Ectogenesis as the dilution of sex or the end of females?

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A Brief Introduction

Technofeminisms[1] are dealing with new sets of challenges directly related to the possibilities opened by transhumanism[2]. Among the huge list of possible technological advances, we direct our interest towards reproductive technologies, in particular *ectogenesis* (foetus pregnancy and growth outside a human womb). Although some authors defend the benefits of this technology for the advancement of gender equality (Bulletti et al. 2011; Murphy 1989; Chavatte-Palmer et al. 2011), we want to suggest a radically different scenario: the studies on ectogenesis will not liberate women – once they are not 'limited' by the duties of childbirth (and care) – nor blur gender differences according to evolutionary requests, but they can rather reinforce the current male gendered dominance (Aristarkhova 2005; Coleman 2017; Smajdor 2007). A study of the situated nature of existing studies and experiments on ectogenesis, as well as a study of the current clashes between the possibilities offered by technology and the more probable biased outcomes will offer us a sound background to think about the limits of technological transformation that are directly related to social pressures, rather than to a "natural or rational outcome" in relation to such technologies. Despite the fact that from a biotechnological perspective embryos have been created without fertilisation by sperm nuclei, consequently eliminating the need of males for reproductive purposes, more intense efforts are being invested into extra womb pregnancy. Biotechnologies, and especially those related to reproductive tasks, are being gendered biased, following a tendency also present into AI and robotics industries and researches (where assistant roles are always ruled by 'female characters'). At some point, the lemma of xenofeminists of "Gender abolitionism" (Cuboniks 2018; Hester 2018) can become true…but could this abolition to imply the emergence of a neutral gender which true essence was a male reference (for example at bodily level)? Under such scenario, the dilution of females under an over-dominating male-society, thanks to technology, would create a specific scenario: males would not need women for reproducing new human beings. Could it mean the end of the existence of females (as humans able to be pregnant and to give birth), or even a definitive undervaluation of female's ancient roles in favor of a new male prototype?

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[1] The authors want to clarify that the terms "feminism" or "technofeminism", used all throughout this chapter, do not reflect the existence of a homogeneous meaning expressed by a clear community of thinkers but, instead, convey a rich, diverse and even contradictory set of social agents who are being engaged into the debates about human equality beyond (classic) sexual morphologies. Such debates are being held using different or even opposite points of view about a broad range of topics.

[2] Transhumanism (usually abbreviated as **H+** or **h+**) is a philosophical concept to define the process of using new technologies to enhance human intellect and/or physiology. This implies an upgrade or modification of human body that could achieve a permanent nature into a posterior era, the posthumanist. A different concept, "singularity" is also used as a temporal moment in which machines and humans will reach similar natures, and consequentially is related to transhumanist and posthumanist debates. This later period would imply the abandon of enhancement of previous bodies because they would have been reached a completely new evolution. See Lilley (2012), Ranisch & Sorgner (2014) or Eden (2015) for more a detailed analysis.

1. Transhumanism, Singularity and Ectogenesis: why it is not in the Agenda?

Although xenofeminists theoreticians published their manifesto in 2015 ("Xenofeminism: A Politics for Alienation") and was released recently a book on this topic (Hester 2018), the blatant truth is that in current worldwide debates on singularity or transhumanism the related debates about feminism are mostly neglected or completely residual. It is not surprising if we take into account an obvious fact: gender issues are still not included among the most 'hot topics' for philosophical researches, nor have they been historically part of the academic interests. The human being has been historically conceptualized in Western and Eastern traditions as a male subject, with no biological constraints at his essential nature: a divine being with a pure soul. Even the cognitive approach, more embodied and naturalized, has considered an apparently neutral notion of human cognition not close to the real differences easily found in actual scenarios but at the same time far from the crucial aspect of human life: the skill to reproduce ourselves, a process that marks and determines much bodily and social behaviour. As happened in the past, when the female body was completely neglected (Schiebinger 1986; Mangham & Depledge 2011), the appearance of it is only related to reproductive processes. This androcentric bias can be traced through Renaissance medical textbooks, like Vesalius' *De humani corporis fabrica libri septem* (1753), up to our days.

