Richie Nimmo

The Bio-Politics of Bees: Industrial Farming and Colony Collapse Disorder

> You will probably more than once have seen her fluttering about the bushes, in a deserted corner of your garden, without realising that you were carelessly watching the venerable ancestor to whom we probably owe most of our flowers and fruits (for it is actually estimated that more than a hundred thousand varieties of plants would disappear if the bees did not visit them), and possibly even our civilisation, for in these mysteries all things intertwine. — Maurice Maeterlink, *The Life of the Bee* (1901): 317-18

Honeybees and "Colony Collapse Disorder." Many have argued that human and nonhuman animals share profoundly entangled genealogies and histories of co-evolution (Haraway; Shepard). This is certainly true of humans and honeybees, which have been intimately intertwined for much of human history. There are many species of bees, but *Apis Mellifera* or the "western honeybee," in particular, has been an immensely significant presence — particularly in western societies — at least since ancient Egypt (Preston 8, 32; Wilson 1). Humans have shaped and reshaped honeybees, especially in the modern era, through selective breeding, intercontinental transportation, and changing beekeeping practices; but bees have shaped human societies perhaps more profoundly, having played highly significant roles in human food production and material culture, as reflected in the exceptionally rich cultural history of apian discourse, folklore, and symbolism (Ransome; Wilson). Honeybees have also been important actors in world-historical events such as the European colonial settling of the Americas, which for the Native Americans was synonymous with the relentless westward spread of "the white man's fly," the honeybee (Ransome 272). Prior to the emergence of the international trade in sugar and the dramatic reduction in its cost in the first half of the 19th century, honeybees were the source of the primary sweetener in the European diet (Wilson 160, 161, 165). Meanwhile mead — made from fermented honey — was the staple alcoholic beverage for all but the most affluent, being much cheaper than imported wine, which was the main alternative (Preston 31; Wilson 156-160). Beeswax, with its unusually high melting point, was vitally important for making candles, a key source of artificial light in the pre-industrial age. Although today the importance of candles has been diminished by electricity, beeswax is still used as an ingredient in products as diverse as polishes, electrical transducers,

and cosmetics, while honey continues to be a significant commodity and is now marketed as a "natural" and "healthy" alternative to sugar (Preston 48-49, 97). Far more important than beeswax and honey production, though, is the pivotal role of bees as vectors in plant pollination.

Though other species such as bumblebees also contribute to pollination, honeybees are particularly industrious pollinators. It is estimated that at least a third of the food consumed globally by humans depends directly upon insect-pollinated plants, and that another third relies upon insect-pollinated crops at some stage in its production, with honeybees making by far the greatest contribution (Buchmann and Nabham). This makes honeybees a vital part of the agricultural economy, with the annual monetary value of their "pollination services" running into hundreds of billions of dollars (Gallai, Salles, Settele et al.). Underpinning their agro-economic importance is the role of bees as key agents of ecosystem fertility, which would be dramatically curtailed without their constant labor. Einstein is often reputed to have said that if bees were to disappear from the Earth, then humans would have only 4 years left (Benjamin and McCallum 7). The veracity of this attribution is very doubtful, but its persistence since the middle of the twentieth century underlines the popularity of the notion that bees serve as something like a canary in the coalmine for the overall health of the eco-system. This is not a baseless idea, as few species are quite so sensitively calibrated to their environment as bees, as indicated by the use of the substances that accumulate in their pollen and nectar as a key measure of environmental pollutants in "bio-monitoring" projects (Stone). This in turn helps to explain why the rapid decline in honeybees has caused such alarm, not only amongst apiarists and entomologists, but also among environmentalists, governments, and scientific institutions. As Claire Preston elegantly puts it:

> Bees stand for the difference between the life and death of our species and of our planet, as agricultural pollinators, as producers of food and light, as handmaidens of the wild vegetation without which our landscapes would be eroded, barren and empty of wildlife, and by whose efforts our soil is fertile. (163-165)

The term "Colony Collapse Disorder" was first coined in January 2007 in a report by a working group at Pennsylvania State University engaged in researching the causes of a spate of particularly dramatic honeybee losses amongst US beekeepers that autumn (Cox-Foster, Frazier, Ostiguy et al.). It was intended to refer to the phenomenon of sudden, dramatic, and unexplained losses of honeybee colonies, in many cases involving the overnight disappearance of vast numbers of bees with hardly a trace. The

apocalyptic overtones of the new term caught the public imagination and quickly became ubiquitous in media reports, firstly in the US and then worldwide, so that CCD came to be widely perceived as a new, unprecedented, and urgent crisis not only of honeybees but of pollination itself, and therefore of agriculture and food production (Williams, Tarpy, vanEngelsdorp et al.). In fact, it is doubtful whether CCD was as new and unheralded a phenomenon as was widely assumed; though colony losses in the US showed a marked acceleration from 2006-7, many beekeepers in France had become convinced a decade earlier that the worsening trend of honeybee losses already observable at that time was linked to the introduction of "Gaucho." This is a brand name for products manufactured by the German agrochemical company Bayer containing Imidacloprid — amongst the most widely used of the class of systemic pesticides known as neonicotinoids (Jacobsen 90-93). The decade-long struggle of French beekeepers against neonicotinoids was effectively internationalized by the surge in publicity surrounding the appearance in the US in 2006-7 of what began to be called "Colony Collapse Disorder."

