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Enfolding the BioSocial Collective: Ontological Politics in the Evolution of Social Insects

Introduction. Imagining and representing "nature" is always a work of political inscription which simultaneously enacts some tacit vision of social relations and human community. This is particularly true of representations of nonhuman animals, our perceptions and definitions of which have been so fundamental to the work of human self-definition through the ages. When we imagine animals we imagine ourselves, and the nature, possibilities and limits of our own human existence. This article traces how honey bees have been imagined and represented in a significant scientific development of recent decades, and critically explores the resonance of this for our thinking about social and political organization. The analysis draws upon the concept of "ontological politics" (Mol; Whatmore), which foregrounds how our inscriptions of "nature" and "the natural" are constitutively interwoven with visions of "society," "culture," and "the social." Thus ways of knowing "nature" and its others are always involved in defining conditions of social and political possibility through the work of co-constructing human and nonhuman subjects, objects, collectives, and their interrelations, and inscribing ontological boundaries and domains as a given reality or common world. On this basis, the article examines some key developments of the last fifty years that have contributed to a particular trajectory in scientific studies of bees and other social insects, namely a turn to conceptions of evolution as perpetual competition for relative genetic advantage, governed by a mathematical logic. While not quite a paradigm shift, this has marked a significant change of emphasis in entomology, and constitutes a new problematic, which has given rise to new kinds of study addressing different questions and mobilizing a particular conceptual framework. This analysis traces the conceptual architecture of this and explores how it inscribes a particular ontology of "nature" and "the social."

Ontological politics is not just a matter of inscriptions in the abstract, but of world-making practices bound up with lived politics. The task then is to unfold the politics that are being enacted within particular assemblages, and to situate this critically within the wider field of political relations. In this vein, this article argues that the ontological politics of a late modern turn to conflict in scientific studies of bees has been entangled with key contemporaneous currents in socio-political and economic thought, which share a vision of a world fundamentally shaped by competition between atomized and rationally self-interested actors. This is not to posit a quasi-causal interrelationship, but rather an ontological resonance, overlap, and cross-fertilization, consisting in a mutual reinforcement of framing assumptions. Thus the aim is not to make an empirical contribution to the history of ideas, but to develop a sensitizing framework for thinking-through the politics of recent scientific visions of an iconic nonhuman society. The analysis therefore carefully retraces some pivotal moments in these developments in entomology in order to examine the ontological work involved, exploring what was foregrounded and inscribed as "real," and conversely what was bracketed and rendered marginal or invisible.

The specific argument is that the trajectory of the turn to conflict in studies of social insects, as an exemplar of what – following Tim Ingold — I will refer to as neo-Darwinism, is bound up with the ontological politics of inscribing and entrenching a "nature" that is separate from and prior to the social, knowable by particular sorts of knowledge, and thus amenable to certain kinds of politics. Once this "politics of nature" (Latour, *Politics*) is identified, it becomes contestable, and this article develops a critical reading which identifies a work of ontological exclusion or containment of the social at every stage. In order to problematize this, the analysis draws upon currents from relational ontology and theories of biosocial complexity, in order to posit an alternative ontological-political vision and to imagine what sort of "nature," "society," and "politics" might emerge if the social is instead reckoned back into the evolutionary process. In this way, the analysis and argument that follows is at once about science, the nature of bees, and their mode of existence, but also about ourselves, our nature as human beings, and the social and political possibilities of our own mode of existence.

Imagining a Nonhuman Community. As neither human "subjects" nor mere "objects" of nature, animals have long been enrolled as cultural boundary creatures inhabiting the liminal border zones between "nature" and humanity. As inhabitants of these border zones, animals have been central to what we might call the anthropomorphic imagination — the ongoing work of self-definition that is an abiding preoccupation of human cultures (Shepard). But this anthropomorphic imagination often focuses upon animals whose physiological and cognitive characteristics are more easily amenable to an anthropomorphic model of conscious being, subjectivity, and selfhood, meaning vertebrates, mammals, primates, and cetaceans. Social insects, and bees in particular, are a significant exception. There is a remarkably rich cultural history of apian anthropomorphism, that is, of cultural imaginings and representations of bees vis-à-vis human beings, but it does not center upon speculation about the consciousness of bees and the nature of a bee's subjective experience, but instead upon the nature of "bee society," on the colony as a political community or collective, and on the extent and significance of its similarities with human society.