Contemporary utopias about the human future are not postgendered but, again, male-centered, using this privileged body as a framework for the technological or engineered extension or upgrade. The male archetypes are also expressed and debated mostly by male participants, especially dominant in the fields of technology. Also, very curiously, technofeminisms have been debating crucial aspects of reproductive techniques as one of the leading topics, basically because they particularly affect current (and future) female bodies, as well as all the politics related to them. In a nutshell: reproduction is not in the agenda of cutting-edge researches on utopic or dystopic human scenarios, although it is obviously the key aspect for the possible revolution of human evolution. The basic way of creating new humans is directly related to reproductive processes, now closer to a complete control of their processes under technological manipulation.

2. The Definition, History, and Debates on Ectogenesis

Ectogenesis (from the Greek *ecto*, outer, and *genesis*, origin) is the artificial reproduction outside the female body (O'reilly 2010: 324), and this word was introduced in 1883 by a paper on pathogenic anatomy to describe bacteria that reproduce outside the body. Nevertheless, this is not the reason for its success, which is rather its use by scientist J.B. Haldane. In 1924 he published an essay *Daedalus, or, Science and the Future*[3] in which he explained ectogenesis and in vitro fertilisation, a work that was an important influence on Huxley's *Brave New World* (1932). Although Haldane was a multitalented scientist, some of the ideas of this essay are just mere speculation or mere cultural bias. Not only did he described the great challenge for humanity in relation to ectogenesis, but he also described a key aspect of human evolution, that is, the

[3] Accessed: March, 28th 2019: https://ia800408.us.archive.org/19/items/Daedalus-OrScienceAndTheFuture/daedalus-haldane.pdf

active selection of men for women through the latter's faces and beauty (avoiding Paleolithic "fat" archetypes). Interestingly, there is an underlying contradiction between Haldane's strong support of human enhancement and techno-evolution and the basic technological aspects related to human evolution. For example, he describes the domestication of animals for consumption as indecent: "Consider so simple and time-honored a process as the milking of a cow. The milk which should have been an intimate and almost sacramental bond between mother and child is elicited by the deft fingers of a milk-maid, and drunk, cooked, or even allowed to rot into cheese. We have only to imagine ourselves as drinking any of its other secretions, in order to realize the radical indecency of our relation to the cow" (Haldane, 1924).

Haldane received replies during that decade from several intellectuals from a broad range of disciplines. Anthony M. Ludovici, a nietzschean philosopher, wrote a book (Ludovici 1924) in which he argued against ectogenesis, because it was part of a feminist plot against natural and therefore necessary duties of women (pregnancy and reproduction), as well as its implying the emancipation of women from the domestic sphere and even possibly from their dependence on men (on a social and sexual level). These worries about the perils of women's emancipation for the sake of the maintenance of the social order had also been previously defended by neurologists like Paul Julius Möbius in his infamous book *On the Physiological Idiocy of Women*, published in 1900. Some replies supported the idea of ectogenesis as a way to help infertile women or to avoid for the healthy ones the gestation problems and duties (Haire 1927). Following a mechanistic approach embedded with the new posthumanist visions, biochemist J.D. Bernal gave his support to the replacement of malfunctional bodies with efficient machines, in this case, wombs (Yuko 2012). Other voices, like poet and pacifist Vera Brittain, defended natural pregnancy because of the health perils for the child gestated in artificial wombs (Brittain 1929).

During the next 4 decades, debates on these topics were scarce. At the beginning of the 70's, many prominent intellectuals took up the topic again. The main cause was the fundamental and radical book of Shulamith Firestone, *The Dialectic of Sex: The Case for Feminist Revolution*, published in 1970. Firestone considered that not only feminists led their fights against heteropatriarchy, but against the bodies of women, too: the oppression against women has not only cultural roots but also biological ones. One fact, reproduction, was at the backbone of all disadvantages of women, and it should be solved by using technology – especially ectogenesis. Only when freed from birth and care duties could women be equal and decide without pressure over their own paths. This implied the end of the classic understanding of the family. This sharp attack on classic Western parenthood or kinship schemas (which reproduce scalable hierarchical social structures) and on the female bodies was received with great controversy (Merck & Sandorf 2010).The disagreement of feminists over the female body can even be found in authors like Simone de Beauvoir, who created a new philosophical space for the phenomenology of gender or sex, because, up to her work, the human being was idealized as a simple and unified being, obviously under a male stereotype. From this male perspective, men were labeled as "normal", "positive" or "good" while the woman was relegated to taboo because of her reproductive capacity and menstruation, the latter is still by some women sometimes referred to as "the curse". Since the menarche,