CCD has since been at the center of a fierce international debate among beekeepers, farmers, pesticide companies, green groups, and entomologists, with different interested parties preferring different potential explanations for the collapse in bee numbers. Candidates for a cause include: the rapid global proliferation of the parasitic Varroa mite and associated viruses introduced into previously unexposed and therefore highly vulnerable honeybee populations by migratory beekeeping and the transcontinental trade in bees; loss of genetic diversity due to the poor breeding practices perpetuated by some commercial breeders and the crowding-out of native pollinators; intensive use of honeybees in commercial migratory pollination involving the long-distance transportation of bees and leading to intolerable stresses on the species; the effects of the increasingly frequent unseasonal weather associated with climate change on the reproductive and foraging cycles of bee colonies; and changing agricultural landscapes involving the loss of areas of diverse flora, such as the wildflower meadows vital in sustaining native bee populations (vanEngelsdorp, Evans, Saegerman, et al.; Williams, Tarpy, vanEnglesdorp, et al. 846). So far none of these has emerged as an exclusive or undisputed causal explanation for CCD, and there is a growing view among entomologists that all or many of these factors in complex interaction are likely to be contributors to the phenomenon (Neumann & Carreck 1-6).

The case against neonicotinoids as a likely principal cause was nevertheless deemed sufficiently compelling for the European Union to impose a moratorium on the use of neonicotinoid pesticides for two years from April 2013, pending further research into their effects (EU Regulation 485/2013). This was the culmination of more than a decade of campaigning by French beekeepers together with an array of assorted environmental organizations from across the EU and beyond, who are convinced that neonicotinoids are the primary cause of the rapid decline in honeybee colonies seen around the world since at least the 1990s, and accelerating since 2006-7. Although the moratorium was a significant victory for the beekeepers and their allies, it is set to expire in December 2015 and has already been subjected to vigorous legal challenge by pesticide companies, with the scientific evidence on both sides being fiercely and continuously contested (Maxim & van der Sluijs; Schmuck). Colony Collapse Disorder then constitutes an animal-technocultural assemblage of formidable complexity, surrounded by considerable controversy.

An Animal-Industrial Complex? A promising approach to such assemblages might be derived from the work of scholars in the tradition of critical animal studies, who have developed and applied the concept of the "animal-industrial complex" (Noske 22-39; Adams; Twine). This emphasizes the political-economic processes that underpin changing organizational forms, technologies, and practices in industrialized farming or "agribusiness," enabling transformations in human-animal-technological assemblages to be grasped critically as moments of wider structural relations. From this perspective, as Barbara Noske puts it, "What is really taking place is an ever-increasing interpenetration of agriculture, advanced technology, banking interests and government institutions" (23). A sometimes submerged yet significant current in such critical animal studies work is a strand of liberationist thinking on human-animal relations that regards all human relations with domesticated animals as by definition relations of ownership, domination, and exploitation, which vary only in the degree of mastery or control exercised over the animal (Clutton-Brock). The concept of the "animal-industrial complex" builds upon this "control model" (Hurn 58-59) and extends its logic into the critical analysis of agribusiness, focusing in particular upon the structural transformation of animal farming since the mid-20th century. Thus political-economic processes of concentration and monopolization are shown to be intrinsically connected to the development of ever more rationalized and intensive "livestock" systems (Winders and Nibert).

Conceptions of the animal-industrial complex have been informed by Marxist, feminist, and, to a lesser extent, Foucauldian theory concerning the interface between the

economic, the political, and the technological. Thus technology is conceived as a materialization and mediation of social relations, most crucially relations of power and domination. Numerous scholars have shown how critical theories of capitalist and disciplinary technologies need not be restricted to the analysis of relations between human beings, but are highly applicable to the intensive animal production systems characteristic of contemporary agribusiness. From hog production in intensive confinement systems (Novek), to computerized and mechanized dairy production (Holloway; Stewart et al.), to mechanized and automated slaughter (Adams 62-63), the role of technology in industrialized animal agriculture is grasped as a means to enable ever more precise and totalizing control over the animal's body and its bodily activity in the interests of increased productivity, efficiency, and profitability. The apparatus of intensive animal production systems can thus be understood as assemblages of disciplinary technologies geared toward the production of "docile" and "productive" nonhuman bodies. There are indeed striking parallels between the control systems of industrial animal farming and the logic of Taylorism and scientific management as strategies of increasing control over the laboring human body within capitalist production processes in order to facilitate higher rates of exploitation. Barbara Noske points out that the constant objective is to eliminate as "wasteful" every aspect of the animal's activity which does not materially contribute to an economically valorized output:

> The animal's natural capacity for movement, play, preening, social interaction and contact with the natural environment is almost felt to be subversive: much animal behaviour is referred to as "unbusinesslike". Like the human worker's creativity it has to be kept under control, or better still, done away with. All animal activity must be directed towards cheap and rapid production of human-wanted things. (15)

The model for such intensive animal production systems and the clearest expression of their logic is often taken to be the slaughterhouse. It is significant that Henry Ford obtained the idea for his assembly line method of production from a visit to the slaughterhouses of Chicago, where he observed the progressive dismemberment of animal carcasses in a series of distinct operations, carried out by workers who remained stationary whilst the carcasses were moved from one operation to the next via a system of aerial hooks. Ford's innovation was to grasp this as a "disassembly line" and reverse its logic in what became the assembly line model of mass automobile production

(Adams 63; Rifkin 119-120). Carol Adams suggests that this historical intersection of animal slaughter and capitalist production is not just historical but structural, arguing that "[t]he dismemberment of the human body is not so much a construct of modern capitalism as modern capitalism is a construct built on dismemberment and fragmentation" (64). In the slaughterhouse this process of fragmentation is fundamentally a process of transforming living subjects into economically valorized objects.

Even where the actual death of the animal is not the primary output or product of the industrial process, as in intensive egg or milk production for example, the process can still be grasped as one of objectification and de-animalization, in which the specific, irreducible, and qualitative animal is made absent, rendered non-specific and fungible, a living object, an organic machine, not unlike the clockwork creatures of Descartes's mechanistic materialism. Central to this transformation is the work of translating the animal subject into a series of quantitative measures. As Hugo Reinert puts it:

> Within the agroindustrial processing apparatus, distinguishing traits for these "living objects" are given as measurable: processed animals are specified in terms of quantifiable attributes such as age, gender, size, lifespan, growth rate, feed-to-weight rations, fertility, offspring survival rates, productivity and meat yield. (46)

Critical animal studies approaches are thus underpinned by a trenchant critique of objectification, reflecting a widespread tendency to ground the critique of particular forms of human-animal relations in an ethico-political affirmation of the subjectivity of nonhuman animals as conscious, social, and minded individuals (Arluke and Sanders 42-48; Irvine). As a critical strategy this undoubtedly has many strengths, not least that it is able to draw upon the rhetorical power of a potent blend of animal rights discourse with feminist critiques of objectification and Marxist critiques of alienation and exploitation, all of which presuppose an affirmation of the subject. But this approach loses much of its cogency when the animals in question are quintessentially collective in their species-being, in their whole mode of existence, and when an assertion of the subject status of individual animals cannot therefore hold as the persuasive center of critique, and begins to look inappropriately anthropomorphic or even Neo-Cartesian (Plumwood 152-153).

Any critique of apiculture rooted in a condemnation of the objectification of bees means understanding bees as subjects in the first place, equivalent in essence to cows, sheep,

pigs, and indeed humans. This would seem risible to many, and not in this instance due to any knee-jerk anthropocentrism, but because it neglects the biosocial specificity of *Apis Mellifera* in an attempt to assimilate the species to a ready-made critique conceived almost entirely in reference to vertebrates, and predominantly mammals. It is not of course that honeybees are unique in being social creatures — many mammalian and non-mammalian species are social, and just as with humans this does not rule out acknowledging their individual subjectivity, which is intimately bound up with their social existence and not the opposite. But the sociality of bees is qualitatively different, consisting not of subject relations between anatomically similar individuals, but of the sort of absolute biologically embedded collectivism that has led to serious scientific propositions concerning the validity of understanding bees as "super-organisms," that is, where the colony itself is considered the organism rather than the individual bees it comprises (Tautz), as well as centuries of cultural imaginings concerning the nature of "bee politics" and apian social organization (Wilson 106-139).

A proverb once popular amongst beekeepers has it that "one bee is no bee," which nicely sums up the highly asymmetrical relationship between the individual and the collective that is present in what are technically known as "eusocial" insects. Eusociality is the "highest" — or most thoroughly social — form of sociality recognized by sociobiologists and others who study nonhuman social organization. It is relatively rare, with most social animals exhibiting a lesser degree of sociality. Eusociality is defined by several characteristics, including: socialized care for offspring, or cooperative "brood care," such that care for the offspring of other individuals is the norm; the co-existence of multiple generations of adults within a colony; and a division of labor between specialized behavioral groups or "castes." A particularly distinctive aspect of eusociality is that individuals in one caste will lose one or more of the biological capacities of the individuals in another caste during their development, so that the social division of labor is effectively "fixed" in the differentiated anatomical development of the component individuals, such that the interdependence of the various groups comprising the colony is absolute.