An old beekeepers' proverb speaks of the quintessentially collective and social nature of bees, *Una apis nulla apis* — "one bee is no bee"; this is an enduring cultural idea which has recurred in different regions and historical periods over many centuries. At least as far back as ancient Greece, bee colonies were thought of as a kind of political community in nature, an ideal natural polity, and bees symbolized virtuous dedication to the collective good (Wilson, *The Hive* 107-108; Preston). In fact, only a small proportion of the many thousands of species of bees are social insects, so the characterization of bees as highly social reflects the cultural preeminence of one species, Apis Mellifera or the "western honey bee," in human thinking about bees. As the apian species most amenable to the semi-domestication of managed beekeeping, Apis Mellifera has been involved in an exceptionally close and enduring relationship with humans for millennia, which has afforded ample opportunity for close observation of honey bee colonies. Thus the rich history of apian folklore and symbolism is permeated with imaginative reflection upon the nature of honey bee "society" and the colony as a kind of political community; indeed, the cultural history of the honey bee could be aptly characterized as a never-ending thought experiment on the nature of collectivity vis-a-vis individuality.

The fabled collectivism of honey bees is often evoked through examples of what is taken to be their "extreme" altruism: bees are often said to "work themselves to death" producing honey not for their own consumption, but for the future security of the hive (Preston 11); they will sting any creature that threatens the colony, even though this results in their own death (Starr et al. 787, 788; Garson 30); and sick bees will willingly exclude themselves from the hive wherever possible, in order to minimize the spread of infection to others in the colony (Rueppell, Hayworth and Ross). In each of these examples, collectivism is closely associated with altruism and construed as the antithesis of self-interest, and the cultural perception of bees has been fundamentally shaped by changing political inflections of this core idea of self-denying altruism. This is epitomized by the prevalent Renaissance emblem of the beehive accompanied by the motto *Non Nobis*, meaning "not for ourselves" (Wilson, *Hive* 19-20); as Claire Preston (53) observes, "the unstated corollary ... is 'instead for others.'" This enrolment of the bee as a symbol of civic virtue as distinct from private interest runs very deep in the cultural imaginary. It has gone hand in hand with the perception of bees as assiduous, productive, and hard-working, as perpetually engaged in tireless labor for the good of the hive (Preston 54), and much has been made of the fact that the male drones, who do not work, are soon excluded from the hive and left to die once they have served their reproductive purpose (Wilson, *Hive* 30-32).

So the cultural enrolment of bees as symbols of civic duty, altruism, industriousness, and collective virtue is simultaneously social, political, and economic in its scope and in its resonance. This has lent to anthropomorphic thinking about bee "society" a remarkable potency, and bees have very often been enrolled to assert the righteousness or naturalness of certain forms of political, social, and economic organization, as ostensibly demonstrated by their example in nature. Throughout much of the medieval and early modern period, for example, bees were acclaimed as paragons of good governance, hard work, and obedience; they were hailed as exemplary of a natural order in which everyone contributes to the common good, by knowing his or her place within the social hierarchy and fulfilling his or her duties efficiently, in a kind of apian functionalism (Wilson, *Hive* 24, 26). English Royalists in the 16th and 17th centuries pointed to what they perceived as the perfect submission of bees to their ruler as evidence that monarchy is indeed founded in nature and divinely ordained (Preston 62). One telling feature of these visions of bee society was the assumption that the colony was a patriarchy, that the Queen was in fact a male "King Bee," a misconception which was not dispelled until the beginning of the 17th century (Preston 60-61).