or the first menstruation, de Beauvoir explains, women perceive their bodies as dirty, inferior, because of the bad smell of the 'impure' blood, as well as because of the social (male-guided-orientation) disgust towards it. Nevertheless, she explores at the beginnings of the first chapter the origins of humanhood: "As for ordinary women, *pregnancy, giving birth, and menstruation diminished their work capacity and condemned them to long periods of impotence*; to defend themselves against enemies or to take care of themselves and their children, *they needed the protection* of warriors and the catch from hunting and fishing provided by the males. As there obviously was no birth control, and as nature does not provide woman with sterile periods as it does for other female mammals, *frequent pregnancies must have absorbed the greater part of their strength and their tim*e; they were unable to provide for the lives of the children they brought into the world" (de Beauvoir, 2010: 97). There is a critique of the heavy duties of women: "But pregnancy is above all a drama playing itself out in the woman between her and herself. She experiences it both as an enrichment and a mutilation; the fetus is part of her body, and it is a *parasite* exploiting her; she possesses it, and she is possessed by it; it encapsulates the whole future, and in carrying it, she feels as vast as the world; but this *very richness annihilates her*, she has the impression of not being anything else. A new existence is going to manifest itself and justify her own existence, she is proud of it; but she also feels like the plaything of obscure forces, *she is tossed about, assaulted*. What is unique about the pregnant woman is that at the very moment her body transcends itself, it is grasped as immanent: it withdraws into itself in *nausea and discomfort*; it no longer exists for itself alone and then becomes bigger than it has ever been" (de Beauvoir, 2010: chapter 6, The Mother)[4]. Even being aware that such oppression can be produced and transmitted by heteropatriarchy, the root of such disadvantage in a competitive society is the differences between males and females in terms of bodily investment at reproductive level (Shefer 1990).

As an example of such gendered biases into scientific analysis we need to consider the recent inclusion in 2013 of premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD) into the canonic psychiatric book *Diagnostic and Statistical Manual of Mental Disorders* (*DSM−5*) (Epperson et al. 2012). In the book it is said that "after careful scientific review of the evidence, premenstrual dysphoric disorder has been moved from an appendix of DSM-IV ("Criteria Sets and Axes Provided for Further Study") to Section II of DSM-5" (op. cit: 155), in order to analyze something that is estimated considering "twelve-month prevalence of premenstrual dysphoric disorder is between 1.8% and 5.8% of menstruating women". It implies to consider that at this very moment between 34 and 109 million of women are suffering from a mental disease because of their menstruations − something unbelievable, that even reinforces the old classic bias against the cognitive properties of women during their fertile days which was recently dismantled by (Sundström & Gingnell 2014).

During the same period, empowerment of women about their roles and value increased as we can find into the work of Carol Gilligan *In a Different Voice: Psychological Theory and Women's Development*, from 1982. She considered both classic ethical schools (deontology and consequentialism) male-centered while there was a feminine option:

[4] Italics are ours, and capture the reluctant perception of some feminisms towards the female body in relation to reproductive processes, something placed into first position of feminist debates by Firestone.

the ethics of care, though the morality of empathic caring, which can be seen as a reformulation of the already existing idea of moral sentimentalism, but now under feminist glasses. Related to these ideas, ectogenesis was then studied as a technology that could prevent the creation of bonds between parents (especially mothers) and their kinship. This approach was slipping dangerously into a new form of essentialist naturalism which stated that only real or genuine care bonds could be created between natural-born kids and their mothers, something that excluded adopted kids from this process (for example in classic heterosexual couples or single-parent male families), among a large list of possible baby-adults relationships observed elsewhere in human societies and described as nurture kinship (Holland 2012)[5]. Anyhow, it is clear that at the core of human social evolution care and cooperation are the fundamental glue of such collective complexity (Axelrod 1981).

The influential Warnock Report of 1984, says about ectogenesis, at page 72: "We appreciate why the possibility of such a technique arouses so much anxiety. There are however two points to make about this. First, such developments are well into the future, certainly beyond the time horizon within which this inquiry feels it can predict. Secondly, our recommendation is that the growing of a human embryo in vitro beyond fourteen days should be a criminal offence".

