

bloodlines— Mammalian Motherhood, Biotechnologies and other Entanglements

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Abstract: *This paper outlines my current sculptural research project **bloodlines** focusing on the ways in which dairy cows are entangled with multiple biotechnologies and the wider environment. **bloodlines** brings extant works such as **fleshlumps**, **boobscape** and **slink**, together with new works, to represent the dairy industry, the environmental impacts of animal agriculture and the biotech innovations of in-vitro meat and bio-fabricated leather. These works are linked together by a web of interconnected fluids: excreta, milk and blood. In this new work, I hope to make the links between the dairy industry and these extended concerns both visceral and visible.*

Keywords: *Sculpture, Art, Diagrams, Dairy Cows, Motherhood, Mammals, Foetus, Foetal Bovine Serum, FBS, Biotechnology, Bio-fabricated leather, In-Vitro Meat*

This paper explores my current sculptural research project *bloodlines* (2018>), which investigates the entanglement of dairy cows with biotechnologies, and the increasing impact of dairy farming on our environment, and thus continues my work on the lives and deaths of dairy cattle. My work on the dairy industry was initially motivated by my research into the death of pregnant dairy cows and the sourcing of by-products (slink leather) and co-products (such as foetal blood) resulting in my series of latex mammalian bodies *slink* (2011>). Later the lives of dairy cattle and themes of mammalian motherhood and milking became the focus of the series *boobscape* (2016>). My artwork focuses on those things we share with fellow creatures, and our mammalian kin, from anatomical and biological similarities such as flesh and skin, to our fear, pain, birth, death and social and emotional bonds.

bloodlines commenced when I was researching the use of cellular technology in the production of in-vitro meat and bio-fabricated leather. *bloodlines* is a multifaceted and sprawling project that brings together extant and future sculptural works, indicated in this paper with preliminary drawings and examples. Whilst this paper outlines some of the many components of *bloodlines* it takes as its key focus the collection and use of foetal bovine serum. Cellular technologies such as in vitro meat and bio-fabricated leather have, to date, been reliant on foetal bovine serum (FBS) as a growth medium for mammalian cells taken from donor animals. FBS is sourced from the blood of foetal calves, and the ‘culling’ of pregnant dairy cows is one source of FBS.

As I reviewed the regulations and policies around the slaughter of pregnant cows and the methods of collection of foetal co-products, and attempted to keep abreast of the fast-moving developments in the biotechnology industries, I started to map out the information visually. I used diagrams to set out the connections between the various industries, the bodies and the lives. Diagrams are a method of using symbolic representation to convey information visually. A diagram separates something into component parts and indicates the relationships between them. Diagrams explain, elucidate, make clear, but they also obscure. Some diagrams incorporate a logic of concealment, for example, diagrams that outline the process to make in vitro meat or bio-fabricated leather depict the donor animal as a decontextualized source object, an object from which cells are procured, one object amongst many in the workflow to create in vitro meat. What these diagrams leave out is what interests me, for example, the bodily specifics of the donor cow, their lives, the conditions they live in, the process to extract cells from their

bodies. *bloodlines* plays with the idea of the diagram, linking bodies and products through fluid-lines representing blood, milk and excreta, all the while focusing on making animal bodies visible and visceral.

Recognising the relevance of my existing sculptural works, I incorporated these into the project, continuing my sculptural methodology of re-using, re-forming, re-remembering sculptural bodies, and the iterative nature of my artwork, which sees no project reach an endpoint. In addition, further entanglements between the dairy industry and the environment, such as the impact of antibiotics and nutrient leaching on our soils and waters merged into this project. The *bloodlines* project has emerged as a speculative sculptural diagram (fig. 1) interconnecting and entangling the dairy industry with the death of foetal calves, the production of bio-fabricated products and wider environmental issues.