The history of apian anthropomorphism also encompasses a tradition of more egalitarian associations, however. Whilst Royalists in England hailed the divine monarchy of bees, revolutionaries in France adopted the beehive as a symbol of the Republic, denoting the community of workers and the civic ideal (Preston 73). This alternative view was always latent in cultural representations of bees, but with the social and political upheavals of the 19th and 20th centuries it became much more sharply distinguished from the more hierarchical and conservative strands of bee mythology. Bees were often adopted as symbols of cooperation and communal ethics by social reformist and workers' movements (Wilson, *Hive* 106), although this was opposed — and often swamped — by the association of bees with the dangers of collectivism by its opponents. For them, far from the bee colony being an ideal polity, it was a mindless and malign collective epitomized by the "the swarm," which — like "the mob" — was a multitude frighteningly devoid of individual intelligence and free will. Indeed, from the 1950s onwards, and in the context of the Cold War, bees were increasingly equated with totalitarianism, and represented in western mass culture as an evil collective, signifying the irrational mentality of the crowd (Wilson, *Hive* 134-135, 138-139) and evoking anxiety and dread of the soulless collective.

Cultural imaginings of bees and "bee society" then have been deeply entangled with historically changing — and contested — political inflections of collectivism, individualism, cooperation, subservience, altruism, and self-interest. Hence, there is a political significance to apian discourse which at least equals that of commonly anthropomorphized species that are physiologically and evolutionarily far closer to human beings. Insofar as western thought has involved an enduring binarism of society and individual, apian discourse has been a barometer of the ever-shifting relationship between those potent mythic poles.

The Politics of Apian Natures. One might be tempted to distinguish the history of cultural imaginings and representations of honey bees from modern entomology, since the latter examines the organization of bee colonies "objectively," using scientific methods, as distinct from anthropomorphic metaphors and symbolic associations. But it would be a mistake to draw too absolute a distinction between scientific and non-scientific ways of knowing, given that science is social activity and scientific "facts" are socio-materially produced (Bloor; Mendelsohn, Weingart and Whitley; Knorr-Cetina; Latour and Woolgar). As Sheila Jasanoff puts it:

> Scientific knowledge […] is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions — in short, all the building blocks of what we call the social (5).

Moreover, before acquiring the status of "facts," scientific knowledge-objects must be assembled and made meaningful, which is a material-semiotic practice. Hence scientific discourse is replete with metaphors, rhetorical and narrative devices, and cultural associations of much the same kind as those found in quotidian ontologies (Gilbert and Mulkay; Woolgar; Haraway, *Primate Visions* 4; Crist; Keller 117-118). Far from being separate from politics then, scientific knowledge and discourse is capable of profoundly shaping socio-political discourse and socio-political realities, and indeed is always and everywhere involved in this ontological-political work. This is doubly true of the sciences of animal behavior, which combine the political efficacy of scientific knowledge-claims with the ontological role of nonhuman animals in definitions of "the human" (Shepard; Crist; Haraway, *When Species Meet*), wherein changing visions of animality are constitutively interwoven with changing definitions of humanity, which in turn are entangled with discourses of race, gender, class, sexuality, community and hierarchy (Haraway, *Primate* 1).

There is not a radical break or discontinuity, then, between the centuries-long cultural history of anthropomorphic imaginings of honey bee society and modern entomological work on apian social organization. Both are part of one continuous history in which changing visions of apian sociality and apian politics have interacted with the changing political inflections of discourses of sociality, collectivism, individualism, altruism, and self-interest. This has been given an intriguing twist in recent decades by one significant development in entomology, which has challenged the very idea that bees are in fact cooperative by nature and dedicated to the collective good of the colony. Rather than an example of altruism or of spontaneous cooperation, on this view the collective organization and integration of the colony is a mere epiphenomenon concealing an underlying reality governed by self-interest and inter-individual conflict. Collectivism is explained as the byproduct of a biological calculus whereby the pursuit of self-interest leads ineluctably to apparently cooperative behavior, and altruism is unmasked as something imposed upon the individual organisms that make up the collective by a hidden logic of self-interest that is conceived as embedded in the nature of life itself.

