease. Diseases began to be categorized by the gross changes seen in the tissue. (3)

In other words, tissues were first identified via methods of gross anatomy, but with the advent of microscopy, the cellular foundations of tissues were explored, along with a new interest in the cellular basis of disease. Medicine developed new diagnostics and treatments based on this work. Thus, while tissues are certainly utilized heavily in the study and diagnosis of disease, in the last half of the century, tissues have taken on a decidedly therapeutic role: they are increasingly used as means of treatment. Waldby and Mitchell (2006) explain:

> Solid organ transplantation has been practiced since the late 1950s and commonplace since the late 1970s, as the refinement of tissue typing, surgical techniques and immunological suppression has allowed organ donors to be matched with compatible recipients. Skin, bone, heart valves, and corneas can now be banked and used in surgery. Reproductive tissue—sperm, ova, and embryos—can be donated and transplanted. Umbilical cord blood is increasingly harvested during birth procedures, stored, and used as an alternative to bone marrow in transplants. The recent development of techniques for propagating human stem cell lines derived from embryos means that embryonic tissues may become the source for a completely new range of transplantable tissues sometime in the future. (6-7)

Add to this list one of the earliest forms of therapeutic tissue use, blood donation, and one can see the whole gamut of bits of flesh that can become tissues with therapeutic uses.

Bits of flesh with recognized therapeutic capacities have what scholars have called *biovalue*, the "surplus of in vitro vitality produced by the biotechnical reformulation of living processes" (Waldby and Mitchell 2006:32). Originating in the notion that "tissues constitute the biological substrate of the self, the condition of viable human life" (Waldby and Mitchell 2006:31), the concept captures the "ways that the bodies and tissues derived from the dead [or the living] are redeployed for the preservation and enhancement of the health and vitality of the living" (Rose 2007a:32). In other words, the inherent capacity of the body to reproduce itself is biovaluable because it is exploitable, amplifiable and exchangeable, capable of being transferred between bodies. These processes are at least in part driven by markets. As such, biovaluable entities are, in many ways, commodities. Rose writes, "Vitality can now be decomposed, stabilized, frozen, banked,

stored, commoditized, accumulated, exchanged, traded across time, across space, across organs and species, across diverse contexts and enterprises in the service of both health and wealth" (Rose 2007b:3).

Almost anything that exhibits vitality is biovaluable. For example, the vitality of plants and animals are mined for their therapeutic properties. One cannot hear a plea for the protection of the Amazon Rainforest without also hearing that there could be potential "cures" lurking in the as-yet-undiscovered plants and animals that inhabit it. In this sense, biovalue carries with it an imperializing imperative. At the same time, some entities are considered more biovaluable than others. For example, bits of flesh that provide pluripotent stem cells are perhaps some of the most biovaluable human tissues, since they are believed to be capable of generating nearly any kind of human tissue required, and as they are particularly difficult to come by in a political and cultural climate wary of their ontological status. Waldby (2002b) writes that

> For advocates of stem cell research the life of the embryo is a form of raw biological vitality. From this point of view the embryo is not killed. Rather its vitality is technically diverted and reorganized. (313)

While we do not yet know their full potential, stem cells then, are biovaluable tissues, *par excellence*.

But perhaps a rather ambivalent concept lurks behind biovalue—that of "vitality." Vitality is a recognized capacity of body matter to be (or be made to be) generative in such a way that it benefits human health. Certainly, the concept is linked to ideas about life and death, with life generally considered to be vital and death non-vital. However, there are, of course, cases in which entities can be "vital" but considered dead, as are there varying degrees of "deadness"—those considered "brain dead" point to this tenuous ontology (Lock 2002). Or, consider biopsies of tumours. Certainly, tumour cells are "living" despite that they are often seen as antithetical to vitality, since they are potentially deadly. At the same time, they have biovalue in that they can be used to diagnose illness or for research that can enhance health. Molecularized (Rose 2007a, 2007b) tissues—those that have been reduced to mere molecules such as DNA—also share this ambivalent relation to life. Doyle has even coined the term "postvital" to account for the ways in which "Bodies have been overlooked and recast as an effect of a molecule, an extension or supplement to the real, timeless, deathless bit of immanence known as DNA" (Doyle 1997:8). Barad (2008) argues

