
CATHERINE WALDBY
THE
OOCYTE
ECONOMY
THE CHANGING MEANING OF
HUMAN EGGS

The Oocyte Economy

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Catherine Waldby

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coauthored papers, I have returned to the original datasets, carried out my own reanalysis of the interview and focus group material, and substantially amended, updated, and recontextualized the argument and analysis.

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Introduction

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This book addresses a particular cell lineage—human oocytes, the gametes or reproductive cells specific to women. These are the cells that transmit genetic inheritance from mother to child and orchestrate the processes of conception and gestation. At the broadest level, in this book, I ask what it means to live with this cell lineage. How does its particular history, trajectory, and affordances intersect with the biological and social lives of women? How do women experience and understand the capacities and constraints of these cells, and how do they incorporate them into their everyday lives as an element of reproductive practice?

These are questions nicely located at the pivot point between nature and culture. As biological questions, they interrogate the relationship between part and whole, cellular life and organism life. Our bodies, like those of all complex organisms, are constituted of cell matrices that cooperate in our coherence. Each kind has its own evolutionary history. Our bodies are ecosystems that assemble cellular communities, which lead back into evolutionary time (Dupré 2012). The exquisite coordination of

lymphocytes, macrophages, and B cells that orchestrates our immune system and defeats viral and bacterial infection plays out ancient dynamics among the earliest microbial life. The capacity of our gut to digest food depends on the vast array of symbiotic bacteria that have coevolved with more complex organisms like ourselves and that lend us functional capacities to metabolize what we eat (Ley et al. 2008). Our blood, with its complex components—hemoglobin, erythrocytes, leukocytes, plasma—and its salinity identical to sea water, recapitulates an evolutionary history that leads back to invertebrate life in the primitive oceans (Cooper 1976). Our cells cooperate in our organism life. Basal nuclei are subsumed into the larger structures of the brain, so that they serve the entire body rather than local stimuli (Sarnat and Netsky 2002). Cardiomyocytes bundle into cardiac muscle, so that their contractile force create a heartbeat (Gutstein et al. 2003). The qualities of organism life that emerge from this cooperation are nevertheless contingent and indebted to the material specificities of the cells themselves. Cardiomyocytes may lose their communicative capacities and become arrhythmic, out of sync, so that the heart no longer provides stable support for blood circulation (Harvey and Leinwand 2011). All our cells may immortalize themselves, losing their ability to die. Immortalized cells form tumors, disrupting other organs and the very life of the afflicted. The life of the cell and the life of the organism coincide imperfectly, and their cooperation is partial. In the case of oocytes, their fertile capacity is not simply at the service of the women who embody them. Many women find that their projects and plans are at odds with this capacity, and their experience of this disjuncture forms one of the major themes of this study.

As cultural questions, they interrogate the historical nature of embodiment. Fertility as a human capacity is ordered and highly meaningful for all cultures, dependent as they are for their continuity on the ability of their members to bear children. My question can be considered properly, however, only for quite particular social locations and historical moments. Prior to the middle of the twentieth century, oocytes as a tissue simply formed part of the in vivo texture of fertile experience, rather than as a distinct element. Since the mid-twentieth century, biologists, clinicians, and women themselves have sought technical traction on human oocytes, as a means of controlling fertility more generally. A protracted history of experimentation, first in invertebrates and nonhuman mammals, then in humans, created the conditions for clinical in vitro fertilization (IVF)

in the late 1970s. The protocols for IVF isolated and externalized oocytes so that they could be manipulated through laboratory procedures. This opened the way for an ever-expanding suite of technical services that give women with the necessary income the ability to manipulate and order their oocytes and try to bring them into line with their life course.

Such services are attractive because oocytes as a cell lineage involve a particular set of temporal constraints. Their biology is characteristically parsimonious and atretic. The rarest of cells in the human body, they mature one by one, each lunar month, and most women produce only four hundred mature oocytes over their lifetimes. Women lose their fertile capacity steadily in the first half of a typical lifetime, so that few conceive after the age of forty. This biological schedule is more and more at odds with the costs of household formation and the demands of credentialing and professionalization that characterize the life course of middle-class women in postindustrial democracies. As more and more women seek higher education, demanding careers, and the satisfactions of the public world, they also find that they must grapple with the intransigence of their oocyte biology, if they wish to have children.[1] Techniques that defer oocyte fertility, compensate for their intrinsic parsimony, or access those of another woman are highly valued by women who discover that they may not be ready to conceive in their twenties or early thirties. The demand for IVF and other assisted reproductive technologies (ARTS) has accelerated year on year in Australia, the UK, and the United States throughout the early twenty-first century, driven primarily by women in their mid- to late thirties or early forties (Human Fertilisation and Embryology Authority 2016; Macaldowie, Lee, and Chambers 2015; Centers for Disease Control and Prevention 2017). Beyond the Anglosphere, reproductive epidemiologists estimate that global use of assisted reproduction is increasing by 9 percent per year, and they report that women over forty make up a steadily increasing proportion of fertility patients (Dyer et al. 2016).

This book is largely concerned with the social relations that inform and are elaborated around this body of technique. In this sense, it is not an anthropological investigation into the human meanings of fertility, but rather a more specific "tissue economy" account. Since my work on the Visible Human Project, in the late 1990s, I have investigated human tissue economies across several different tissue types—cadaveric (Waldby 2000), blood and solid organs (Waldby and Mitchell 2006), embryonic and hematopoetic stem cells (Waldby 2006; Gottweis, Salter, and Waldby

2009), oocyte donation (Carroll and Waldby 2012; Boulos, Kerridge, and Waldby 2014), and multiple studies, with Melinda Cooper, that focus on the relationship between women's reproductive biological materials and biological innovation in therapuetic cloning and stem cell treatments (Waldby and Cooper 2008, 2010; Cooper and Waldby 2014).