It is very sad to see that the 14-days rule has only a religious background, not a scientific one (Cavaliere 2017; Vallverdú & Delgado 2009), and reproduces such bias in legislation. Taking into consideration a more comprehensive analysis of ectogenesis, Singer and Wells published in 1985 the influential book *Making babies: the new science and ethics*. Elegantly they summarized the state-of-the-art using five reasons for and five objections to ectogenesis, always having in mind the moral debates and argumentation. At the end of the 80's and the beginning of the next decade some authors (such as Murphy 1989) asked, from a more cautious approach that took into account how ectogenesis could force us, to rethink women's relations to pregnancy. For example, Cannold (1995) assumed that ectogenesis would become something positive because it would reduce the amount of abortion. The argument was extremely weak, because it is clear that abortions were already present as well in surrogate processes (D'averta 1987), and nothing except explicit laws could make unfeasible to cancel an ectogenetic process if the implied agents would ask for it (monetary problems, death, divorce, general crisis, severe illness, change of view, spontaneous abortion, and the like). Some countries like Spain even regulated ectogenesis as early as 1987 despite of the absolute technical impossibility of Ectogenesis[6].

But for several authors of the next decade, like Mary O'Birne, Adrienne Rich or Andrea Dworkin, ectogenesis was not the freedom panacea but, again, the unification of male-centered and controlled medicine over women's rights and power. New reproductive techniques were even perceived as being oriented towards solving primarily the male problems or rights to the obtaining of kids (Becker, 2000). Robyn Rowland even talks

[5] For example in polyandric as well as in polygamous societies

[6] According to the published Law at BOE 31/10/1986 – 122/000062 – Art 20: "B) Son infracciones muy graves (...)"s) La ectogénesis o creación de un ser humano individualizado en el laboratorio." [Are serious faults: ectogenesis or laboratory creation of an individual human being].

about a conspiracy of men against women because of their jealousy of women's reproductive power (Rowland 1992).
The last and more comprehensive approach to ectogenesis was released in 2006 after the publication of a very comprehensive book on the topic (Gelfand & Shook 2006), with a diverse and rich set of contributions, and among them we can find a review of the early ideas of Singer & Wells in 1984.

3. The State of Ectogenesis and Supportive Reproductive Techniques

The first scientist who claimed to create human life in a lab was the alchemist Paracelsus in the 16th century. In *De natura rerum* (1537) he describes his method for creating small men or "homunculi", something obviously false. John Hunter wrote the first report of artificial insemination in medical literature in 1790, treating a male patient with severe hypospadias (a congenital disorder of the urethra where the urinary opening is not at the usual location on the head of the penis). Hunter advised him to collect his semen in a warmed syringe and inject it into his wife's vagina (Ombelet & Van Robays 2015).
Before we talk about the more recent debates, we'd like to refresh some data about the history of researchers implied into the emerging field of artificial reproduction. An obvious fact can be stated: moral and religious values always present in the discussion of reproductive events. As an example of it, we would like to remind the reader of the moral furor against anesthesia in childbirth which arose in 1846. After Dr. James Simpson began to administer anesthesia, Christian followers, among them several physicians, argued that the Bible required a painful process (Genesis 3:16). In 1849, the editors of one of Canada's medical journals asked Abraham De Sola, Canada's first rabbi, to give his interpretation of Genesis 3:16 making a long analysis of this Bible paragraph, concluding that there was a way to justify anesthesia in childbirth (Cohen 1996). James Marion Sims, one of the fathers of gynecology, who perfected his surgical techniques by operating without anesthesia on enslaved black women, also made the first artificial insemination, originally called "artificial fructification", "artificial fertilization", "artificial fecundation", and "artificial impregnation" (Davis & Loughran 2017). According to his records, he performed 55 "artificial fructifications" requiring a "uterine injection" on six patients at his renowned Woman's Hospital in New York City, one of them even successful although the patient later miscarried (Sims 1885). Moral critics against such medical practices made difficult their implementation and normalization. Walter Heape performed rabbit embryo transfer experiments between 1890 and 1897 (Heape 1891).
During the 1930's and 1940's some authors tried to study mammalian oocytes and exposed them to spermatozoa with several degrees of unsuccessful results (Pincus & Enzmann 1935; Menkin & Rock 1948). In 1966 some preliminary results about fertilizing human oocytes in vitro were reported (Edwards et al. 1966). After the 1950's creation of pioneering oocyte induction by hormonal or chemical treatment, ICF was successfully deployed in the late 1970's (Steptoe & Edwards 1978) and in the 1990's was developed intracytoplasmic sperm injection (ICSI).
Meanwhile, in 1958, ectogenesis achieved new results with Westin, Nyberg, and Enhörning, who were the first to describe an extracorporeal perfusion system for human foetuses, and seven years later, in 1965, scientists tried unsuccessfully to connect the