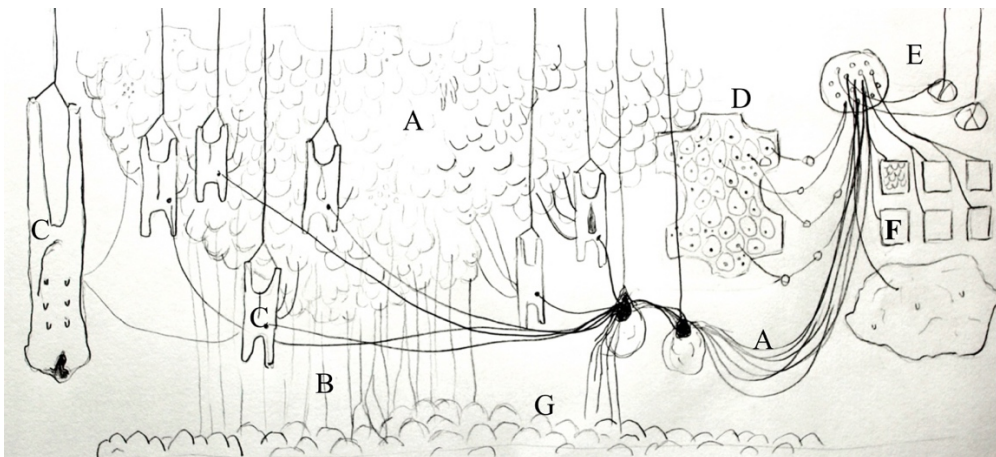


Fig. 1 Sketch for *bloodlines*, 2018.

bloodlines places the mother – and more specifically the maternal dairy cow – in the central position of the diagram (fig.1 A) through the wall installation of the work *boobscape*, (see fig 2). *boobscape* (2016>) uses the suffix -scape to denote a wide or extensive view, and reflects my broad investigation into lactation, mammaries and interconnected human and non-human histories of motherhood and milk.



Fig. 2 boobscape, 2016-18, Latex, tissue and string. Photo: Kerry Leonard.

boobscape started with udders and teats, but quickly transgressed species boundaries with udders blurring into breasts and teats blurring into nipples pointing to our shared mammalian homologies and interconnected histories. Mammary glands and milk have connected humans with other species since Linnaeus introduced the term ‘Mammalia’ in *Systema nature* (1735) as a class in which the females of the species have mammary glands, adopted in English as ‘mammals’ (Schiebinger 188-9). Histories of wet-nursing entangle multi-species mammalian bodies; animals have and continue to provide nursing milk for human babies. Humans are also known to breastfeed animals, however, these entanglements are rarely utopic encounters, as Simoons and Baldwin found when humans suckle other species, human needs almost always supersede the animal’s needs, and affection is ‘supplemented or supplanted by economic concerns’ (Simoons 435). In Western cultures interspecies suckling, or adults drinking human breast milk, or drinking milk from non-normative sources (like dogs) are often sites of taboo, disgust, myth and social humour. Even breast-feeding in public generates complex reactions, with recent psychological research suggesting that negative reactions to breast-feeding in public are based

upon threats associated with human creatureliness, that is to say breast-feeding reminds us that we too are animals (Cox).

The blurred boundaries of the mammalian breasts/udders (see fig.3) not only speak to these histories of interspecies suckling but also of current biotechnological research. Aims to reproduce and market the qualities of human milk have led to experimentation with transgenic cows, and while it was possible in the 1980s to say that the ‘chemical and immunological characteristics of milk were highly species specific, so that attempts to “humanise” ruminant milks were something of a biochemical nonsense’ (Cowie 228), advances in biotechnology have changed this. In 2011, news proliferated about the Chinese led research that had created human milk through cows. Scientists used somatic cell nuclear transfer, to introduce human proteins into the DNA of Holstein cattle embryos, which were then implanted into surrogate cows (Yang). Cows are now positioned as ‘bioreactors’ for the development of human milk; ‘using the mammary gland bioreactor system of dairy cows provides not only a good way to produce rHLZ but also a way to transfer the benefits of human milk to cow milk’ (Yang). Transgenic cows are renamed ‘biofactories’; their bodies’ positioned as factories for the new bio-farming/bio-pharming industry, producing human milk or other therapeutic resources, and these words start normalising these technologies, and obscuring the animals’ lives.



Fig. 3 detail boobscape (2016-18). Latex, tissue and string.

The multiplicity of leaking udders and teats in *boobscape* illuminate the industry's focus on the animal's economic productivity and udder health. Small supernumerary teats grow in stages into larger engorged breasts, indicating the continuous line of animal production from insemination, selection, milking, then finally to the slaughterhouse. Masses of breasts cluster, forced together like some futuristic milking machine, with milky threads leaking from the nipples/teats. The skin around the nipple/teat is thickened and ridged with bulging veins and stretched torn tissue to evoke the pain and effect of mastitis (see fig.4).



Fig. 4 detail *boobscape* (2016-18). Latex, tissue and string.