This study builds on this body of scholarship in that it shares a concern with how forms of circulation and valuation made possible by biomedical technique condition the significance of the tissue. The idea of a tissue economy is that donated human tissues (blood, embryos, organs, sperm, oocytes) have a productivity that can be ordered in different ways. While still inside the donor's body, tissues are part of the self and help to sustain the person. Once donated, they can sustain the life and health of the recipients (as in blood and organ donation); they may be banked for future use (for example, cord blood); or they may become elements in laboratory research (for example, embryonic stem cell lines). In each case, tissues are procured, managed, banked, and circulated in a system designed to maximize their latent productivity. Within the body, different tissues have different qualities and capacities—blood oxygenates the organs, while bone marrow generates the blood system itself, for example. Once donated, these qualities necessarily delimit the kinds of circulation possible for the tissue. Its capacity as transferable material is shaped at the intersection of its function in the body, its durability, its immunological specificity, and the kinds of technical and social systems available to procure, potentiate, store, and distribute it.

Reproductive tissues introduce an additional complexity here, because they form intermediate materials between two different bodies, the parental and the offspring. The tissues may constitute and sustain prenatal life—the gametes in conception, and the placental, uterine, and cervical conditions that facilitate fetal existence—or they may sustain postnatal life, as breast milk is generated and provided to the infant. Oocytes play a pivotal role in the moment of conception, as do sperm, but they also lend themselves to the orchestration of the embryo and the gestational conditions of the pregnancy in a fashion that makes them particularly vital intermediary tissues in the processes of reproduction. This capacity is the quality that confers their value and forms the key to the oocyte economy.

Some tissues offer little affordance to technical intervention. The heart, kidneys, and most other solid organs are simply transferred between donor and recipient intact, with limited technical intervention in the

organ itself, although both donor and recipient bodies require preparation to facilitate the process. Blood was donated whole during the early and mid-twentieth century but today is usually transferred in factions, as plasma, for example, or as platelets that target specific conditions more precisely than does whole blood. Some tissues are extremely time critical; solid organs generally must be transferred between donor and recipient within a few hours, involving complex cold-chain logistics and specialized courier services to avoid deterioration of the organ. Some tissues, like cord blood, are readily frozen, while whole blood is not. The ability to cryopreserve, to freeze and thaw, tissues is perhaps the single most important technique in the repertoire that shapes a tissue economy. Until very recently, oocytes could only be donated fresh, a situation that has placed striking constraints on their forms of circulation. One of the major themes of this book is how a new capacity for cryopreservation is reshaping the oocyte economy, from the most intimate transactions between a donor and a recipient to the development of a global corporate market. Here we will see how new technical developments can render formally intractable tissues into more flexible, valuable substances.

A second feature of tissue economies is that they are not socially neutral but are *implicated in power relationships*. When a person donates tissue, they make a bodily sacrifice in favor of another person, or of a research program. Hence, the biotechnical capacity to transfer tissues immediately raises questions of just distribution. Who should give tissues, under what circumstances, and to whom? Oocytes are particularly mobile, dense points at which such power relationships play out. While solid organ donation (hearts, kidneys, livers, lungs) is managed in most jurisdictions according to principles of social equity, medical need, and humanitarian justice (Healy 2006; Waldby and Mitchell 2006), oocytes are transacted under more variable regulatory conditions. In some jurisdictions, such as the Australian states and most northern European countries, oocytes are treated according to the gift systems that order organ donation more generally. They must be given altruistically and without inducement. No jurisdiction, however, has succeeded in establishing a public gift system for oocytes along the lines of national blood donation programs. Only a tiny number of women will donate oocytes to strangers altruistically, so women seeking such donors will generally wait in vain. In many other places, however, oocyte provision is transactional. Young women sell their oocytes to older women in exchange for money, although this is

habitually framed as compensation rather than frank payment (Cooper and Waldby 2014). This monetization is a quite exceptional feature of oocyte circulation. No other human tissue is so systematically ordered through significant money transactions, and this feature conditions the power relations between provider and recipient in particular ways.

In my research I have tackled this transactional aspect of the oocyte economy from two different directions. In my book with Melinda Cooper *Clinical Labor* (Cooper and Waldby 2014), we considered this economy from the point of view of production and labor, that is, with a focus on the *fertility providers*. We located oocyte transactions as one of the forms of embodied, transactional work associated with the lower echelons of the biomedical and pharmaceutical industries. We argued that oocyte provision should be understood as a specific kind of post-Fordist service work, continuous with but also distinct from the various forms of embodied service labor that proliferate in today's postindustrial economies. While this form of reproductive labor is typically framed as altruistic, and payment is framed as compensation, we set out the terms through which oocyte provision could be understood as a kind of fertility outsourcing. As in other forms of labor outsourcing, the oocyte vendor is constituted as an individual contractor who supplies the elements of fertility from outside the family proper in exchange for a fee.

In this book, I consider oocyte transactions from the other side of the relationship, as a practice of consumption and a kind of experience, as well as a form of economic relationship between different classes of women. I draw on 130 interviews with fertility clinicians and stem cell scientists, and women who have experience with fertility treatment, egg donation, egg freezing, and fertility tourism in Australia, the UK, and the United States. While some of the interviews were conducted with potential and actual oocyte *donors* in Australia, where donation is strictly regulated and noncommercial, the rest of the interviews were focused on the *acquisition* of oocytes, through international travel, and on the management of personal fertility through oocyte banking. In this sense the book is focused on a relatively privileged group—primarily middle-class, white, heterosexual, professional women living in the metropolitan centers of the Anglosphere. The cities of Sydney, London, and San Francisco feature here, cities with wealthy citizens and highly specialized service economies, where professional women can purchase niche forms of private clinical assistance to help them manage the refractory aspects of their

fertile lives. The lives of oocyte vendors are in some cases quite similar—particularly in California, where vendors are typically highly credentialed, newly graduated women in their twenties—but in the majority of cases, oocyte vendors are drawn from the ranks of the precariat, women who work as undocumented cleaners and nannies in Spain, or young women from the former Eastern Bloc countries who travel to Greece and Cyprus to sell their eggs. The conditions of oocyte vending are examined at length in *Clinical Labor* (Cooper and Waldby 2014).