umbilical vessels of lamb foetuses to an oxygen exchanger, inside an arterial-venous system (Callaghan 1965). In 1970, with the invention of the ECMO technique (for Extra Corporeal Membrane Oxygenation) some researchers maintained sheep foetuses alive for 55 hours (Doppman et al. 1970). With all the mass media interested on such advancements, the birth of Louise Joy Brown in 25 July 1978 (weight 2.608 kg) became a fundamental moment in the history of humanity, because she was the first human to have been born after conception by in vitro fertilisation, or IVF. The several miscarried embryos necessary for obtaining her was also topic of intense debates (Squier 1994).

Again working on ectogenesis, a Japanese team, led by Yoshinari Kuwabara, used artificial placentas inspired by ECMO as well as extracorporeal oxygenation in their incubator. These were the first successful experiments to keep a goat foetus alive for 165 hours (Kuwabara et al. 1987), while the second was alive for 236 hours (Kuwabara et al. 1989). Interested in support for newborns, Prof. Kuwabara was also a leading investigator on hormonal and chemical aspects of breast milk (Takeda et al. 1986) and during the next decades he would made important contributions to ectogenesis.

After Louise Brown, the second historical benchmark was a sheep: technical advances made possible in 1996 the first cloned mammal, a sheep called Dolly. She was cloned from an adult somatic cell, using the process of nuclear transfer, and that success was received with worldwide interest (Brem & Kühholzer 2002). Meanwhile at Temple University, Dr. Thomas Shaffer created an artificial amniotic fluid for lambs (Shaffer et al. 1996), and other advances made at Leeds were small steps towards human ectogenesis.

At the very beginning of the 21st century, Professor Hung-Ching Liu at Cornell University's Center for Reproductive Medicine built an artificial womb and grew a mouse fetus to nearly full-term in it, and also experimented with human zygotes. She ended the experiment after 10 gestation days because of the 14-days rule (Carlston 2008). Since then she has been growing endometrial human tissue and checking future possibilities. In 2012, Japanese researchers were still making advances in artificial placenta (Miura et al. 2012; Miura et al. 2015), basically interested in improving preterm survival and decreasing neonatal mortality. In 2017 was created an improved artificial womb, a "biobag" that obtained better animal testing results (Partridge et al. 2017). As the authors stated: "Here we report the development of a system that incorporates a pumpless oxygenator circuit connected to the fetus of a lamb via an umbilical cord interface that is maintained within a closed 'amniotic fluid' circuit that closely reproduces the environment of the womb. We show that fetal lambs that are developmentally equivalent to the extreme premature human infant can be physiologically supported in this extra-uterine device for up to 4 weeks".

After that milestone, later research has been exploring the future of ectogenetic reality (Church et al. 2018; Usuda et al. 2017), and recently, in March 2019, the survival of a preterm baby born at the 24th week with a weight of only 268gr are examples for the positive correlation between such laboratory advances and the improvement of neonatal health results.

4. Ectogenesis, Feminism, Technofeminism and Xenofeminism: from Utopia to Dystopia and Back?

Ectogenesis has been a topic of debate among specialists in ethics and medical ethics as well as among feminists thinkers or ethicists. Technofeminisms (de Voss 2019; Judy 2004) have been focused on technological aspects of women liberation, and thanks to the work of Donna Haraway (Haraway 2013), the technofeminisms have been explained around the idea of cyberfeminism (Matrix 2001) and the idea of the cyborg (Puente 2008). Basically, these feminisms are WASP feminisms that are even open to see the differences among the feminist discourses as "peripheral". The main debates about this topic have been controlled by WASP philosophers working in rich countries while feminists living in poor countries have not been interested on the importance of such debates. In that sense, the feminist approaches to technological utopias or dystopias (and ectogenesis is a fundamental hot topic of these conceptual frameworks) are clearly far from being intersectional or decolonial.