> we err in helping ourselves to the notion of a "life state" (state of "aliveness") and to the presumption of its inherently determinate nature. . . [C]oncepts like "life state" or "aliveness" are not merely ideational; rather, they are specific material configurations. And the semantic and ontological indeterminacy is resolvable only through the existence of a specific material arrangement that gives meaning to particular concepts to the exclusion of others. (170)

Ultimately, then, vitality is recognized when biovalue is determined through complex and heterogeneous phenomena, not the other way around.

The recognition of biovalue and consequently vitality is one part of the process of procuring bits of flesh that become tissue. However, tissues must also be, in Callon's

(1998) words, "disentangled" from associations that render it incompatible with its objectification in biotechnological arenas. Citing Margaret Lock, Waldby (2002a) writes that

> Within the technical frameworks of biomedicine and the commodity frameworks of biotechnology capital, such fragments are generally treated as detachable things, biological entities that are severed from social and subjective identity once they are donated or removed from a particular body. That is, they are legally regarded as alienable—available for transfer from the originator to others by donation or sale. (240)

Contested notions of individuality and ethics come into play in this process. If potentially biovaluable bits of flesh are to come from human beings, these bits must become detachable or "alienable"—and this includes through physical, social, and psychical processes. Amid contradictory notions of alienability and individual integrity, conditions for the procurement of tissues are constantly negotiated. Tissues themselves have a part in negotiating alienability. For example, as Landecker's work points out, tissue culturing would not be possible if tissues were not capable of living "without being reattached to a living body, without being inside a body" (Landecker 2007:66).

These negotiations are also profoundly linked to questions of ownership and property rights. In the biotechnological arena, tissues are implicated in property and contractual regimes, especially those of intellectual property. There are a number of well-known legal cases in which claims to ownership of tissue, cell lines, DNA sequences, and the like, have been contested, such as the *John Moore vs. the Regents of the University of California*, 1984-1990 case, where the ownership of a cell line derived from an excised spleen was disputed (Wilson 2008:9). As Lock (2001) writes,

> Human body parts do not have universal value, and, once potentially available for conversion into circulating commodities, their worth, and more basically the question of whether or not they are alienable, is open to dispute... [T]he commodification of human cells, tissues and organs incites particular concern because boundaries usually assumed to be natural and inviolable are inevitably transgressed, raising concerns about the "self" and "other," "identity," "genealogies," group continuity and so on. Disputation is not simply about ownership, property rights or alienability; it is also constituted in large part out of a profound angst about a perceived violation of the moral and political order. (65)

Perhaps the translation from waste to tissue is the least problematic, since people most often do not have a strong psychical or physical connection with their waste products. Waldby and Mitchell note that some "tissues—hair, urine, or saliva—have been historically treated as 'abjects' that may be readily commodified precisely because they are waste, and do not signify the donor" (Waldby and Mitchell 2006:26). Waldby and Mitchell suggest that wastes have various levels of ontological significance for subjectivity. They write,

> Generally speaking, human tissues are more likely to be classified as waste as they lose ontological significance. Tissues that we consider essential to the

> body's integrity and function—organs, blood, skin, the limbs—are strongly invested with ontological significance, and their loss is a catastrophe for the subject. Tissues that are routinely shed or expelled by the body—hair and nail clippings, nasal secretions, saliva, pus, skin particles, urine, feces, sweat—are either ontologically neutral (hair clippings) or ontologically repugnant (urine, feces, pus), the opposite of value. (Waldby and Mitchell 2006:84)