While this book focuses on the more privileged, consumption side of the oocyte economy, I do not want to imply that the experience portrayed here is less significant than that of the providers. Rather, the oocyte economy gives us a way to consider the deeply felt, affectively charged question of what fertility means to women who are still among the earliest generations for whom childbearing is largely elective. It also informs us about the conflicts across the life course of working women between the constraints of biology and the demands of credentialing and career establishment. The pattern of demographic and economic growth in advanced economies is increasingly determined by the fertility decisions of older women, who delay childbearing primarily because of concerns over affordability and the demands of working life (Commonwealth of Australia 2008). This cohort of women, however, is now faced with the growing body of medical evidence concerning age-related decline in the fertility of oocytes (Trounson and Godsen 2003). They turn in growing numbers to in vitro fertilization (IVF) and other kinds of assisted reproductive technology (ART) and hence must encounter the capacities and material constraints of their oocytes as a consequence of treatment.

Oocytes give particular insights into this situation precisely because they can be externalized, circulated, banked, transacted, and donated. Unlike most biological elements of female fertility—uterine, fallopian, cervical, which remain securely in vivo—oocytes have developed an ex vivo social life, and their significance for women mutates through these varied social locations. Like all human tissues, oocytes are charged with highly personal qualities. Their material constitution is marked by genetic, histological, and ontological qualities that link them irreducibly to their donors (Anderson 2008). Oocytes, as gametes, transmit the germ line, to use August Weismann's nineteenth-century term, "the living *hereditary substance*, which in all multicellular organisms, unlike the substance composing the perishable body of the individual, is transmitted

from generation to generation" (Weismann 1892, xi). In Weismann's formulation, the gametes are the body's immortal cells, which transmit species being and family ancestry from generation to generation, while all other cells are somatic. Somatic cells constitute the body of the organism, but they are repeatedly replaced in its lifetime, and they are destined to die. In this sense oocytes transmit distinct historical qualities. They are profoundly associated with what I term in the book "generational time," the ways in which each woman locates herself in a family ancestry and a potential line of descent. Oocytes are the material capacities necessary to communicate generational time; they link the past and the future of the family through the woman's body. For women who feel the past and the future in this way, the ordering of their oocytes gives them a technical means to reconcile the demands of the present, particularly the demands of public life and individual performance, with this *longue durée* sense of inherited self, ancestral time, and obligation to continue the next generation.

For these reasons, oocytes have a particularly acute kind of value, associated with both their signal capacities to create and continue family and their rarity, their precipitous loss of capacity in the middle of the life course. This personal value has been complicated by their centrality in the business model of the private fertility sector, and more recently in the biomedical innovations associated with embryonic stem cell research and therapeutic cloning (Franklin 2013). This brings us to a third characteristic of tissue economies: *they are increasingly caught up in various kinds of capitalization and market value*. The life sciences are increasingly industrialized and configured as a bioeconomy, a form of wealth creation and commercial innovation that builds on the laboratory manipulation of vitality (OECD 2006; White House 2012).

The commercialization of oocytes dates from the early IVF era. During the 1980s, the new fertility treatments were largely classified as elective procedures by the National Health Service (NHS) in the UK (Lord et al. 2001) and as too difficult to regulate amid antiabortion politics in the United States (Jasanoff 2005). In Australia, since the early 1990s, a copayment system under Medicare has publicly subsidized IVF treatment, although there are routinely large gaps between fees set by the clinic and subsidy payments (Chambers, Hoang, and Illingworth 2013). In each case, fertility treatments were largely undertaken in private clinics as fee-for-service medicine. The production and management of patients' oocytes are essential elements of IVF treatment, and these technical skills are central to the

sector's service provision and revenue generation. In many jurisdictions, brokerage, the procurement and curation of oocytes from desirable donors, creates an additional revenue stream for fertility clinics.

Oocytes also underpin some research sectors of the bioeconomy. Since the birth of Dolly the sheep in 1996, laboratories have sought human oocytes to try to replicate in humans the technique used to create Dolly, somatic cell nuclear transfer (SCNT). Although SCNT cannot be legally used for human reproduction, the method can be applied for *therapeutic* cloning, the creation of patient-specific stem cell lines. This demand for research oocytes has proved almost impossible to meet, however, as highly experimental laboratory requirements compete with reproductive demand. As I discuss in chapter 7 of this book, a handful of laboratories interested in SCNT have negotiated a workable procurement system through the professionalization of their providers and their inclusion within the value chain of innovation.

In this book, I aim to elucidate the consumption and innovation dynamics that inform the oocyte economy, but also the kinds of desire, imagination, and identity that animate it. The women interviewed for this study describe complex feelings about their oocytes, and they use them to reason, plan, and fantasize about both their past and their future. As tissues, oocytes are eminently relational, linking women back into their family history, laterally into their relationships with husbands and partners, and forward into their relationships with children, actual or potential. Women unable to produce sufficient oocytes to conceive through IVF describe a sense of bereavement, the erasure of a relational capacity that they had assumed was theirs. Donated or purchased oocytes link provider to recipient, often in terms that the women interviewed found difficult to reconcile. The oocyte economy, in other words, accounts for systems of value locatable in both public and private worlds, in commerce and in family, at global and intimate scales.