The context for this is that altruism and altruistic cooperation have long been a problem for the dominant current in evolutionary thinking that permeates much of behavioral biology, which normalizes self-interest on the basis that organisms must always tend to favor whatever behavioral traits benefit the propagation of their own genes (Crist 127-128). While there is no consensus on the mechanisms by means of which this genetic imperative is realized in the behavior of actual organisms, self-interested behavior is regarded as an inevitable outcome of the evolutionary process because behavioral traits which do not favor the propagation of the bearer's genes will by definition self-select for obsolescence. In this ontology, therefore, natural selection is held to operate at the level of so called "selfish genes" (Dawkins), which are the real evolutionary agents, and organisms are essentially the bearers of an underlying genetic logic forever playing itself out through their inherited behavioral and physiological traits. As Eileen Crist explains, "The rationality of genes is pictured as a kind of hidden hand that — via the programming of neurophysiological machinery — guides behaviors so as to optimize the chances of survival and maximize the reproductive output of their carriers" (139).

It is difficult, within this vision, to explain the apparent acquiescence of the thousands of female worker bees in a colony to a lifetime of working ceaselessly for the collective without seeking to propagate their own genes by reproducing themselves. This is "eusociality" — the highly collective and integrated form of sociality found among honey bees and a handful of other species, mostly insects, defined by a complex social division of reproductive labor, multiple overlapping generations in a colony, and large numbers of reproductively inactive workers (Wilson, *Insect Societies*; Wilson, "Eusociality"). Indeed, Darwin identified eusocial insects as a serious problem for his theory of natural selection:

> I will confine myself to one special difficulty, which at first appeared to me insuperable, and actually fatal to my whole theory. I allude to the neuters or sterile females in insect communities: for these neuters often differ widely in instinct and in structure from both the male and fertile females, and yet from being sterile they cannot propagate their kin. (236-237)

Darwin's main concern was how it was possible for these sterile females to have evolved a distinctive morphology when they do not breed — how it was that they had not therefore been rendered an evolutionary dead-end by the process of natural selection. This "special difficulty" subsequently became generalized into the broader "problem of altruism" — the question of how it was possible, in terms of natural selection, for behavioral traits to evolve which were disadvantageous to their bearers, but advantageous to the community, a situation thought to be mostly sharply exemplified by altruistic behavior, defined as giving priority to the interests of others over oneself.

Darwin never solved his problem to his own satisfaction and was driven to suggest that perhaps, in the case of highly integrated social species like honey bees, natural selection operated at the level of the colony as a social collective rather than the individual organism (236-237). This significant self-modification of Darwin's otherwise elegantly consistent theory later gave rise to a fierce debate on the validity of notions of "group selection" or "multi-level selection," in which some influential figures supported Darwin's "group selection" hypothesis (Wilson and Sober; Wilson, "Eusociality"; Wilson and Wilson). But the view that has become dominant in recent decades holds that group selection is a fanciful wrong-turn rendered unnecessary by the discovery of the gene and by subsequent advances in genetics science. On this view, the solution to "problem of altruism" is considered to have been furnished by William Hamilton's theory of "inclusive fitness," which built on the recognition that genes are shared with relatives in order to propose "kin selection" as an extension of natural selection beyond the individual to those with whom genes are shared ("Genetical Evolution") In this way, Hamilton was able to explain how altruistic traits can emerge if they preferentially benefit relatives, in a manner that was still consistent with the classical principles of natural selection (Herbers 214-216). This not only provided an apparently workable solution to the problem of altruism that had long dogged evolutionary theory, but also reinforced by theoretical demonstration the central tenet of neo-Darwinism — that selection operates at the level of the gene or "genotype" rather than at the level of the organism, let alone the social group or collective.

Having ostensibly solved the broader "problem of altruism" that had emerged from Darwin's observations of social insects, Hamilton also attempted to resolve the "one special difficulty" itself, by deploying his theory of inclusive fitness to the evolution of eusociality. He proposed that the social organization of eusocial insects could be explained by their "haplodiploid" system of sex determination, wherein the males develop from unfertilized eggs by parthenogenesis and have a single set of chromosomes, whereas the females develop from fertilized eggs and have two sets of chromosomes ("Genetical Evolution"; "Extraordinary Sex Ratios"; Herbers). Hamilton observed that this mode of sex determination results in the peculiar situation of females being more closely related to their sisters than their mothers, and he argued that this could explain eusociality because it meant that females would propagate their own genes more efficiently by helping their mother to produce more sisters than by seeking to reproduce themselves ("Genetical Evolution"; "Sex Ratios"; Herbers; Ratnieks, Foster and Wenseleers 582-583). Hence, according to Hamilton, the apparent altruism and collective cooperation of eusocial workers was actually an expression of inclusive fitness, which is to say a manifestation of the underlying logic of genes operating through a hidden calculus of kin selection.