Mastitis is an infection of the mammary gland, and as cows age their propensity for mastitis increases. The mastitis pathogen enters the mammary gland through the epithelial cells. The inverted *boobscape* casts (see fig. 5) alludes to these epithelial cells, the inverted breasts resembling cells pushing together, the nipple/teat resemble the cell nucleus. It is the mammary epithelial cell which initiates the cow's immune response to the mastitis pathogen.



Fig. 5 detail boobscape (2016-18). Latex, tissue and string.

Mastitis leads to tissue damage and a decrease in milk quality; including higher somatic cell content, the possibility of pathogenic bacteria and contamination by medication. Affected milk needs to be collected separately and disposed of. Milk is a pollutant 100 times more powerful than dairy shed effluent. It must not be discharged into waterways as the fatty acids in dairy products can lead to eutrophication (Ag Vic). Mastitis is also one of the leading causes of antibiotic use in dairy farming (FAO). Cows get a break from milk production during the last fifty to sixty days of their next pregnancy. This is called the drying off period and it allows the farmer to treat mammary infections and for the udder and teats to recover from repetitive milking. During the dry phase, cows are routinely given preventative treatments of penicillins, cephalosporins, or other beta-lactam drugs (Oliver). The large-scale use of antibiotics in agricultural animals is an act of slow violence (Nixon) to other species. Transferred via urine and dung, antibacterials leach into the earth, remaining biologically active, and could have profound effects on aquatic and terrestrial ecosystems (ARLS; Zhou; Suzuki). In *bloodlines* the ecological effects of these liquid leakages are indicated by the spill of milk and excreta lines from the breasts of *boobscape* (see fig. 1, B), flowing down to the floor and spilling over sculptural anemone and fungal forms, the inclusion of these forms are addressed later in this paper.

Dairy cows are completely entangled in agricultural biotechnologies: they are managed from their conception through to their death, in order to procure a cheap and regular supply of cow's milk. Traditional dairy farms are being replaced by intensive dairy farming, where cows are kept indoors and their feed is manipulated. There are no opportunities to graze, and the

cows can spend their lives on concrete floors, which along with the weight and size of their engorged udders, causes lameness and hoof problems. The increasing intensity of dairy farming is contributing to 'metabolic disorders and other health and welfare deficiencies' (More 73). Selective breeding has massively increased the production capacity of udders, and milking only once or twice a day puts great strain on the muscle and tissue of the udder. Milk making is physically hard work, and dairy cows are expected to produce milk for up to ten months of the year, depleting the body of minerals and nutrients.

Dairy cows are sent to slaughter pregnant due to lameness, mastitis, decreased productivity and 'old age'. They are also sent to slaughter for economic reasons such as low milk prices and farm management reasons, for example lactating at different production times. It is also common in intensive farms to inseminate the entire herd of dairy cows then send them to slaughter when convenient (More 73). Some cows are inseminated simply to make them more manageable on the farm through the reduction of oestrus behaviours:

[a]nimals may also be made pregnant, despite the intention for subsequent slaughter, to modify their behavioural characteristics in ways desirable for the duration of their period on the farm. This is most commonly seen in the case of dairy cattle. (More 18)

The worn out slaughtered pregnant body of the dairy cow is included in *bloodlines* by the large adultforms in my series *slink* (see centre figure in fig. 6). Created in thickened latex, with multiple teats and some embedded hair, this was my first sculptural form that combined the characteristics of both human and non-human animals, as an attempt to overcome mammalian hierarchies. This work formed part of the series *slink* (2011>) which responded to witnessing, through visual and textual forms, the death of pregnant cows and the collection of by-products, such as FBS and slink leather from foetal bodies (mowson). In the agricultural industry the word *slink* is used to refer to the foetal body removed from the mother in the slaughterhouse, the *slink room* is where foetuses are processed for foetal blood. *Slink* is also the term for the unblemished skin of the foetal body, which is highly desirable for luxury leather items.



Fig. 6 detail slink (2012-14), latex, tissue and string. Photo: Kerry Leonard.