Fieldwork and Data

The fieldwork for this book, supported by three grants, extends over three continents and eight years. The initial study, funded by the Australian Research Council (ARC) and carried out between 2008 and 2011, involved a research collaboration with a Sydney fertility clinic, investigating women's

preparedness to donate oocytes for research.[2] Three participant groups were interviewed: twenty women who were ex-IVF patients, five reproductive oocytes donors, and six clinical and counseling staff. Focus groups were organized with fourteen young women (aged thirty and under), with no direct experience of IVF, regarding their understandings of and feelings about donating oocytes for research. As the field methods were face to face and qualitative, we also gathered extensive contextual knowledge about how women understand and value their oocytes, how they felt about giving them, and under what circumstances they might consider such a gift (Carroll and Waldby 2012; Waldby and Carroll 2012; Waldby et al. 2012, 2013; Boulos 2014; Boulos, Kerridge, and Waldby 2014).

The second study, carried out from 2008 to 2010, investigated the understandings of stem cell scientists and regulators about oocyte donation for research, funded as part of the European Union's Regenerative Medicine in Europe FP7 project. The chief investigators, Kathrin Braun and Susanne Schultz, interviewed forty-five key informants in Europe and in California (Braun and Schultz 2012), and they generously gave me access to their transcripts for this book. As my focus is on Australia, the UK, and California, however, I have made use of only the fourteen interviews that correspond to those locations.

The third study, supported by my ARC Future Fellowship, focused on cross-border oocyte transactions and the implications of new vitrification technologies for women and the fertility industry.[3] This involved interviews with thirty-three clinical, laboratory, and business staff in Sydney, Brisbane, London, San Francisco, and Phoenix, Arizona. I also interviewed fifteen women who had banked their oocytes in London, and nine women based in Australia or the UK who had traveled overseas to obtain oocytes from a commercial donor. These interviews took place between 2012 and 2014. I pursued three additional interviews in the UK with clinicians and ethicists involved in mitochondrial donation during 2015. In each of the chapters that deals with this material, I provide more detail about the interviews. The appendix lists all the nonprofessional interviewees by pseudonyms and gives some information about their circumstances, while professional interviewees are described by their position in the main text only. The Human Research Ethics Committee of the University of Sydney granted ethical approval for this research.

Hence the data presented here give snapshots of particular questions in particular locations at particular times with particular kinds of infor-

mants.[4] The time line these data describe maps some of the key developments in both stem cell research and fertility medicine, particularly the global regulatory fallout from the Hwang scandal in 2005 (see chapter 7), the dwindling of SCNT funding after the development of induced pluripotent stem cells in 2006, and the repercussions of oocyte vitrification and the growth of medical tourism on these sectors.[5] The time line also tracks how the notions of a "fertility cliff" and a "biological clock" have become key reference points in women's popular culture, in marked distinction to the celebration of late motherhood in women's media during the 1990s (Jermyn 2008).

The three salient urban locations—Sydney, London, and San Francisco—provide some degree of comparability in demographics: each of them is a global city with a high-cost, high-service economy, a center of innovation and finance, with the kind of relatively wealthy professional population of women who typically form the client base for fertility treatments. At the same time, each location provides important kinds of comparisons around regulation. Australia has maintained a conservative, anticommercial ethos regarding oocyte donation. The UK has taken a more liberal approach to procurement since the advent of egg sharing in the late 1990s, and since 2009, it has moved toward payment of significant compensation (£750, or US$1,000, at time of writing), which attracts providers while staying within the terms of European Union (EU) anticommercialization laws around tissue donation (Human Fertilisation and Embryology Authority 2015a). California has anticommercial statutes, but in practice, oocyte providers are paid for fertility services, and the state has an extremely vigorous clinical and brokerage sector dedicated to the curation of desirable oocyte genetics. These regulatory differences produce quite different systems of oocyte procurement and management, as well as niche services to circumvent them.

These particularities illuminate some dimensions of the oocyte economy and fail to account for others. When possible, I have drawn on secondary data, particularly from the excellent feminist research on ARTS more generally and extensive historical and regulatory research to enrich the primary data at my disposal. I do not claim to give a comprehensive account but rather draw on the breadth of approaches to consider what oocytes mean and how they are valued, for women, for the clinicians and embryologists who work with them, and for the research scientists who hope to leverage their reanimating powers in various ways.

Experience and Method

While the research presented here draws extensively on expert informants and biomedical research, it also engages directly with the more experiential, affective, and embodied dimensions of the oocyte economy. The majority of research for this book involved face-to-face, one-to-one interviews, over one to two hours. In most cases, these interviews proceeded at the participant's home, sometimes with children and partner present, sometimes not. In every case, the interviews involved discussion of experiences considered private, highly personal, and distinctly emotional. They touched on the desire for children, the difficult negotiations with partners, the onerous and often distressing nature of fertility treatment, the failed cycles, the miscarriages, the hope invested in frozen eggs or embryos, and the woman's sense of her life course and how it mediated relationships between different generations and family histories. In some cases, particularly in the interviews with women who had frozen their eggs, the discussion touched on painful relationship breakups, divorce, and the bleakness of life contemplated without a partner and children.