Similarly with honeybees the two sexes are not born but "made" according to the needs of the colony. The queen is produced by the workers through the feeding of high quantities of royal jelly to a selected larva, and thus becomes far larger than the other bees and the only reproductively viable female in the colony. The queen and colony are then able collectively to determine the proportion of female workers and male drones

amongst the brood, depending upon the age of the current queen; the female workers develop from fertilized eggs whereas the male drones develop from unfertilized eggs and are also fed differently by the workers. Drones do not forage, make honey, or participate in the maintenance of the hive, their sole function being to mate with a new queen in the event of the colony swarming. The female worker bees perform the entire labor of the colony and are differentiated into age-based castes with different roles, including: brood-care and feeding; maintenance of the hive including honeycomb construction and clearing out dead bees and any failed larvae; attending to the queen; carrying water into the colony to help to maintain the right temperature; making and storing honey; guarding against invaders; and finally foraging for pollen to feed to the larvae and nectar to turn into honey. Thus honeybee colonies manifest remarkably complex social organization, which is accomplished not by large individual brains but by biochemical mechanisms such as differential pheromone secretion to distinguish one caste from another; hence all of the complexity remains at the collective level, the individuals being mere instruments of the collective intelligence of the colony. That is why, as Claire Preston argues, "almost none of the standard western ideas of individuality and autonomy of self have any purchase in the study of bees" (15). It is therefore highly problematic to assimilate the ultra-sociality of bees to the inter-subjective models of sociality that underpin critiques of objectification.

The Industrialization of Bees. The commercial use of honeybees primarily as providers of "pollination services" has undergone a marked process of concentration paralleling the development of agribusiness more widely, with the rise in recent decades of large commercial pollination operations geared towards fulfilling the pollination requirements of very large-scale monocultures. This is at its most dramatic in the central Californian almond industry, where 60 million almond trees planted in grids of uniform lines at uniform distances over 600,000 acres supply more than 75% of the world's almonds (Singeli; Traynor). The precipitous rise in global demand for almonds since the 1990s has driven the move towards large-scale intensive monoculture, as almond farmers have sought to capitalize upon rising prices. This in turn has fuelled a huge demand for pollination, massively outstripping the existing pollination capacity of local pollinators, and leading to heavy reliance upon long-range migratory commercial pollination, with millions of hives being trucked in from across the US and even flown in from Australia. The scale of the demand does not just reflect the enormous scale of almond production but is magnified by the specific pollination requirements of almonds, combined with the particular rationale of intensive production (McGregor). With many fruits, such as peaches or apples, it is the fruits themselves that are eaten, and they therefore cannot be grown too densely, as this will tend to prevent a yield of

large and attractive fruits. With almonds, it is the pits that are eaten and a larger number of smaller fruits is actually desirable. Thus, rather than requiring a pollination rate of around 10 percent for a viable crop, with almonds almost total pollination of all flowers is required (Singeli; Traynor). Moreover, almonds are cross-pollinating, meaning that pollen from the flower of one almond tree cannot pollinate another flower on the same tree or even a tree with the same genetics; for pollination to occur the bee must visit a flower of a different variety of almond tree whilst still carrying the alien pollen, before it returns to the hive.

This would not be a problem under normal conditions of bio-diversity where a variety of types of trees is likely to be growing in proximity. Under conditions of intensive monoculture, however, where the trees are essentially clones and nothing else is grown for thousands of acres, it is a significant logistical challenge. Consequently, almond farmers must grow at least two varieties of almond trees, which are usually arranged in alternate rows. Even then this is a very inefficient trajectory for a bee, whose sole concern is to gather nectar, and bees will usually prefer the next nearest flower, which tends to be on the same tree. Bees will only visit other trees before returning to the hive to "offload," if there is such intense competition for each flower that they are forced to look slightly further afield for nectar. These factors in combination mean that almond orchards must be super-saturated with bees — at a level of around 2 hives per acre — in order to achieve commercially optimal levels of pollination, resulting in around 1 and a half million hives being trucked into the Californian almond orchards each fruiting season (McGregor; Traynor; Singeli).

Almond production is the most dramatic case of an intensive industrial monoculture reliant upon commercial apiculture for its viability, but it is far from the only example. The unrelenting logic of rationalization and intensification is driving many other branches of agriculture towards this model, which is in turn driving the transformation of apiculture along similar lines. Increasingly, beekeepers are turning away from relying principally on honey production supplemented by occasional commercial pollination, and toward a focus on pollination as by far the main part of their business. Though it is most advanced in the US, this trend is global in scope; large-scale monocultural agricultural systems around the world are increasingly and disproportionately dependent upon the "pollination services" of the western honeybee (Aizen & Harder 915–18).