The multiple foetal bodies were represented through little latex ‘bodysuits’, the latex cast is both fragile and translucent, alluding to aged vellum and membranes. The method used to kill a foetal calf is dependent upon whether or not bioactive co-products are to be collected from its body. There is a range of methods for collecting foetal blood. Flow Laboratories Pty Ltd, an Australian company that started collecting foetal blood in the 1960s established what they called the ‘Flow method – direct cardiac puncture’ (Gaynor 139). In Australia to process foetal bodies abattoir workers undertake the unit currently titled AMPA2153 ‘Process slink by-products’, which is part of the Australian Meat Processing Training Package. The ‘Flow method’ remains current practice in Australia, the aim is to collect the foetal blood as soon as possible, while the foetal heart is still beating, to clean the injection site of any mucus or amniotic fluids, puncture the needle directly into the heart and use a vacuum to suck the blood into collection bottles. The

Flow method states that direct cardiac puncture produces the maximum yield of blood from the foetal body and allows the abattoir to bleed up to 8 slinks at a time.

There are various sac like forms in *slink* that were made in response to global guidelines that recommend foetal calves be prevented from taking a breath or inflating their lungs (OIE). This is done by placing the amniotic sac or a plastic bag over their heads, or by clamping their trachea. Taking a first breath means that the calf's brain becomes oxygenated and this is considered to contribute to the ability to feel pain (More), additionally a breathing calf is re-categorised as 'live' stock and therefore subject to different regulations for the method of their death. When the abattoir is not collecting foetal bio-actives the recommendations are to leave the foetus in the mother's unopened uterus until they are dead, which is approximately 20-30 minutes after their mother is killed. If they emerge from the mother's body alive at this point they are to be killed with a captive bolt or 'blow to the head with a suitable blunt instrument' (OIE).

The 2017 Consensus Report from the Third Workshop into the Replacement of FBS noted that there remains a regulatory gap in relation to foetal animals in the current codes for the slaughter of livestock animals. Whereas the treatment of foetal animals is directly covered in scientific use, the EU Directive No 2010/63EU 'On the Protection of Animals for Scientific Purposes', determined that:

there is scientific evidence showing that such forms in the last third of the period of their development are at an increased risk of experiencing pain, suffering and distress, ... [s]cientific evidence also shows that procedures carried out on embryonic and foetal forms at an earlier stage of development could result in pain, suffering, distress. (Valk 3)

Foetuses used for foetal blood are not included in the Scientific Directive, they are categorised as agricultural livestock and hence unprotected by these regulations, despite the argument that FBS is directly implicated in scientific research (Valk, 3). There have been sustained attempts to replace the use of FBS with serum-free cell culture media, with the main arguments being the unreliable quality of FBS, the unregulated and almost opaque market that has repeatedly fraudulently misrepresented the product (Valk 4), as well as the arguments for animal welfare concerns (Valk; Brindley). There is a high demand for the co-products of

pregnant cows, it is estimated, based on industry figures, that approximately 800,000 litres of FBS are produced annually which equates to approximately 2 million fetuses being harvested globally (Valk 2). Biotechnology industries face increasing challenges getting access to these raw materials; the price is high, the supply is 'accidental', and the quality of FBS is variable. Brindley et al state: 'Without a sustainable supply or viable alternatives to these components, the commercial-scale production of cell therapies will be impossible, halting the momentum of the industry' (7). Further they suggest that it will in fact be the shortage of supply and the high cost of FBS, not regulatory pressures that will actually force the scientific community to develop and use other alternatives (Brindley 10).

A further pressure on the supply of FBS is the emergent in vitro meat (IVM) and bio-fabricated leather industries. FBS is, currently, an integral growth medium for the IVM industry. The process to create IVM requires extracting or harvesting cells by biopsy from a donor animal; these cells are then bathed in a growth medium, a liquid that contains nutrients and a percentage of FBS. It can take around 50 litres of FBS to produce a single burger (Reynolds), which equates approximately 150 foetal calves. Since Mark Post from Maastricht University presented the 'meat' burger in 2013 using in vitro technology, the industry has captured the public imagination and the investment dollars. There are now multiple start-up companies experimenting with beef, pork, seafood, gelatine and eggs. Even meat producers are getting into the action; Tyson Foods and Cargill, the 'two top meat producers in the world', are investing heavily in this new technology (Chatsko). The scarcity of FBS and resulting high prices has led Meat and Livestock Australia (MLA) to investigate the possibility of improving the collection of foetal blood. One report estimated that in 2006 10-20% of cows were sent to slaughter pregnant, equalling approximately 290,000 cows, with a possible collection value of 580,000kg of blood, of which only 30% was actually collected (O'Grady 9). The report also identified the market value in collecting additional bioactive materials such as placental tissue (this term can include the uterus and the slink), alongside the foetal blood (O'Grady, 18). One of the key factors affecting the stability of supply was found to be the fact that farmers report receiving little or no financial incentive to supply pregnant animals (Brindley et al 10). The MLA report stated that the difficulty of supply could be easily resolved through offering a higher price for pregnant cattle:

if growers knew they could obtain better prices for pregnant animals they would most certainly supply them. This occurred on a small scale when the foetal blood prices were at their highest and some growers were offered 10% premiums for ‘pretested’ cull cows in 2004. (O’Grady 9)