In the interviews I conducted, participants were often angry, frustrated, or grief stricken, regretful, and sometimes tearful. My colleague Katherine Carroll, who also conducted a portion of the interviews, notes the highly personal, sometimes distressing emotional tenor:

> Asking about the IVF experience and the willingness of women undergoing IVF to donate embryos or eggs involves hearing about the most intimate of concerns: tales of repeated failed attempts at pregnancy without IVF, then repeated failed IVF treatments, miscarriages, emotional distress, financial hardship and in some cases, even domestic violence, eviction and incarceration. The interview may also touch on career achievements and failed marriages, often at the cost of starting a family in fertile years. These stories are shared over a cup of tea, a glass of juice, while holding the baby, meeting the husband or engaging with the toddler. (Carroll 2013, 552)[6]

Carroll explicitly engages with this emotional tenor to argue that qualitative, face-to-face research about fertility and reproductive experience, like many other domains of feminist research, requires a particularly intense kind of emotional labor from the interviewer. On the one hand, the inter-

view demands a receptive empathy, a nonjudgmental, open acceptance of the affective ethos the woman brings to her account, and on the other, it requires sufficient detachment to maintain the safety and ethical integrity of the interaction and the data it produces. The interview makes full sense only through a degree of identification between interviewer and participant, a sense of shared experience:

> Emotions and emotionality have traditionally been kept at bay in social research for reasons such as the fear of contaminating data, the difficulty of translating emotion into textual accounts or because of the fear emotional disclosure may have on professional academic careers. Thus, emotional and rational ways of knowing were placed in opposition, with the former occupying a lesser standing. However, it is clear that embodied, experiential and emotional ways of knowing pre-empt, coexist with and inform what is labelled "objective" knowledge. (Carroll 2013, 556)

This kind of empathic intersubjectivity can also be regarded as an entry point into broader social processes. While this study gives extensive attention to the experiential dimensions of the oocyte economy, I do not treat this experience as *self-evidently* significant. Rather, following Joan Scott's now canonical argument about the status of experience in history, I ask how experience counts as *evidence*, as data demanding social analytics and historiography. While experiential accounts are expressive of social relations, they cannot give such relations an exhaustive investigation, as Scott explains:

> How can we historicize "experience"? How can we write about identity without essentializing it? Answers to the second question ought to point toward answers to the first, since identity is tied to notions of experience, and since both identity and experience are categories usually taken for granted in ways that I am suggesting they ought not to be. It ought to be possible for historians to . . . make visible the assignment of subject-positions, not in the sense of capturing the reality of the objects seen, but of trying to understand the operations of the complex and changing discursive processes by which identities are ascribed, resisted, or embraced and which processes themselves are unremarked, indeed achieve their effect because they aren't noticed. (Scott 1992, 33)

Scott suggests that the particularity of experience can be read to open out the relationships between expressive self-formation, the self as felt and interiorized, and forms of subjectivity, the historically constituted, normative forms of social action available to particular selves. To interpret experience in this way involves identification of how the texture of everyday life and immersive time, the particularity of individual histories, are informed by the detail of social history. In this book, the women who offered their experience are knowingly or inadvertently informative about larger social dynamics—demography, gender, class, race, sexuality, kinship, biomedicine—and provide extremely rich accounts of what it means to live these dynamics as styles of life. A salient dimension of this experience derives from their close encounters with biomedicine as both a biological and a social force.

Michel Foucault's propositions about experience and history are helpful here. Thomas Lemke notes the salience of experience as method in Foucault's later work, an articulation point that modulates the relationship between "forms of knowledge, mechanisms of power and relations to the self. It is this . . . tripartite 'matrix of experience' that reorients Foucault's work in the 1980s. Foucault gives up the original plan to study the history of sexuality . . . as 'a history of the experience of sexuality, where experience is understood as the correlation between fields of knowledge, types of normativity, and forms of subjectivity in a particular culture'" (Lemke 2011, 29).[7] This tripartite matrix is proposed at a high level of generality. It becomes useful for the task at hand, however, because it suggests formative relations between scientific knowledge and the emergence of particular kinds of experience and identity. In Foucault's work, this formative relationship is most thoroughly explored in relation to the figure of the homosexual, a category as indebted for its coherence to nineteenth- and twentieth-century biomedicine as to actual sexual practice (Foucault 1978). In this study, I consider the ways in which the experience of womanhood in particular locations is inflected through the knowledge systems of fertility medicine and its capacity to administer women's reproductive biology. The ability to stimulate ovarian follicles, to retrieve multiple oocytes, and to fertilize, bank, or transfer them to another gives women's bodies and lives particular trajectories and constitutes particular webs of relationships. These relationships extend from the most proximate and intimate—those with a sexual partner and with a child—to kinship relations both synchronic and diachronic, and from potential relationships

with future loved ones to remote relations with oocyte providers, known and anonymized, in distant places.

To put it another way, the historical, normative associations connecting womanhood, femininity, and reproduction, the conditions of motherhood, are being rapidly reconstituted by clinical and commercial systems for the redistribution of reproductive capacity (Thompson 2005; Murphy 2012). The women interviewed for this study give poignant witness to both the possibilities and the constraints presented by this dynamic, as they relate their investigations, attempts, successes, and abrupt reversals in the bid for a child and a family. To this extent they also reanimate one of the lost etymologies of the term "experience": its relationship to "experiment."[8] In *Keywords*, Raymond Williams explores the shared terrain of these terms:

> Experience, in one main sense, was until the 18th Century, interchangeable with experiment (cf. modern French) from the common *experiri* [Latin]—to try, to put to the test. Experience . . . became not only a conscious test or trial but a consciousness of what has been tested or tried, and thence a consciousness of an effect or state. From [the sixteenth century] it took on a more general meaning, with more deliberate inclusion of the past (the tried and tested), to indicate knowledge derived from real events as well as from particular observation. Experiment, a noun of action, maintained the simple sense of a test or trial. (Williams 1983, 117)

This sense of experience, with its lineages in empirical experimentation and the history of science, lends itself particularly to the matter at hand. Women have entered courageously into highly experimental relationships with new reproductive technologies. Any advances made in this domain of medicine depend on this willingness to risk sometimes dangerous procedures and highly uncertain outcomes. This preparedness to risk oneself has historically been regarded by feminist commentators as evidence of a kind of false consciousness, of a lack of regard for oneself in the absence of a child, which demonstrates the internalization of patriarchal ideology. In chapter 2, dealing with the history of IVF, I try to reframe this willingness as part of a broader dynamic that encompasses the spectrum of reproductive self-experimentation, from the contraceptive activism of the early twentieth century to the newly chic social egg freezing of today.