Rational Actors and Calculating Genes. Although Hamilton's "haplodiploidy hypothesis" was later called into question as an explanation of eusociality by the discovery that several eusocial insects are not haplodiploid, the broader approach to "inclusive fitness" became very influential within entomology and beyond (Wilson, "Kin Selection"). It led to a raft of new research exploring how underlying logics of kin relatedness might be the key to diverse forms of social behavior. A landmark early paper in this vein by Trivers and Hare pointed out that the logic of inclusive fitness meant that there was a genetic conflict of interest between parents and offspring among haplodiploid insects due to their respective interests in establishing and maintaining differing sex ratios within the colony, with workers benefitting from a preponderance of females over males whereas queens benefitted from a more even balance of the sexes (249-263). This generated an enormous amount of interest in conflict among social insects, and subsequent research increasingly sought to explain various aspects of social organization among social insects by identifying and modeling conflicts of interest emerging from the calculus of coefficients of kin relatedness, as played out within the reproductive dynamics of insect colonies. Although Hamilton's aim had been to explain cooperative behavior, according to population biologist Joan Herbers, "the prediction of such conflicts is considered a more fertile outcome of Hamilton's papers than the literature on cooperation" (215). Indeed, cooperation, altruism, and collectivism were progressively rendered secondary phenomena beneath which the expert gaze —

bolstered by a knowledge of relatedness coefficients — could detect the more fundamental reality of endemic reproductive conflict and self-interest operating at the level of genes (Herbers ; Ratnieks, Foster and Wenseleers).

In 1973 the evolutionary biologist John Maynard Smith and the mathematician George Price published what was to be a landmark paper in evolutionary biology. It took as its point of departure Hamilton's acknowledgement that even natural selection at the level of genes operates in a social context. Since behavior — which neo-Darwinism takes to be genetically shaped or programmed, and therefore subject to evolutionary selection pressures in the same way as genes — involves interaction with other organisms in the environment, it follows that the "fitness" of any given behavior — its tendency to promote that organism's reproductive success — depends upon how that behavior interacts with the behavior of others, as well as with all of the other forces and actors that make up "the environment" in the broadest sense. As the costs and benefits associated with any genetically-influenced trait must depend on the local environment, they are inherently social and ecological (Herbers 215). But acknowledging the complex interaction between genetically coded behaviors and their social-ecological environment risks undermining the explanatory preeminence of the gene. Consequently, there has been a tendency for its adherents to overemphasize one dimension of Hamilton's formula — the "sex ratio" or mathematical coefficients of relatedness between kin — at the expense of the environment which shapes the cost/benefit ratio of any given trait. Joan Herbers suggests that this is also driven by methodological and epistemological pressures, given the relative ease of calculating relatedness coefficients for use in the comparative algorithms favored by "hard" science, in comparison with which studying social-ecological contexts is far more difficult:

> Understanding ecological context for a focal species takes a combination of good natural history and experimentation, which themselves are time-intensive. Furthermore, there is precious little universality in ecology; a hard-won explanation for one population or species may not offer explanatory power for a second. Science far prefers generality to unique solutions, yet for the operation of kin selection, we must expect different explanations in different ecological contexts. (Herbers 216)

Pushed to its logical conclusion, it follows that selection "at the level of genes" is not at the level of genes at all, but rather depends upon a multitudinous environment with all of its contingencies. This is more than just a caveat to be applied to the theory of inclusive fitness, it potentially destabilizes the ontology of evolution as a process unfolding according to an immanent and ineluctable logic, and opens up the prospect of an evolutionary process irreducible to the mathematics of kin selection or the calculus of genes, but bound up with the whole indeterminate process of ontogenesis or becoming. Maynard-Smith and Price's contribution was to avert this looming specter of indeterminacy by drawing heavily from the analytical tools and conceptual apparatus of a theoretical field that had previously had very little to do with evolutionary biology, namely the field of "game theory."