However, it is not clear whether waste materials are to be considered tissues anyway, even if they come from the body and are alienable. Some materials, such as feces, seem to lack the sense in which tissues are "living matter" (Waldby and Mitchell 2006:6) or "vital," while others, such as placentas, which, after delivery, are typically regarded by hospitals, physicians, and indeed, women,[3] to be waste, are considered to be "living" most heartily. The meaning of "living matter" is also not clear. For example, some tissues, particularly connective tissues such as bone and blood, contain a great deal of "extracellular material" which may be regarded as similar to wastes in lacking "vitality"—indeed, Solomon (2003) refers to this material as "nonliving" (35). However, this material exhibits remarkable "vitality." Junqueira and Carneiro (2003) explain that

> The extracellular matrix consists of many kinds of molecules, some of which are highly organized and form complex structures, such as collagen fibrils and basement membranes. The main functions formerly attributed to the extracellular matrix were to furnish mechanical support for the cells, to transport nutrients to the cells, and to carry away catabolites and secretory products. Recent work has shown that, although the cells produce the extracellular matrix, they are influenced and sometimes controlled by molecules of the matrix. There is thus and intense interaction between cells and matrix... Thus, cells and extracellular matrix form a continuum that functions together and reacts to stimuli and inhibitors together. (Junqueira and Carniero 2003:1)

Therefore, the extracellular matrix poses significant challenges to rigidly defined notions of not only tissues, but vitality and life itself. Some interesting biotechnological advents point to this. For example, bits of flesh which we readily consider to be tissue can be stripped of their supposed "living matter," leaving a kind of extracellular skeleton that is both called "tissue" and exhibits vitality. In a recent edition of the magazine *Popular Science*, editors praised a new biotechnological use of donated human hearts in which the "living" cells of a donor heart are flushed away, leaving only the tough "nonliving" extracellular matrix. The recipient's progenitor cells are then made to "recellularize" the heart, such that the heart transplant recipient can survive without immunosuppressant drugs. The same technique has been used on placental tissue to engineer tissue substrates that could be used as therapeutic or cosmetic products (Flynn 2006; Flynn and Woodhouse 2008).

Wastes can share this ambiguous relation to "life," especially since they can be comprised of bits that are thought of as bearing life:

> Waste tissues have also changed status in dramatic ways under the aegis of genetic biotechnology, which can transform even the most modest biological

[3]My PhD dissertation examines the place of placenta in biomedical sciences; this conjecture is based on my as-yet unpublished empirical observations and interviews.

> material into both a marker for the self [i.e. DNA from cells] and a potentially lucrative source of genetic material or biological chemicals... Such rapid transformation of status, in and out of waste, gift, and commodity forms, typify the forms of circulating value assumed by human tissues today. (Waldby and Mitchell 2006:26)

Yet while the ontological significance of wastes in unclear, it is clear that there is significant discursive and rhetorical power at play when an entity is deemed to be "waste." This naming act simultaneously declares it abandoned such that it can be easily collected and used by a third party. A "waste discourse" circulates in the collection of tissues. For example, Waldby and Mitchell (2006) write that "designating some tissues as 'hospital waste' severs them from the identity of their (often-unwitting) donors and frees them up for innovative and profitable forms of circulation and transformation" (Waldby and Mitchell, 2006:28). Consider "spare" embryos generated from IVF treatments. By figuring unused embryos as possible "waste" rather than "potential people," stem cells can be procured from them. Waldby explains: "advocates of stem cell research generally portray the spare embryo as a precious substance. If it is not freely donated it will be simply wasted, a recklessly squandered resource" (2002b:313).

At the same time, "waste discourse" is not all-powerful. In particular, the Alder Hey organs scandal [4] in Liverpool showed that individuals and communities are unwilling to let doctors and other health practitioners have full rein on wastes and tissues in their hospitals. Richardson (2004) writes

> Not knowing the fate of the constituent parts of their child is, for some people, heartbreaking. That someone else might possess unrestrained power to classify and dispose of parts of their *own child* along with soiled dressing as "hospital waste" is to them a scandalous and malignant wrong. That the designation "clinical waste" might have been used as a cover for other nefarious uses is, of course, suspected by many. (25)

After the scandal, regulators recognized that "the fact that tissue might be described as 'waste' or 'abandoned' no longer means (if it ever did) that a third party can take control of it and use it for their own purposes" (Liddel and Hall 2005:182).