In doing so, I try to give just and empathic witness to the experiences that form the substance of this book, and to fully consider the evidence they provide of the contemporary oocyte economy and of reproductive relationships more broadly. Rather than measuring these experiences against a particular set of articulated normative positions, I attempt to discern the ethos, quality of social experience, and lived meaning that the women interviewed felt for their oocytes. The practices of superovulation, of seeking an oocyte donor, and of freezing one's eggs are necessarily encountered as everyday life, immersed in the particularity and irreducibility of the present, while also pointing toward the already lived and yet to be lived life.

In seeking to assay this qualitative texture, I draw on another term of Raymond Williams's—"structures of feeling"—which beautifully modulates the loose relationships between formally articulated worldviews, historical dynamics, and "meanings and values as they are actively lived and felt" (1977, 132). Williams writes,

> It is not only that we must go beyond formally held and systematic beliefs, though of course we have always to include them. It is that we are concerned with meanings and values as they are actively lived and felt, and the relations between these and formal or systematic beliefs are in practice variable. . . . An alternative definition would be structures of *experience*: in one sense the better and wider word, but with the difficulty that one of its senses has that past tense which is the most important obstacle to recognition of the area of social experience which is being defined. We are talking about characteristic elements of impulse, restraint, and tone; specifically affective elements of consciousness and relationships: not feeling against thought, but thought as felt and feeling as thought: practical consciousness of a present kind, in a living and interrelating continuity. We are then defining these elements as a "structure": as a set, with specific, internal relations, at once interlocking and in tension. (1977, 132)

"Structures of feeling" suggests useful ways to consider, for example, the anxiety or grief evident in many of the interviews for this study, ways to trace these intense feelings back into public understandings of genetics and historical norms around family formation and the ordering of motherhood, without reducing their particularity and personal force for the woman interviewed. Rather, it provides a way to investigate how the

institutions and formal practices of biomedicine and family formation are effective as "lived, actively, in real relationships" and through "a kind of feeling and thinking which is indeed social and material . . . [yet] before it can become [a] fully articulate and defined exchange" (Williams 1977, 130–131). Structures of feeling distill broad social formations in the detail of everyday life, not as derivative phenomena, or "secondary evidence," but as a condensate in an irreducible, yet social, particularity. So while few of the interviewees explicitly articulated their grief, hope, anxieties, and misgivings in terms of genetic research, kinship, gender, or the political economy of household formation, their personal accounts speak directly to these analytic systems and inform our understandings of them in enriching ways.

The lived and felt values around oocytes that emerge from the material are often expressed in terms of fertile *time*: time lost and regretted, time wasted in failed conception attempts, time gained through egg freezing, and the ways in which the experience of fertility recursively redeems or condemns life already lived and life to come. The present management of oocytes through IVF, egg donation, or egg freezing are all ways to order the everyday present into a much desired future, when the woman's biological relations with partner and children would be secured. This temporal inflection of feeling is not arbitrary. Rather it responds to the material capacities and constraints of oocyte biology, their continuity of the germ line, and their time-critical fragility. Women's biological schedules are recalcitrant, and their generative capacities elusive, so that they press on other dynamics in women's lives (education, work, household establishment, partner selection) and make their negotiation more time acute.

In chapters 4, 6, and 7, I explore how this sense of generational integrity and continuity is disrupted by the practices of oocyte donation, in which the donor's genetic lineage substitutes for the recipient's. The sense of indebtedness, obligation, fractured maternity, and anxiety expressed by the women I interviewed toward their anonymous donors constitutes another key element of the structure of feeling generated around the oocyte economy. Oocytes can constitute intercorporeal relationships between women because they can be transferred from one to another, and the quality of these relationships, their meaningful and affective dimensions, is highly informative of the historical dynamics at play in the increasingly global relations of reproduction.

Organization of the Book

The chapters proceed in a loose chronological order, although each chapter also takes a particular thematic focus. Chapters 1 and 2 are the most explicitly historical. In chapter 1, "Temporal Oocytes: Fertility and Deep Time," I consider the evolutionary history of human oocytes, and how their particular material qualities as mammalian gametes shape the ways in which they can be experienced. I foreground three biological characteristics: One is the deep generational continuity inherent in the gametes, their ability to memorialize the evolutionary history of speciation and family ancestry and propel it into the future through reproduction. The second is anisogamy, the sorting of mammalian gametes into tiny, copious, motile ex vivo sperm and large, rare, nonmotile in vivo eggs. Much ART treatment is designed to make eggs more like sperm, ex vivo, numerous and mobile, and hence manipulable in the laboratory and clinic. The third quality is totipotency, the capacity of the oocyte not only to continue the germ line, as do sperm, but also to incite and unfold the embryo and establish the gestational conditions for pregnancy. The demand for donated oocytes is largely driven by this totipotency. For women seeking a reproductive donor, the provided oocytes can establish the elusive pregnancy, while for stem cell scientists, totipotent oocytes can unleash the ontogenic processes that establish a patient-specific embryonic stem cell line. Totipotency then confers immense value on oocytes. Of all the cell lineages, only they can act to establish new lifetimes. For women they can readily become the aspect of embodiment most committed to what I term in chapter 1 "generational time," the succession of lifetimes and the possible ways in which generations are created and coexist.