The youngest version of such technofeminisms is xenofeminism (Hester 2018)[7], and they radically blend DIY actions (as with Del-Em), cyberfeminism, posthumanism, accelerationism, neorationalism, materialist feminism. Their call for a new thinking, abandoning any possible hybrid politics that could be inherited from the biopolitics of the cultural traditions. Perhaps it resembles the nietzschean notion of the "Übermensch", but adding the technological flavour. Just for this reason xenofeminism does not really offer an intersectional approach, but even in this case their conceptual contributions are extremely interesting. After their 2015 manifesto (by the Laboria Cubonicks working group), they have tried to see through technics and feminist glasses, but without inheriting most of such classic ideas. For example, they are anti-naturalist, as well as gender abolitionists, exploring the possibilities that new technologies provide to human beings. Obviously, they borrow some of their ideas from Firestone, and in that sense consider ectogenesis as the perfect way to liberate women (or men, or whatever the choice or creation, as Hester 2018: 31 says "Let a hundred sexes bloom!" – .reformulated by *Open Source Gender Codes*) from birth and care. Despite xenofeminists agreement with ecofeminists, who consider techno-science as a patriarchal/anti-nature/colonial activity, they reject the idea of the necessity of the female body in relation to reproduction. The new technologies should be glued by a xenofeminist sisterhood idea that we consider somehow naïve: why should posthuman or transhuman beings feel themselves part of the same domain? Why cooperate after that moment between us? Besides nice words or wishes, are there some ideas from the cognitive sciences and from the anthropological studies that should be part of this debate: how do we create identity? How can kin be conceptualized or even used to intensify the difference instead of the equality? How do our minds learn from other beings and try to imitate them? The difference can be refamiliarized, it is true, but not without cost. One of the possible outcomes is the loss of empathy. To talk about "solidarity with the alien" (op.cit.: 66) is provocative, but empty. Why should we solidarize with the Other? Is it an emotivist approach to reality (using different bodies, we can enter into a post-cognitive and post-emotivist scenario, completely different, Vallverdú 2017)? Vegans solidarize themselves with cows but anyhow they kill lettuces,

[7] Rejecting the claim that science and technology are inherently masculine or patriarchal, Xenofeminism looks at attempts to repurpose technology to liberate women. Xenofeminism stresses that the forces of technology – like any given individual – do not operate in omnipotent isolation but within a complex web of power dynamics.

defining special ethical thresholds for the validation the murder of living systems murder for feeding purposes. This is an example about how solidarity among beings or species can be modulated according *ad hoc* rules. And only somebody without knowledge about plant cognition and feelings would say that plants are just *things* (*to-be-eaten*).

Even taking into account the huge capacity of human beings of putting themselves into another one's shoes, perhaps we are not truly open to accept any choice, basically because some choices can be harmful or not so advantageous for us. Our socio-embodiment regulates our affordable access to the notion of the "other". It is curious to see that technofeminisms, like that of Firestone, tend to see technology as a relief or motor of change, as the herald of equality, always from a utopic perspective[8]. But what if these technologies were the definite set of tools for keeping safe the heteropatriarchy or some variations of it? Whatever the choice we do, it is beyond any doubt that the role of ectogenesis will be crucial for the evolution of humanity.

5. The Epidemiology of Ectogenesis

Although we can affirm that medical practices have historically maintained a form of male control over women, and that reproductive technologies have been oriented towards the male help in detriment of women's welfare, ectogenesis has been the result of two opposite but connected technologies: first, how to help couples (yes, couples, not single or single-parent families) to become fertile, and second, how to help preterm babies to survive. In a nutshell: how to get into the womb and how to get out from it (even prematurely) as safely as possible. Once physicians were able to control the extrauterine fertilization as well as save more preterm babies (23 or 24 gestation weeks is currently the minimum) the obvious question was there: can we do the full process extrauterinely? Surely the answer is "yes" and the success of such process is only a question of time and technological and theoretical advances. Therefore, we can affirm that ectogenesis fills the gap between current reproductive techniques and preterm care.

Anyhow, the question here is to think about the *epidemiology of ectogenesis*[9] from a complex or holistic point of view. Two brief preliminary questions: a) are assisted reproductive technologies successful at the moment? and b) which are the health consequences of being born preterm?