However, industry leader Mark Post has noted there is not enough serum in the world to grow the cells for the mass production of IVM; alternative serums need to be found (Ireland). Although, to date, despite significant scientific effort, this search has not resulted in any significant alternatives being developed to market.

FBS also plays a significant role in the meat language/naming wars that have already commenced around the possible introduction of IVM. In Australia ‘Meat’ is defined as ‘the whole or part of the carcass if slaughtered’ of ‘any animal’. As researcher Dr Hope Johnson has pointed out, ironically IVM that is cultured using FBS would actually fit this term, being derived from part of a slaughtered animal, although it could not simultaneously be termed ‘victimless meat’ (Johnson). In February of this year, the US Cattlemen’s Association filed a petition to the US government that took a two-pronged approach, arguing that plant based or insect based meats should not be able to use the term ‘meat’, and that IVM should not be allowed to use the term ‘beef’ which should only be applied to those bovine animals ‘born, raised and harvested in the traditional manner’. ‘Traditional’ however has not been defined, leaving it open to critique; are artificial insemination, large scale feedlots and industrialised abattoirs ‘traditional’?

IVM is widely heralded as potentially replacing the large-scale slaughter of animals. Bhat and Fayaz argue that IVM offers potential health and environmental benefits, and the opportunity to reduce animal suffering significantly. The authors propose, somewhat optimistically, that potentially a ‘single farm animal may be used’ for the collection of cells. Cellular technologies, including IVM, and some bio-fabricated leathers, currently by necessity require the collection of cells by biopsy from donor animals. IVM harvests muscle cells, and bio-fabricated materials utilise a range of collagen-producing cells, including epithelial cells. Whilst animals will not need to be killed to harvest cells, the numbers and living conditions of the donor animals are rarely discussed. As researchers Adrianna Ferrari and Andreas Lösch have argued: ‘[t]he topic of human-animal relationships in a future world with IVM [in vitro meat] is rather seldom part of the message of innovators who prefer to focus mainly on the advantages’

(82). So while IVM is situated as a solution to intensive animal agriculture and its damaging environmental effects, it continues to rely upon the use of the animal body. Instead of directing attention towards alternative plant-based possibilities, IVM works within the anthropocentric ideology that considers other animals' bodies as resources and products. It is an approach that does not question the necessity to eat meat, but rather directs enormous resources towards facilitating this 'need'.

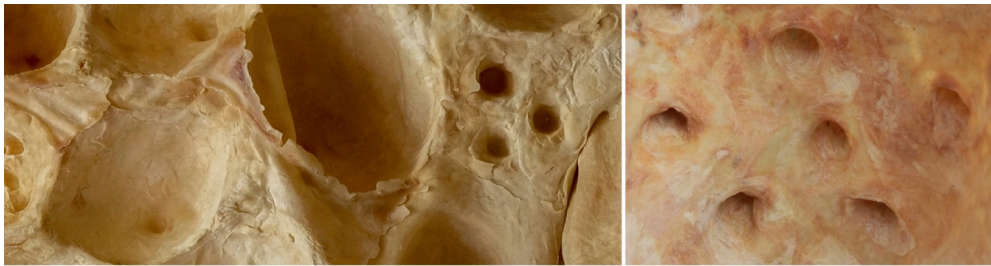


Fig. 7 inverted cast of boobscape

While I celebrate innovations to significantly reduce the number of animals suffering for research and food, in *bloodlines* I also keep the focus on the bodies of donor animals and the current reliance on FBS and its source (the bodies of pregnant cows and their foetuses). I use the inverted casts (see fig. 7) to represent the harvesting of cells from the body of donor animals. The multiple supernumerary teats around the breasts when inverted create the effect of multiple puncture marks, operating as a testimonial representation of the body of donor animals subjected to multiple procedures.