Chapter 2—"Twentieth-Century Oocytes: Experiment and Experience"—draws on the historical overlap between these two terms to account for the emergence of human fertility medicine from the experimental ethos of twentieth-century reproductive biology. The IVF techniques that would eventually be deployed to treat women with fertility problems were pioneered and refined in laboratories concerned with pure research into mammalian embryology and endocrinology, as well as applied research in livestock husbandry. In both cases the experimental methods involved controlled interventions into the processes of conception and ontogenesis, pragmatic technical tinkering designed to perturb normal developmental sequences and render at least some elements external to the mammalian

body so that they could be resequenced and recombined in useful ways. I argue that this more strictly scientific sense of experiment is rendered as a form of self-experimental experience for those women who participate in the drawn-out attempts to apply animal reproductive techniques to human beings. This willingness to be "test-tube women" during the 1960s and 1970s was driven largely by the early successes of the women's movement in improving reproductive conditions, through the advent of the Pill and the rescinding of punitive legislation around the legitimacy of children born out of wedlock. The sudden reduction in adoptable children propelled many women to seek a clinical solution to their fertility problems, so that the inability to have children became a medical rather than a social issue. They, and the clinicians who struggled to adapt techniques developed in livestock to human physiology, discovered that the most obdurate, intractable point in the process involved the production and harvesting of oocytes. At this point, oocytes became objects of direct, discreet experience and desire.

Chapter 3, "Precious Oocytes: IVF and the Deficit Spiral," explores this intractability at length through interviews with women who have gone through IVF, either for their own fertility treatment or as an altruistic donor to another woman. I argue that while IVF and its ancillary techniques are designed to create oocyte surpluses, in practice they create deficits. In vitro fertilization has a repertoire of treatments and techniques addressed to the production and harvesting of numerous ex vivo oocytes. Women who go through such treatments, however, frequently, indeed usually, discover that these techniques cannot compensate for the scarcity and incalculable potency of their oocytes, qualities inherent in the materiality of oocytes that no current techniques can redress. Through a detailed account of the interviewees' experiences, I consider the ways in which the incalculable qualities of oocytes, their resistance to ranking and testing, in concert with their capacity to transmit generational time and to establish gestation, help to constitute their nonfungible value for women in fertility treatment. They are precious, without substitute, and the most fragile point in the quest for a child.

In chapter 4, "Global Oocytes: Medical Tourism and the Transaction of Fertility," I consider the development of a global market for "other women's oocytes," when the bid for a child with one's own does not succeed. Unlike one's own oocytes, with their irreducible qualities of genetic selfhood, kinship, and ancestry, third-party oocytes are ordered on (usually) regional

markets and transacted between women with similar appearance and quite different economic positions; that is, older, wealthier women purchase oocytes from younger, poorer women with whom they share a physical resemblance and an ethnic phenotype. These transactions may take place within a single jurisdiction, but the regulatory discrepancies between states has also produced a global market. Women who live in more conservative jurisdictions, like Australia or France, where transaction is criminalized, will travel to more permissive locations to purchase oocytes as part of fertility treatment. In this chapter I examine the experience of nine women based in Australia and the UK who have traveled overseas in their bid for a child. Their experience tells us a great deal about the structure of feeling ordered through the oocyte economy. The decision to travel overseas is generally taken after extended, onerous engagement with fertility treatment, and an intensified desire for fertile oocytes as the means to a child. Though all but one of the women I interviewed did give birth to children, most were haunted by the figure of the oocyte provider, in the sense that they lacked a secure sense of their claim to motherhood proper. They felt, to varying extents, that the provider was the "proper" mother, that the child did not sufficiently resemble them, and that the child might resent them in the future because they were maternal imposters. I discuss what this sense of insecurity says about the public understandings of genetics and about the contemporary constitution of motherhood. I also consider a compelling exception to these accounts, a women of European descent who intentionally sought out a nonidentical "Asian" provider, a strategy associated with "rainbow" adoption and queer family formation among the cosmopolitan denizens of liberal cities like Sydney (Murphy 2013).

Chapter 5, "Cold-Chain Oocytes: Vitrification and the Formation of Corporate Egg Banks," examines the transition from the transaction of fresh oocytes to that of frozen ones. The global market I describe in chapter 4 has developed as a form of medical tourism because all parties to the transaction—provider, clinic, and recipient—have to be in the same place at the same time, for rapid transfer of the fresh matériel. Over the last ten years or so, however, vitrification protocols have been developed to flash freeze oocytes. This technique opens out an entirely new suite of logistical and scalar possibilities for the oocyte economy. In this chapter, based on interviews with clinical and business staff at four egg banks in London, California, and Arizona, I explore how these new logistics reorder

both pragmatic and affective relations between oocyte provider and recipient. The intense sense of displacement described by some of the women in chapter 4, the lack of maternal entitlement and deference to the imagined claims of the egg provider, derive, in part, from the one-to-one, batch-by-batch form of the transaction. Each woman has her menstrual cycle synchronized with and receives a complete set of superovulated oocytes from a single provider, and both women have to be present in the clinic on the same day, even if they do not meet. In this sense, the women share different aspects of a single reproductive process, coordinated by the clinic, and this configuration shapes some of the structure of feeling I describe in chapter 4. Oocyte vitrification opens up more modular possibilities, so that transfer is less constrained. Oocytes can be procured without the need for a synchronized recipient. They can be frozen after provision, with batches subdivided into smaller units. They can be shipped through space and kept in time. All these capacities detract from the intense one-to-one nature of fresh transfer. I argue that, just as the subjective experience of blood transfusion changed when blood was fractioned rather than given whole (Waldby et al. 2004; Waldby and Mitchell 2006), so too do oocytes lose some of the personified aura. Rather the role of the provider becomes more professionalized, a development also evident in research donation. I take up this point further in chapter 7.