One way of dealing with this is to obtain consent through donation. Certainly the parents in the Alder Hey scandal held this opinion: "By general agreement, human body parts should be transferable only by free gift from next of kin, never taken without asking" (Richardson 2004:254). Yet much like the identification of wastes, donation is a contested and fraught process, retaining much of the same problems as waste economies, including questions about personhood. As Lock writes in *Twice Dead* (2002), her well-cited book on organ donation and brain-death:

> Mixed metaphors associated with human organs encourage confusion about their worth. On the one hand, the language of medicine insists that human body parts are material entities, devoid of identity whether located in donors

[4] This scandal involved the removal and retention of human tissue without authorization at the Alder Hey hospital in Liverpool from 1988 to 1995. Children's tissues were among those collected, which, when revealed, caused an outcry among grieving parents and the public at large.

> or recipients. However, in the rhetoric of promoting donation, organs are animated with a life force, and donor families are not discouraged from thinking of their relatives as "living on" in the bodies of recipients. (319)

A large body of literature details the varied experiences of families, donors, and recipients (see for example Arnold and Youngner 1995; Youngner et al. 1996; Fox 1992; Lamb 1990); for my purposes, it is enough to note that donation itself is not enough to fully disentangle bits of flesh from the individuals and social relations in which they originated.

Employing Tissue

The point of all of this tissue procurement is to, as noted, enhanced the vitality and health of the living. Increasingly, our health is likely to be owed to someone else's—including nonhuman others'—tissue or the products of their tissue. Allogenic transplants, which use tissue from one body to create tissue products that are used in another's, are an example of this (see Kent et al. 2006). The notion of intercorporeality, coined by Weiss (1999), has been proposed to theorize these forms of embodiment. This concept suggests "that the coherence of selfhood is constantly risked, fractured and transformed by virtue of the fact of being embodied" (Waldby 2002a:251), that "no form of human embodiment is discrete and self-identical" (Waldby 2002a:241), and that the body itself may very much be a bricolage. Intercorporeality is perhaps most clearly experienced in pregnancy in which the boundaries between mother and foetus are not distinct. But it is also expressed in embodied experiences with organ donation. A recipient explains her deeply embodied experience of intercorporeal phenomena:

> There is no other surgery like a transplant. I can't compare it to anything. It's the only surgery where you *gain* a body part. I'll tell you something, it's completely psychological. I hated mustard, I swear. I never touched it. It was never in the house. Now I put it on everything. My mother looks at it: "What are you doing? Are you pregnant or something?" I go, "Seems like it." (Lock 2002:343)

Certainly, this liminality adds to the list of what makes tissue tissue. Yet what structures have supported practices of organ donation and transplantation, or any other use of tissue?

A great deal of infrastructure is in place to procure tissue, create an environment of acceptance of tissue collection, do research or biotechnological work on tissue, and distribute tissue and tissue products. The notion of "tissue economies" has been used to describe these processes and to suggest that they operate like an economy, in which the productivity of tissue obtains value, expressed as biovalue, that can be exchanged and distributed. Perhaps the frontline work in tissue economies is done in "tissue banks," complex entities that collect tissues, organize them, participate in regulation, etc. Tissue banks do the work of disentangling tissues from individuals and some of their social, cultural, political, and ethical baggage. Tissue economies are also comprised of institutions including universities, hospitals, governments, funding agencies, and venture capitalists, as well as individuals such as patients, clients, consumers, doctors, and scientists. The shape of tissue economies is further determined by broader social values and myths—in particular, imagined communities defined by altruism (see Waldby and Mitchell 2006:1-6). Yet tissue

economies are not merely ephemeral, but express the agency of material realities. The biology of the tissue limits what can be done with and to it, and the technologies used to intervene have their own capacities and limitations. Thus Waldby and Mitchell (2006) note that a key feature of tissue economies is their technicity—the intersection between the tissue material and the technology guides the overall shape of tissue economies.