Moreover, the forms of intensive monoculture that underpin the growth of large-scale commercial apiculture would be unthinkable without the extensive use of agrochemicals. The rapid growth of agricultural productivity since the 1950s owes as much to the increasing use of fertilizers, pesticides, herbicides, fumigants, biocides, and insecticides as it does to mechanization and the development of new agricultural machinery. By eliminating the impacts of various "pests" upon crops, chemicals have enabled agricultural productivity to be raised well beyond the levels that would otherwise be achievable. Indeed, the practices of late modern agriculture are so thoroughly permeated with chemicals that the large agrochemical corporations must be considered key political-economic agents in the agro-industrial complex, with a structural role comparable to that of the major food-producing multinationals. But just as the benefits of agrochemicals to farming productivity and profitability are well known, the evidence of detrimental and escalating environmental consequences has been mounting since the publication of Rachel Carson's *Silent Spring*, which detailed the severe bio-diversity and habitat losses associated with the growing agricultural use of highly bio-toxic organophosphate pesticides.

The development of the neonicotinoid class of pesticides was hailed as a significant breakthrough, offering a far less toxic alternative to organophosphates, which would achieve similar results through a different and more targeted mechanism, thereby reducing the undesirable impact upon non-targeted organisms in the eco-system. Bees, in common with all insects, were known to have been highly vulnerable to organophosphates, but were supposed to be relatively protected from exposure to neonicotinoids. As "systemic" pesticides, these do not need to be sprayed so liberally and repeatedly over crops, but instead can be used more selectively, often to treat seeds before planting, because they are taken up by the plant and become sealed within its cells. In theory this enables neonicotinoids to effectively repel the insects that feed on the crops without harming other organisms in the environment. Mammals in particular are believed to be less susceptible to toxic effects from neonicotinoids than from the earlier generation of pesticides. The rationale according to Bayer's promotional literature was as follows:

> We have to protect the insects that help us while getting rid of the ones that don't. This is why we at Bayer CropScience only develop insecticides that are safe when used responsibly and correctly, and which do not present a hazard to human beings or the environment […] These products comply with the tenets of integrated pest management. They can be applied multiple times and even shortly before the harvest […] an

> important tool in sustainable agriculture. (http://www.cropscience.bayer.com/en/Products-and-Innovation/Brands/Insecticides.aspx)

Much like "smart bombs," however, the much-vaunted precision of neonicotinoids has proved far more unpredictable when taken out of the controlled environments of selective testing and unleashed upon the formidable complexity of the real environment (Suryanarayanan). Industry-sponsored tests of the effects of neonicotinoids upon bees conducted prior to their mass commercial release have been shown by subsequent independent research to have been woefully inadequate, focusing almost exclusively upon establishing lethal doses, with very little consideration of the longer-term effects of cumulative sub-lethal doses (Maxim and van der Sluijs). Moreover, only a very narrow range of standard routes of exposure were considered, which failed to take account of the possibility of exposure through dust, nectar, and pollen. There is now growing evidence that under certain conditions neonicotinoids can become concentrated in pollen at far higher levels than were anticipated or claimed in initial tests, and that prolonged and cumulative exposure to neonicotinoids through multiple routes of exposure results in symptoms of acute nervous–system confusion, such as failure to return to the hive, as well as damage to the immune systems of bees, both of which are closely associated with Colony Collapse Disorder (Goulson 983-984).

It might reasonably be concluded that banning or severely restricting the use of neonicotinoid pesticides represents an efficient and effective single solution to CCD. Such an assumption is certainly prominent in much of the "save the bees" discourse that has proliferated since 2007. But a singular focus upon neonicotinoids fails to acknowledge the full socio-ecological significance of CCD and overlooks the longer-term problem of pollinator decline. Indeed, the popular understanding of CCD as a "crisis of bees" takes the world dominance of the western honeybee as given and thus fails to properly address the decline of native bees and the many other pollinators that performed the work of pollination perfectly adequately prior to the globalization of *Apis Mellifera* and the industrialization of agriculture (Buchmann & Nabham). The irony is that the international proliferation of the honeybee is intricately bound up with the forms of agricultural organization that have not only led to the steady decline of native bees and other pollinators, but have also engendered the very practices of intensification which meant that it was only a matter of time before something like CCD developed. Thus the crisis of the honeybee is really a crisis of the current agro-industrial food system at large — a system so heavily reliant upon industrially ratcheting up the

pollination work of a single species is patently unbalanced, lacking in resilience, and unsustainable.

Bio-Power and Resistance. Rather than abandon the critical framework of the "animal-industrial complex" in thinking about apiculture, an alternative approach might be to reconceive the factory farm as a technopolitical apparatus of disciplinary power over vital processes, rather than as a system of domination over individual nonhuman subjects as such. What is common to factory farming and intensive apiculture, from this point of view, is not the objectification or exploitation of subjects but the material friction between, on the one hand, living organisms and vital systems with their own complex rhythms and systems of bodily, behavioral, and ecological self-regulation, and on the other hand industrialism, understood as the systematic application of instrumental and calculative rationality to the organization of production in order to maximize productivity. This means, as Val Plumwood puts it, "applying to highly complex situations and systems specialised and instrumentally-directed forms of knowledge whose aim is to maximise outputs, often with devastating results" (38).