In chapter 6, "Private Oocytes: Personal Egg Banking and Generational Time," I consider another dimension of vitrification: the development of personal egg banking for women who wish to preserve their own fertility in time. The ethics of private oocyte banking, or "social egg freezing" as it popularly termed, are now much debated, particularly as high-profile companies like Google now offer egg-freezing fees as part of a salary package for young female employees.[9] I want to set this approach aside, however, and consider instead what the desire to freeze one's oocytes says about fertile temporality. The women I interviewed wished to use egg freezing as a way to reconcile otherwise incommensurable time scales, those of credentialing, career, partnering, and household formation on the one hand, and those of generational time on the other. I use the idea of generational time to account for the way that the fertility of oocytes transmits generational continuity, locating the woman in her parental and ancestral lineage and projecting her into the future of children and descent. This capacity is time critical and must be deployed in the first half of a woman's life, a constraint that often conflicts with the demands of

professional life and the vagaries of thirty-something couple formation in the metropolitan centers that form the focus of this book. So, private egg banking has gained commercial traction and a clientele because it offers a way to synchronize these different time scales, at least in theory, and tamp down the urgency to conceive.

Chapter 7, "Innovation Oocytes: Therapeutic Cloning and Mitochondrial Donation," moves away from personal experience and considers two of the most salient research programs associated with oocytes: their use to create patient-specific stem cell lines, sometimes termed "therapeutic cloning," and their very new application in clinical treatments to prevent the transmission of mitochondrial conditions from mother to child. While these applications are at one remove from questions of personal fertility, they nevertheless require women to act as oocyte providers, as each program depends on the biological action specific to human eggs. These two domains are highly specialized, and only a handful of laboratories are actively pursuing such research. I examine some of the specific procurement dynamics used in each domain, and analyze what this tells us about how the oocyte provider is figured. In the case of SCNT and therapeutic cloning, the history of procurement is highly politicized, and very few laboratories have succeeded in establishing a sustainable form of provision. I examine two such programs in the United States, which have successfully created highly professionalized provider panels. In the case of mitochondrial donation, only one UK clinic has approval to recruit egg donors, and at present their approach is modeled on that of reproductive donation and appeals to community. Mitochondrial donation returns us to the question of structure of feeling, however, because its regulatory framing separates "proper" genetic motherhood from donor contribution and tries to secure a clear hierarchy between different maternal claims in the creation of the healthy child.

In the concluding chapter, I try to consider what the structure of feeling played out in these pages might tell us about the ethics of oocyte *regulation*, how legal systems might better reflect the new relations of kinship, maternity, and family formation described by the oocyte economy.

Notes

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Introduction

1 In Australia, for example, between 2007 and 2008, 55 percent of births were to women aged thirty to thirty-nine, with a significant proportion to women over thirty-five (Kuleshova 2009). In Britain the number of live births to mothers aged forty or over has nearly tripled between 1990 and 2010 (Mullen 2011).

2 Catherine Waldby, Ian Kerridge, and Loane Skene, CIS, 2008–2011, "Human oöcytes for stem cell research: Donation and regulation in Australia," ARC Linkage Project—LP0882054.

3 Catherine Waldby, CI, 2011–2015, "The oöcyte economy: The hanging meanings of human eggs in fertility, assisted reproduction and stem cell research," ARC Future Fellowship—FT100100176.

4 Notably, all but one participant was heterosexual. I have drawn on secondary literature to flesh out points of comparison with the dynamics of same-sex relationships.

5 Hwang Woo Suk and his research team published two fraudulent papers in *Science* (in 2004 and 2005) falsely claiming to have created the world's first human SCNT cell lines in their South Korean laboratories. When the fraud was identified, in 2005, investigators also discovered that the team had procured more than two thousand oocytes from paid providers and some from the laboratory researchers. I discuss this case in more detail in chapter 7.
6 Margaret Boulos, Kim McLeod, and Brydan Leanne also conducted some interviews. In addition, Margaret Boulos conducted the focus groups for young nonpatient women.
7 Lemke's quote from Foucault can be found in volume 2 of *The History of Sexuality* (Foucault 1990, 4).
8 Lost in English but retained in modern French. Thanks to Michelle Jamison for bringing this point to my attention.
9 See, for example, Henderson (2014).

One. Temporal Oocytes

1 In human beings, a typical sperm is 5 to 7 μm long, while the diameter of the ovum is twenty times that size.
2 "Cloning" is a term that refers to many forms of in vivo and in vitro cell division in biology, so I use SCNT throughout as a far more specific descriptor for the process that produced Dolly.

Two. Twentieth-Century Oocytes

1 "From 50.7 conceptions resulting in live births per 1,000 unmarried women aged 15 to 44 in 1971, the overall total rate of nonmarital conception plummeted to 29.7 in 1976" (Carmichael 1996, 302).
2 Single, never-married mother households increased from 1.2 percent of all families in the UK in 1970 to 8 percent in 1994 (Kiernan, Land, and Lewis 1998).
3 "Abandoned tissue" is the term used historically to characterize tissue excised during surgical procedures and made available to researchers without the need for formal consent. For a discussion of this category, see Waldby and Mitchell (2006).
4 Haldane's speculative work, *Daedalus, or, Science and the Future*, presented at Cambridge in 1923, proposed the virtues of "ectogenesis," human reproduction in the laboratory rather than in vivo, and was an influence on Aldous Huxley's *Brave New World* (Clarke 1998).