As the mathematical study of approaches to predicting behavior in situations of conflict or competition, game theory first emerged in the 1940s and developed through the 1950s in the context of Cold War politics. It was initially rooted in a model of how rational and self-interested actors would behave in a two-person zero-sum game, such as chess, poker, or intercontinental thermonuclear war (von Neumann and Morgenstern; Myerson). Indeed, game-theoretic thinking contributed to the doctrine of nuclear deterrence through "mutually assured destruction," which was based on the central game-theoretic scenario of the "Nash equilibrium." This is a situation of strategic balance where, despite neither player being able to win decisively, the potential costs to either player of changing their strategy to a more hawkish or aggressive one consistently outweigh the benefits or "payoff" of such a shift, in such a way that a stability or stalemate prevails, resembling a sort of cooperation, as long as both players are rational, self-interested, and understand the structure of the game (Nash, "Equilbrium Points"; Nash, "Non-Cooperative Games"; Easley and Kleinberg 166).

Maynard Smith adapted this to evolutionary biology by treating the genetically-determined characteristics and behaviors of organisms in a population as their "strategies" in the "game" of evolution, where reproductive success or "fitness" is the aim or "payoff," and this depends upon the rival strategies of the other organisms with which it interacts (Easley and Kleinberg 209-210). In his seminal 1973 paper on "The Logic of Animal Conflict," Maynard Smith stated that his pivotal concept, the Evolutionarily Stable Strategy, was "derived in part from the theory of games, and in part from the work of […] Hamilton on the evolution of the sex ratio" (15). Hamilton himself was in turn influenced by this concept and went on to use it in his later work (Hamilton and May; Comins et al), praising its "combination of simplicity and generality" (Sigmund 4). Its value for him also lay in the fact that, by showing how apparently cooperative and altruistic behavior could arise from rational competitive strategies, game-theoretic approaches to evolution appeared to drive a stake into the heart of notions of "group level selection" and to confirm selection at the level of genes acting upon individual organisms, and in some special cases upon kin groups.

In its impact and influence, the emergence of evolutionary game theory powerfully established the idea that the central tenets of game theory need not be confined to analyses of artificial and circumscribed interaction-situations such as games of strategy like chess, but were suited to grasp the underlying competitive logic of life itself, in all its diverse manifestations (Maynard Smith, "Theory of Games"; *Evolution and the Theory of Games*). Maynard Smith's Evolutionarily Stable Strategy — paralleling the Nash equilibrium — became the basis of a wave of new work deploying game-theoretic approaches and analytical models, not just in evolutionary biology and behavioral ecology, but also in economics and political thought. It embedded the notion that wherever there was life there could be found the same fundamental dynamic of inter-individual conflict and competition between rival strategies, and that if one identifies the actors and their strategies correctly and at the right level for the phenomena in question, then the whole process can be grasped as unfolding according to mathematical principles.

Towards Biosocial Becoming. Game theory then has provided a way to address the problematic social dimension of evolution in a manner consistent with the principle of evolution by natural selection at the level of genes. But the ontology of game theory is "social" only in the limited sense that the situations or "games" analyzed by game theorists are always multi-player, no player acts in isolation, and the outcome of a game depends upon how the strategies of all of the players affect each other reciprocally. The sociality of game-theoretic ontology ends there, because the players themselves are not social — their ultimate motives and their very constitution as separate players are treated as pre-given by the nature and rules of the game, built into the situation, and not amenable to social renegotiation. Moreover, the actors of game theory are reflexive only in the limited sense that their rational decision-making includes the capacity to modify their strategies in response to the strategies of others, which still entrenches a view of the actors themselves as fundamentally atomized, self-contained and bounded individuals, compelled to perpetually calculate and recalculate their own actions in relation to the hostile and self-seeking strategies of others. In these respects the ontology of game theory is ultimately not social in a meaningful sense, but is rather an ontology of asocial individuals acting with limited strategic reflexivity in competitive situations.