Nikolas Rose (2007a, 2007b) assesses the shape and implications of tissue economies, identifying key five processes: molecularization, or the ways in which tissues are stripped, isolated and decomposed, removing specific attachments and conferring mobility; optimization, the process by which the vitality of human life is managed, optimized and capitalized upon, which, according to Kent et al. (2006:2), creates both use value and exchange value; subjectification, or the ways in which biomedical, 'somatic' notions have come to dominate both individual notions of selfhood and more general ideas about citizenship; expertise, or the burgeoning fields of knowledge and practice that enjoy significant power to shape biological futures; and bioeconomics, the notion that these processes are bound up in a larger capitalist economic field (2007a), already implicit in the notion of tissue economies. But it is important to note that tissues themselves have a "history"—they are not inherently commodities. Thus Lock (2002), drawing on Appadurai, argues that

> an item is not necessarily always a commodity, and it may not originally have been created or produced for that purpose... Clearly, in their original function, body parts are not commodities, but they may be commodified. It is important, therefore, to consider how and under what conditions body parts accrue value, at times monetary value, and what local resistance there may be to the alienation of body parts. (P 47)

Clearly, much work can be done to explore the local and macrolevel processes that shape tissue economies and that determine "tissueness." What is required, then, is more than just Waldy and Mitchell's (2006) 'generic' understanding of tissue. We require a language in which to speak what Mol (2002) calls the 'body multiple' of tissueness.

Tissue-Fragments

I have noted a few instances, particularly in the work of Waldby and in works that draw on it, of the use of the term "tissue fragments" (Waldby and Mitchell 2006; Waldby et al. 2004; Landover 2007:14) or simply "fragments" (Waldby 2002a; Amsterdamska and Hiddinga 2003:426; Brown el al. 2006:2) with regards to bits of flesh in biomedical contexts. These terms appear to have been used in passing, and to my knowledge, these have not be defined or explored. Yet I think therein the phrase tissue-fragments (I add the hyphen to suggest what is held in tension in the concept) lies a promising and useful conceptualization of bits of flesh as tissues.

By including the word "tissue," the concept recognizes that "tissueness" is a material reality for scientists and others. Tissues are entities that are indeed "produced," but their tissueness has truth value that proves useful to scientists doing research and providing care. Tissue is a produced effect of heterogeneous relations—but this makes it "more real." The notion of "fragment" retains multiple meanings held in cooperation and tension.

"Fragment" is both a noun and a verb. As a noun, it points to the notion that the fragment comes from something considered "more whole"—the human body. As such, questions of subjectivity can be addressed. Yet "fragment" also retains a sense of fragmentability. Rose's notion of molecularization is captured in "fragment," and we can also understand how, for example, extracellular material can itself be a fragment of a fragment, a fragment of tissue. "Fragment" further has a distinct aesthetic and affective value. Fragments are "in pieces," transient, and capable of being lost or thrown out. Yet a fragment is also a "witness" or evidence, metonymically standing in for memory, placing the tissue in relation to time. It is because of this property that "tissue-fragment" can also account for, for example, intercorporeal experiences of transplant recipients, or the experiences of the Alder Hey parents. It is in this sense too that "fragment" is a verb. Tissues *fragment* the body, making it intercorporeal, and pointing to the ways in which the body is conceived as composed of discrete types of cells with specific functions within the medical realm. Also embedded in the concept of tissue-fragment, then, is a critical awareness of the reductive tendency of medicalizations of the body.

In this paper, I have pointed to the many processes by which bits of flesh become tissue, including through basic histological practice, tissue procurement, and tissue economies. "Tissue-fragment" captures these dynamics, emphasizing both the process-based and temporal nature of tissues, while also recognizing their material reality. Tissues are transient—and perhaps rather promiscuous—entities, circulating in bodies, laboratories, and institutions. They are also profound hybrids. Even as they are "simply" examined on a glass slide, they are already articulated in and by heterogeneous other actors, both human and nonhuman. Each new situation they find themselves in contests them to the very core, making them boundary objects like no other. Could there be an ontology of these difficult bits of flesh? I suggest tissue-fragment as a useful formulation for exploring the roles played by tissues in medicine, biotechnology, and science.

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