The subordination of living processes to the instrumental calculus of productivity can be grasped as a form of biopower. This Foucauldian concept has already been extended in a posthumanist direction, such as to encompass disciplinary power over nonhuman as well as human life, by a number of animal studies and posthumanist scholars (Agamben; Stanescu; Novek 233-234). Biopower is the power to "make live" in prescribed and desirable ways, and the sovereign power of killing — the power of "making dead," or "thanatopolitics," realized most fully in the slaughterhouse — turns out to be a moment of this wider biopolitics, since a corollary of power over life is power over dying. Thus both the factory farm and the industrial monoculture can be comprehended as technologies of biopower, enacting the disciplinary subordination of life to capital accumulation via the systematic application of mechanistic rationality to vital processes.

As scholars in critical environmental sociology have long pointed out, complex natural systems and processes are amenable to only so much human manipulation and intensification before they tend to reach some sort of critical tipping point, giving rise to any number of unforeseen consequences (Catton and Dunlap; Benton; Dickens 100-103, 115). Thus there is causal force on both sides, with bios always retaining some irreducible particularity, some internal rhythm or self-regulating dynamic that cannot be eradicated by the disciplinary apparatuses of industrial technoscience but at best is

displaced and suppressed, to emerge again in some other form. Jane Bennett articulates this idea in her account of what she calls "the vitality of matter":

> By "vitality" I mean the capacity of things […] not only to impede or block the will and designs of humans but also to act as quasi-agents or forces with trajectories, propensities or tendencies of their own. (viii)

Thus whilst biopower is totalizing it never achieves totality, for if discipline is endlessly innovative, then life is irrepressibly recalcitrant; wherever there is biopower, there is bio-resistance. This is present at every level from the micro-organismic, to the behavioral, to the ecological, flowing from one nodal moment to another and expressing itself wherever there is an element left undisciplined and uncontrolled. Like a liquid it seeps through the tiniest cracks in the edifice of power, meeting the microphysics of domination with a microbiotics of resistance.

The spiraling technocultural arms race that results lies behind such practices as mass feeding with antibiotics, tail docking, debeaking, individual confinement, and indeed the escalating use of agrochemicals, all of which can be understood as the ramping up of technologies of control in response to the unintended consequences of earlier control measures. The object is always to contain and manage "the vitality of matter" and to suppress the tendency of living things in particular to resist their complete instrumentalization and machine-like functional use. This is not of course resistance in any conscious or purposive sense, which is to say in the humanist sense of resistance, but rather the resistance of material recalcitrance, of entropy, and of a chaos which is "excessive" in its complexity and capable of thwarting rational designs. Faced with such obduracy, each technological fix is temporary, as the recalcitrance of bios forever re-emerges in new and unanticipated manifestations. Indeed the severity of the unintended consequences often parallel the ambitiousness of the control measures, such that there is a marked tendency for forms of entropy to set in and for biological processes to break down precisely when they are most fiercely instrumentalized and when every conceivable variable appears to have been reckoned back into the disciplinary technology. This is frequently manifest as disease and contagion — principal antagonists of the bio-political logic of containment and separation — such as in outbreaks of BSE, avian and swine flu, as well as the rise of antibiotic resistance, all of which have been connected with the practices of intensive animal farming.

In the factory farm it is animal bodies that are the object of bio-power, and which are progressively removed from the natural environment and into highly regulated artificial enclosures. In industrial monoculture it is the environment itself that is the object of bio-power, encompassing the complex ecological interrelationships among multiple entities including plants, animals, insects, the material qualities of soil, and myriad micro-organisms. Though the objective is the same — to increase productivity — the technological dimensions are somewhat different. In the factory farm most of the variables at play are amenable to a relatively high degree of technoscientific control, in the field far less so. It follows that there is a correspondingly greater possibility of unintended consequences resulting from any given technological intervention. As Val Plumwood observes, this is "technoscience aimed at increasing production without due regard for effects on larger self-regulating systems containing many unknowns" (38). Indeed, if both forms of intensive farming can be understood as factory systems, they might also be grasped heuristically as ongoing biopolitical experiments, the one under laboratory-like conditions, the other in the field, where the parameters of the experiment are harder to control, its limits less sharply defined, and the variables at play highly unpredictable and open-ended.

Conclusion. This article has explored the possibilities of an analysis of apiculture that draws upon the concept of the "animal-industrial complex" as a critical approach to animal agriculture, assessing its usefulness and limits as a framework for grasping the specific animal-technocultural assemblage of contemporary apiculture, and developing a biopolitical reading of the "apis-industrial complex" as a strategy for thinking about the phenomenon of Colony Collapse Disorder.