The biopsy samples required for both IVM and some bio-fabricated leathers are to be represented by small fleshy lumps created in pigmented microcrystalline wax (indicated here by the example of *wearable fleshlumps*, see fig. 8). The small waxy fleshy biopsy samples will be linked, by bloodlines, to the donor skin (see fig. 1, D), creating the visual link to the source donor body. At this stage I envisage that a number of tissue/muscle samples will also be centrally placed in a container, into which bloodlines, representing the nutrient FBS will flow (see fig. 1 E). The FBS will be traced to the chest of the *slink* foetal bodies, linking the origin of FBS, the foetal blood, to the heart of the foetal calf.



Fig. 8 wearable fleshlumps, 2017

Included in *bloodlines* will also be a number of new works representing hypothetical IVM products and bio-fabricated leather samples. For the IVM samples I will consume and remember existing artworks, using this methodology specifically to embed the meaning and body of one work into another. For example, my fleshy lumps for the performance sculpture *speaking meat* (see fig. 8) were butchered from the thigh, shoulder and buttock of a sculpture of pregnant mammalian form. Using flesh lumps also derived from the pregnant form, I plan to decompose and reform these body parts into mince and strange ‘meaty’ shapes, alluding to the fact that there is absolutely no necessity for IVM to visually mimic meaty structures.



Fig. 9 speaking meat project, 2016 ongoing. Microcrystalline wax and pigment.

For the bio-fabricated leather I will continue to use my latex skin technique to create multiple skin samples (see fig.1 F). Some of the skin samples will focus on the animal body, the bodies that currently provide leather, such as the slink skins. These skins will also include the teats, nipples, brands and scars that are usually the wastage for the leather industry, disrupting the bland neutrality of leather surfaces. Other samples will play with possible futures of bio-fabricated leathers, along the lines of those included in current bio-fabrication patent documents. For example Modern Meadow, innovators of biofabricated materials, have lodged patent application WO2013149083A1 which includes the fabrication of skin patterns such as: ‘dragon, unicorn, griffin, siren, phoenix [sic], sphinx, Cyclops, satyr, Medusa, Pegasus, Cerberus, Typhoeus, gorgon, charybdis, empusa, chimera, minotaur, cetus, hydra, centaur, fairy, mermaid, Loch Ness monster, sasquatch, thunderbird [sic], yeti, chupacabra, and a combination thereof’ (Modern Meadow).

And finally, in this proposed sculptural installation, tangled with the spilling milk and excreta lines, the floor beneath *boobscape* will be littered with upturned breast/udders (see fig. 10) (see fig. 1, G) to allude to the entanglement of other species with the dairy industry and biotechnologies. The upturned forms resemble sea anemones, the strange carnivorous half-plant half-animal creature, in fact, some of the breast surfaces in *boobscape* were modelled upon the wrinkled surface of anemones clinging to piers at low tide. Some sea anemones, such as the *cribrinopsis olegi*, cluster in strange circular shapes, resembling clusters of breasts beneath the waters. The upturned breasts are also a reference to the clustering growth patterns of fungi, and the fairy rings that would mysteriously appear in woodlands in my childhood, the fungus *Clitocybe nebularis*.



Fig.10 work in progress. Latex, tissue and string.

When placed on the floor these breast clusters nod to these wondrous sea and land based organisms, and the ecosystems affected by the leaky fluids, the milk run off, the anti-bacterials, effluent and excess nutrients that cause eutrophication in waterways and coastal ecosystems. Other species are also entangled in IVM and bio-fabrication technologies, as the recent special edition of Paul Schapiro's book *Clean Meat* demonstrated. The edition was bound in bio-fabricated leather and sold for US\$12,790, and whilst this bio-fabricated leather was marketed as 'animal-free', the material was actually made from jellyfish collagen (Hugo), Jellyfish belong to the phylum Cnidaria, like anemones and coral, which is part of the animal kingdom.

Thus *bloodlines* presents an extended view of the connections between the dairy cow, the dairy industry, the foetal calf, the slaughterhouse, the FBS industry, the newly emergent biotechnology industries such as IVM and bio-fabricated leather, agricultural pollution and eutrophication. In bringing together artworks that have focused on different elements of the dairy and meat industries, alongside new works, a 'diagram' develops of industry interconnections and dependencies. A 'diagram' that puts central focus on the bodies of animals entangled in these industries, to be experienced viscerally through sculptural renderings of fluids, flesh and skin.

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