These characteristics distinguish game theory's model of interaction from those common in sociology, for example, where interactions are held to be constitutive of social actors themselves through an ongoing reflexive process (Mead). Indeed, from a more thoroughly relational perspective, "the social" refers to a field in which self and other, inside and outside, organism and environment, coalesce and enmesh in a heterogeneous field of mutual interconstitution. Thus, one does not grasp sociality by acknowledging the co-existence of multiple Cartesian individuals, each encased in their own inviolable individuality, suspiciously peering out at others in an attempt to discern their competitors' strategies and to modify their own accordingly for maximum advantage. In such a model, sociality is only ever a matter of external relations and never of what Karen Barad calls "intra-actions" (170, 178) — dynamic imbrications in which the "insides" and "outsides" of actants are perpetually mixed-up, reconfigured, and enfolded together. By neglecting in this way the constitutive nature of the social as a process of relational becoming, and reducing sociality to the strategic interactions of separate individuals, game-theoretic ontology inscribes what is at best an impoverished view of sociality. Which raises the question of what might emerge from the encounter of evolution with more radically social ontologies, such as the forms of relational complexity theory that are increasingly shaping cutting-edge thinking at the interface of the social and natural sciences (Connolly; Bennett; Ingold; Palsson).

The work of political philosopher William Connolly has been critical in articulating how the rise of complexity theory as a challenge to reductionism in the physical sciences creates possibilities for new modes of trans-disciplinary thinking which explore the implications of a world constantly emerging in contingent ways from the conjunction of multiple, overlapping and complex systems, or what he calls "a world of becoming." For Connolly, reductionism lies in the tendency to isolate, seal off, and hypostatize systems that are always partly open assemblages, and to theoretically model these as "pure" closed systems which in principle are self-balancing, though they may be periodically disrupted by "externalities" (37). I want to argue that this is precisely what is at work in evolutionary game theory, which treats natural selection at the level of the gene as akin to a closed system, by reducing the role of the social-ecological environment in the process to the status of a constant and predictable external variable, little more than a relatively inert stage upon which the logic of genes plays itself out, and which therefore cannot introduce indeterminacy into the very heart of the process.

This is not just a question of how macroscopic systems and their intra-actions are understood, but also of how the agents of these systems are imagined and inscribed, since closed and stable self-contained systems imply one-dimensional, atomized and mechanistic agents. A sense of the intricate relational entanglement of agents and assemblages is captured in Jane Bennett's notion of "agentic assemblages," and her "vital materialism" provides another fertile conceptual resource for thinking through biosocial complexity (23-24, 35). In her intriguing discussion of the numerous limitations of the category of "environment" for a posthumanist politics, Bennett points out that the term always refers to something which is outside, whether outside of the self, human society, or human culture; the environment is what surrounds; it is without, not within, a substrate or context, but always separated in some way from the entity it encircles. Bennett's notion of encountering vital materiality problematizes this with its capacity to show that in a world of porous materials where every boundary and border is permeable, what is without is always already within, and vice-versa, hence there is no "environment," but only "an ontological field without any unequivocal demarcations" (116).

Tim Ingold has examined the conceptual aporias of neo-Darwinism and in particular the associated notion of culture as consisting of "memes," where these are conceived as packets of behavior-determining "information" that operate in parallel with genes. This leads to the sham question of how to understand the inter-relationship between these two "levels," which is an instance of what the philosopher Alfred North Whitehead called "misplaced concreteness" in treating as real what are purely analytic abstractions with no material presence — there are no such separate levels and thus there can be no relationship between them (4). The fallacy is similar in kind to the forms of essentialism and reductionism criticized by Connolly and Bennett, wherein a failure to think relationally and processually results in a tendency to inscribe or assume ontological separations where there are only complex entanglements. This is particularly manifest in the notion that genes somehow "code for" behavior, in a manner that has never been specified and yet is presumed to be substantively unaffected by the dynamic processes through which this "code" is realized in the growth, development, embodied learning, and social interactions of the organism in its complex environment (Ingold 5-7).