The answer to the first question involves considering several variables such as age, health status, use of donor or personal genetic materials, use of fresh or frozen genetic samples, number of cycles, implantations, as well as techniques (DI, ICSI, IVF, GIFT, ZIFT, ET SET)[10]. Even for the best case (healthy, fresh samples, young), the success

[8] We could define such feminisms as "techno-euphorical feminisms". We can find good studies of this trend in (Layne et al, 2010). On the other hand a critical approach to gendered technologies can be found at feminist theory and science and technology studies. Judy Wajcman (Wajcman, 2004) explores the ways in which technologies are gendered both in their design and use. At the same time, she shows how our very subjectivity is shaped by the technoscientific culture of the world we inhabit.

[9] As epidemiology can be defined as the study and analysis of the distribution (who, when, and where) and determinants of health and disease conditions in defined populations, it is possible to consider how ectogenesis can affect health or even produce diseases. For a causal approach to epidemiology we quote Vallverdú (2016).

[10] Check the websites of the Centers for Disease Control and Prevention (CDC): https://www.cdc.gov/art/artdata/index.html and especially

ratio is less than 20%, decreasing considerably for older people. Because of the difficulties and high economic costs, these technologies are still prohibitive to majority of citizens in the world. On the other hand, preterm babies suffer from high levels of mortality or morbidity problems, because, as WHO informs us, around 1 million preterm babies die each year, and those babies who survive can face lifelong physical, neurological or learning disabilities, often at great cost to families and society[11].

The combination of failures before fertilization and problems during gestation are still too great at to consider ectogenesis as a viable technology in the near future. Besides, other factors, such as cognitive (inside the womb, see Olza et al. 2012, 2014; Oitzl et al. 2000), affective (intense biochemical bond with the mother), and care are still not completely known. For example, after decades of pressure towards the consumption of formula, neonatal institutions now request human breast milk for the nourishment of the preterm or IUGR (Intrauterine growth restriction) babies. The quality of human milk is so important that despite all attempts it is still not possible to synthesize it in labs (Anderson et al. 1999). The obvious therapeutic value of skin-to-skin techniques (kangaroo method, Moore et al. 2016; Feldman et al. 2002) are also fundamental but not explored across ectogenetic literature.

Hence, the biochemical mechanisms related to life emergence that happens in women's bodies during egg maturation, fertilization, implantation, embryo maintenance, delivery (the bacterial transfer through vaginal delivery, but not in C-Sections), or nourishment are of the highest complexity and are still not completely understood. Therefore, over-simplistic approaches to ectogenesis could harm babies rather than making childbirth safer.

There is another important aspect: the socioaffective aspects of baby delivery and care. Some classic critics to ectogenesis define it as a technology that could undermine some notions of womanhood (Singer & Wells 1986) as the ectogenetic caregivers would be unnatural. Some authors like (Jeremiah 2006) think that the process of mothering could be preserved despite of the gender the caregiver (a male, a female, a new gender), but even in that case this process of care should be inspired into the female model produced by natural evolution (Ruddick 1995).

Some thinkers even point out that at that moment lesbians could or should reclaim for themselves the ideal of motherhood and family (Calhoun 2003). This could be done obviously using a naturalistic and medical analysis of binomial mother-baby coupling, but without entering into the essentialist ideas found in ecofeminism, also embedded with a religious understanding of the human body (as something sacred and wise, but also idealized at the level of maternal behavior: in nature, several spider species practice matriphagy – babies eat their moms after the eclosion – or some spiders, such as *Pholcus phalangioides*, will prey on their own kind when food is scarce). For chimpanzees, motherhood can be possessive and aggressive with respect to their offspring (Troisi & D'Amato 1984). Natural motherhood has plenty of 'grades of grey'.

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https://nccd.cdc.gov/drh_art/rdPage.aspx?rdReport=DRH_ART.ClinicInfo&rdRequestForward=True&ClinicId=9999&ShowNational=1for a detailed account of such variables and USA data. Accessed March 31st, 2019.

[11] See the World Health Organization website: https://www.who.int/features/qa/preterm_babies/en/, accessed March 31st, 2019.

It is neither true that the loss of ancestors' lineage through ectogenesis (to whom would the baby's genetic data belong or is the company-brand in charge of the process?) would damage these babies, as Leon Richard Kass says (Kass 1979): Piraha tribe do not have numbers in their language and this affect their impossibility of having history as well as of lineage interest (Everett et al. 2005). Nevertheless, they have social bonds and are successfully solving complex human interactions without trauma. Finally, we cannot forget the universal existence of rites of passage related to birth as a fundamental aspect of human existence (Kay 1982; Seline & Stone 2009). Such rituals fulfill both an individual attribution of meaning as well as provide social reproductive structures. Hence, debates about ectogenesis should think about such rites that capture a fundamental social moment: birth. Humans do not see themselves as just "being produced", but the discourses about birth provide us a personal and untransferable meaning within a human group.