The paradigmatic site of human-animal relations for critiques of the "animal-industrial complex" is the factory farm; this article has argued that the factory farm is in turn understood through the terms of a critique of the slaughterhouse as a site of mechanized and routinized objectification. Such a critical strategy demands the acknowledgement of nonhuman animal subjectivity, mindedness, and individuality, which then becomes the basis for an ethico-political critique of objectification. Whilst acknowledging its potency, I have argued that this mode of critique was conceived principally in reference to the mammalian and avian animals that make up most "livestock," and that its cogency is limited as an analysis of eusocial insects such as honeybees. It was argued however that the notion of an "apis-industrial complex" might yet be coherent, if the model of the factory farm is reconceived in such a way as to displace the centrality of the subject in the analysis.

Rethinking the critical-animal account of the factory farm requires re-examining the model of the slaughterhouse as the paradigmatic site for the systematic negation of subjectivity, the transformation of living animal subjects into dead commodities. This model reinforces a view of the factory farm as a machine for the negation of living subjects, quite literally a killing machine or technology of death. But placed in the wider context of other forms of animal farming, the thanatopolitics of the mechanized slaughterhouse looks less like the paradigmatic model for animal production and more like a supplementary moment in a more encompassing biopolitics, in which "making dead" is less significant than "making live." Thus understood, the core processes of the factory farm are not built upon the sovereign power of killing subjects, but upon the disciplinary subordination of living materials and vital systems in such a way as to render them maximally productive. This points to a rather different sort of tension, not another variant of the subject/object divide, but a messy and material friction between the dominant technoculture of capitalist modernity and the complex ecologically-embedded rhythms and processes of living systems which provide both its object and its rapidly deteriorating conditions of possibility.

Situating Colony Collapse Disorder within a biopolitical reading of intensive animal production systems in this way avoids too narrow a focus upon specific practices which — however significant — are no more than elements of this complex and reflections of its essential logic, such as widespread pesticide usage or migratory commercial pollination. That is not to minimize the role of neonicotinoids and other pesticides in pollinator decline, but it recognizes their embeddedness within the self-escalating material contradiction between a technoculture bent upon seeking the increased productivity of living systems in accordance with the logic of industrial capital, and the unreflexive, unconscious, but irrepressible resistance to this that inheres in every particle of those biomaterial systems. Honeybees thus emerge not simply as objectified and exploited nonhuman subjects, but as vital nodes in a complex techno-ecological assemblage — highly vulnerable to the agrochemical technologies pervasive in industrial farming, but also technologies themselves, and indispensable components of the monocultural systems of agricultural production that increasingly dominate the world food system.

Works Cited

Adams, Carol J. "'Mad Cow' Disease and the Animal-Industrial Complex: An Eco-Feminist Analysis." *Organization and Environment* 10.1 (1997): 26–51.

_____. *The Sexual Politics of Meat: A Feminist-Vegetarian Critical Theory*. 1990. New York: Continuum, 2000.

Agamben, Giorgio. *The Open: Man and Animal*. Stanford: Stanford UP, 2010.

Aizen, M. A., and L. D. Harder. "The Global Stock of Domesticated Honeybees is Growing Slower than Agricultural Demand for Pollination." *Current Biology* 19 (2009): 915-918.

Arluke, Arnold, and Clinton R. Sanders. *Regarding Animals*. Philadelphia: Temple UP, 1996.

Bayer CropScience: www.cropscience.bayer.com/en/Products-and-Innovation/Brands/Insecticides.aspx. Web. 6 February 2015.

Benjamin, Allison, and Brian McCallum. *A World Without Bees*. London: Guardian Books, 2009 .

Bennett, Jane. *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke UP, 2010.

Benton Ted. *Natural Relations: Ecology, Animal Rights and Social Justice*. London: Verso, 1993.

Buchmann, Stephen L., and Gary Paul Nabham. *The Forgotten Pollinators*. Washington, DC: Island Press, 1997.

Carson, Rachel. *Silent Spring*. New York: Houghton Mifflin, 1962.

Catton, W R. and R. Dunlap. "A New Ecological Paradigm for a Post-Exuberant Sociology." *American Behavioral Scientist* 24 (1980): 15-47.

Clutton-Brock, J. *The Walking Larder: Patterns of Domestication, Pastoralism and Predation.* London: Unwin Hyman, 1989.

Cox-Foster D., M. Frazier, N. Ostiguy, D. vanEngelsdorp, and J. Hayes. "'Colony Collapse Disorder': investigations into the causes of sudden and alarming colony losses experienced by beekeepers in the fall of 2006." Colony Collapse Disorder working group. State College: Pennsylvania State University, 2007.

Dickens, Peter. *Society and Nature: Changing our Environment, Changing Ourselves*. Cambridge: Polity, 2004.

European Union Regulation 485/2013, 24 May 2013, amending Implementing Regulation (EU) No 540/2011, as regards the conditions of approval of the active substances clothianidin, thiamethoxam and imidacloprid, and prohibiting the use and sale of seeds treated with plant protection products containing those active substances. *Official Journal of the European Union*. L139: 12-26.

Fudge, Erica. *Animal*. London: Reaktion Books, 2002.