A biosocial conception of evolution as the processual unfolding of the whole assemblage of relations and matters of life cannot be squared with the bracketing-off of "proximal" or contextual factors such as "the social environment" from what is conceived as the core process of "natural selection at the level of genes." This does not, of course, mean rejecting evolution per se, but grasps evolution as relational development emerging from ongoing dynamic intra-action between multiple complex and open systems, or what Gisli Palsson calls "ensembles of biosocial relations" (24), conceived not as some admixture of the biological and the social, but as biological all the way up and social all the way down. It follows that there is no genetic calculus which is the universal underlying basis of social behavior, since genes only act relationally within and through a developmental life process that is full of other forces, logics, indeterminacies and complexities.

Conclusion. Entomologists have examined the social organization of numerous species of social insects, but the long and entangled history of human association with honey bees has given rise to an exceptionally rich history of apian anthropomorphism, in which bee colonies have consistently entered the cultural imagination as exemplars of a collectivist political community in nature. Scientific discourse around honey bees and apian social organization therefore has particular political significance; hence the turn to studies of conflict as an underlying genetic driver of social organization among bees and other social insects is not a narrowly technical or discrete scientific development but is also a work of ontological-political inscription with resonance far beyond bees. In particular, by translating game theory — a useful but inherently limited mathematical approach to predicting behavior in specific situations of conflict — into a universalizable approach to all life, the forms of evolutionary theory bound up with these developments have inscribed individualistic competition as the very order of things. This article has sought to contribute to problematizing this, by closely tracing how it was assembled, and by excavating how key uncertainties and contingencies were bracketed off and backgrounded in the process.

At the heart of this is the bracketing-off of the social itself, the complex environment in which organisms must operate. As a destabilizing but ineradicable component of evolution by natural selection, the social has been truncated by being translated into the impoverished social ontology of atomized rational actors. But if sociality is conceived instead as a radically relational process of heterogeneous becoming, this opens the door to alternative conceptions of social insects and honey bee colonies which contradict the prevailing orthodoxy. Theories of "group selection" or "multi-level" selection for example (Wilson and Sober; Wilson, "Kin Selection"; Wilson and Wilson), in which selection at the level of genes and individual organisms is decentered by a broader notion of selection as a process that occurs across multiple interacting units including social groups and whole societies, have been repeatedly rejected by mainstream evolutionary biology but resonate with the anti-reductionism of relational ontologies. So too do theories of bees as "superorganisms," which insist that the colony as a collective entity is the organism rather than the individual bees it comprises (Tautz). An example from beyond entomology is the theory of "symbiogenesis," which maintains that the source of the variation that gives rise to new species is not simply "random mutation" as Darwin suggested, but a process of synthesis in which separate organisms merge to form composites. Ignored or denied for decades, this has only belatedly achieved a degree of acceptance through the work of Lynn Margulis in studies of cell evolution and endosymbiosis of bacteria ("Genetic and Evolutionary Consequences"; *Symbiosis in Cell Evolution*; *Symbiotic Planet*). For Margulis, symbiogenesis revolutionizes our understanding of evolution, because, rather than natural selection through competition being the exclusive driving force of changing forms of life, instead symbiotic relationships of cooperation, interaction, and interdependence play a pivotal role in evolution.

Relational biosocial ontologies do not decisively settle the question of how evolutionary processes should be understood, but they do render contestable the entrenched conception of evolution as autonomous of the social and driven by an immutable inner logic of inter-individual conflict, competition and self-interest. Thus, we do not have to see in the remarkable collective organization of the colony only an unintended consequence of the pursuit of reproductive advantage by calculating genes, and bees need not be thought of as organic machines unwittingly enacting an evolutionary imperative built into their genes, nor as rational actors compelled by the coefficients of relatedness to seek their own self-interest or that of their kin. Instead, when we observe the colony, rather than an interesting case of the genetic determination of social behavior, we may — like so many before us — choose to perceive and imagine a society more collectively integrated than our own, but one where the sociality in question cannot be defined by its distance from nature. In this sense, bees can help us to think beyond not just the categories of "individual" and "social," but also "social" and "biological," and to conceive of a world in which these are inextricably enfolded into each other. It then makes little sense to imagine social organization as determined, dictated, or limited by nature, biology, or genes, for these are constitutively interwoven with the social and do not exist separately from social processes. A consistently relational and processual ontology therefore means a political work of imagining bees and other social beings as biosocial entities woven into the continuous stream of becoming that is the life process itself.

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