6. Final Conclusions

Ectogenesis is still far from being a reality but current techno-scientific advances give support to the feasibility of its future existence. The cultural and economic aspects behind the research justify a cautionary approach to the possible outcomes of such technology. The consequences can affect individuals such as the babies or the mothers, as well as the societies of our planet. If it is applied, our notions of parenthood, kinship, motherhood, humanity or natural will be completely transformed. In fact, some classic institutions like the family have already been critically affected by new informational pressure (Castells 2004). If current inequalities are just transferred to another level of complexity then the opportunity of changing things will be missed (again). If reproduction becomes male-centered, thanks to these techniques and some other still to be created[12], then this is a bad scenario.

We look at the arguments of (Godelier, 2011: 496): "assigning women, but also men, distinct tasks, undervaluing women's tasks and overvaluing men's, giving women a minor role in or excluding them from the rites supposed to reproduce the cosmos and life itself, excluding them, in sum, from access to the most spiritual powers[13], are all processes applied in every area of social life and which engender and continually increase the distance and the social inequality between men and women", and apply them to the new horizon of a world in which reproductive techniques are controlledby males or male-inspired human beings: the rich and specific bonds between humans can be completely changed, with a severe loss of the natural and instinctive connection between females are newborns.

On the other hand, all changes will release unexpected outcomes for which surely we do not have answers, yet. One thing is clear: medical safety for mind and bodies must be assured to the newborns. Not blocking precautionary principles should

[12] See the Dentsu nursing assistant for breast feeding, [http://www.dentsu.com/business/showcase/sxsw2019.html] (accessed March 31st, 2019), is an opportunity for co-parenting and feeding or a thread for women if men decide that it is a valuable and fundamental aspect with social recognition? Historical "female occupations" like nailing or cooking were then headed by men when they become artistic forms with huge economic revenues.

[13] She refers to political-religious powers that undervalued women's skills for the participation into the social action, summarized under the German motto "Kinder, Küche, Kirche" (Kids, Cooking, and Church), (Godelier, 2011: 497).

be applied here if enough lab evidence has been obtained. But common-sense applied to the most important aspect of our species, reproduction, is not an easy task.

Gestation is an intrinsically female capacity, a life and experience domain still reserved for women, where men have no access or presence in the first person, which leaves them in some way in a situation of disadvantage compared to women. From this point of view, it is easy to imagine that, in fact, the main interested ones on the existence of artificial uterus are men (as well as on strange devices for breastfeeding and the legalization of surrogates uterus for rent), because disassociating the gestation of the woman's body would be a break in the order of things that would serve them to conquer a vital space for mankind that has so far escaped control, to be under that of women. Taking into account the multiple attempts of male domination over intrinsically feminine processes, as has already happened with the control of pregnancy and childbirth through biomedicine, in the West, since the nineteenth century the obstetrics had passed to be in the hands of medical men, considered since then "experts", to the detriment of the historic role of the midwife. Consequently, it is not unreasonable to imagine that a generalization of the use of artificial uterus would directly result in kidnapping and the extinction of biological motherhood, in all its potential, since then under the domination of men, and no longer of women. This situation would clearly make male enhancement better for a process like gestation, but the same would not happen with women, who would have stolen a capacity and power that was just theirs.

Finally, from an evolutionary perspective, all living systems are still under evolutionary pressure, and therefore humans are not a final product but an ongoing project. In that sense, ectogenesis is a new possible step (not just a technique, because it implies a change of human reproductive paradigm) that goes beyond any essentialism and consequently will be blurred with genetic engineering, synthetic biology, robotics or artificial intelligence, the contemporary key aspects of our species organization. Humanity has become humanity thanks to our technical skillfulness: creating tools, machines, languages, ideas, heuristics or even successful social cohesive as moral gods (Purzycki 2016; Whitehouse et al. 2019). At the same time, we cannot uncritically trust future technologies because they are socially driven and, consequently, reflect specific values and interests that are far from neutral. There is not a historical arrow that forces us to accept ectogenesis. The technological dictatorship is also a cultural essentialism.

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