Gallai N., J. M. Salles, J. Settele, and B. E. Vaissiere. "Economic Valuation of the Vulnerability of World Agriculture Confronted with Pollinator Decline." *Ecological Economics* 68.3 (2009): 810-821.

Goulson, D. "An Overview of the Environmental Risks Posed by Neonicotinoid Insecticides." *Journal of Applied Ecology* 50 (2013): 977-987.

Haraway, Donna. *The Companion Species Manifesto: Dogs, People and Significant Otherness.* Chicago: Prickly Paradigm Press, 2003.

Holloway, L. "Subjecting Cows to Robots: Farming Technologies and the Making of Animal Subjects." *Environment and Planning D: Society and Space* 25.6 (2007): 1041-1060.

Hurn, Samantha. *Humans and Other Animals: Cross-Cultural Perspectives on Humans and Other Animals*. London: Pluto Press, 2012.

Irvine, Leslie. *If You Tame Me: Understanding our Connections with Animals*. Philadelphia: Temple UP, 2004.

Jacobsen, Rowan. *Fruitless Fall: The Collapse of the Honey Bee and the Coming Agricultural Crisis*. New York: Bloomsbury, 2008.

Maeterlinck, Maurice. *The Life of the Bee*. Tr. Alfred Sutro. London: George Allen, 1901.

Maxim, L. and L. van der Sluijs. "Seed-Dressing Systemic Insecticides and Honeybees." *European Environment Agency Report No.1/2013. Late Lessons From Early Warnings: Science, Precaution, Innovation.* European Environment Agency, 2013. 369-406.

McGregor, S. E. *Insect Pollination of Cultivated Crop Plants.* Agriculture Handbook No. 496. Washington, DC: US Government Printing Office, 1976.

Neumann, P. and L. N. Carreck. "Honey Bee Colony Losses." *Journal of Apicultural Research* 49 (2010): 1–6.

Noske, Barbara. *Beyond Boundaries: Humans and Animals*. 1989. New York: Black Rose Books, 1997.

Novek, J. "Pigs and People: Sociological Perspectives on the Discipline of Animals in Intensive Confinement." *Society and Animals* 13.3 (2005): 221-244.

Preston, Claire. *Bee*. London: Reaktion Books, 2006.

Plumwood, Val. *Environmental Culture: The Ecological Crisis of Reason*. London: Routledge, 2002.

Ransome, Hilda M. *The Sacred Bee in Ancient Times and Folklore*. 1937. Mineola, NY: Dover Publications, 2004.

Reinert, H. "Entanglements: Intimacy and Nonhuman Ethics." *Society and Animals* 22 (2014): 42-56.

Rifkin, J. *Beyond Beef: The Rise and Fall of the Cattle Culture*. New York: Penguin, 1992.

Schmuck, R. "The Bayer CropScience View on Maxim and van der Sluij's Seed Dressing Insecticides and Honeybees." *European Environment Agency Report No.1/2013. Late Lessons From Early Warnings: Science, Precaution, Innovation*. European Environment Agency, 2013. 401-402.

Shepard, Paul. *The Others: How Animals Made us Human*. Washington, DC: Island Press, 1996.

Singeli, A. "The Almond and the Bee." *San Francisco Chronicle*. SFGate.com. 14 October 2007. Web. 22 February 2015.

Stanescu, J. "Beyond Biopolitics: Animal Studies, Factory Farms, and the Advent of Deading Life." *PhaenEx* 8.2 (2013): 135-60.

Stewart, D., R. Shewe, and B. Gunderson. "Extending Social Theory to Farm Animals: Addressing Alienation in the Dairy Sector." *Sociologia Ruralis* 53.2 (2013): 201-222.

Stone, S. "Honey Bees Measure Pollution at Frankfurt Airport." *PRI* 12 Jul 2011. Web. 6 22 February 2015.

Suryanarayanan, S. "Balancing Control and Complexity in Field Studies of Neonicotinoids and Honey Bee Health." *Insects* 4.1 (2013): 153-167.

Tautz, Jürgen. *The Buzz about Bees: Biology of a Superorganism*. Berlin: Springer-Verlag, 2008.

Traynor, J. *Almond Pollination Handbook*. Bakersfield: Kovak Books, 1993.

Twine, R. "Revealing the 'Animal-Industrial Complex': A Concept and Method for Critical Animal Studies?" *Journal for Critical Animal Studies* 10.1 (2012): 12–39.

VanEngelsdorp D., et al. "Colony Collapse Disorder: A Descriptive Study." *PLoS ONE* 4.8 (2009): e6481.

Williams, G. R., et al. "Colony Collapse Disorder in Context." *Bioessays* 32.10 (2010): 845–846.

Wilson, Bee. *The Hive: The Story of the Honeybee and Us*. London: John Murray, 2004.

Winders, B. and D. Nibert. "Consuming the Surplus: Expanding 'Meat' Consumption and Animal Oppression." The International Journal of Sociology and Social Policy 24.9 (2004): 76-96.