



## *Becoming-Dinosaur: Towards a Morphology of Creative Involution*

by Alice Iacobone

**ABSTRACT:** Palaeontologist Jack Horner, along with molecular biologists and other experts, has been working on building an animal that he calls “the Chickenosaurus.” Horner’s purpose is to reverse-evolve a bird into a non-avian theropod by intervening on the genome expression of a chick’s embryo in ways that stimulate the formation of ancestral characteristics (activation of atavism). After a discussion of the project in its scientific detail, I offer a theoretical perspective on the topic that relies on concepts developed by Gilles Deleuze. In particular, I argue that the Chickenosaurus can be regarded as an eligible example of Deleuzian “becoming” and that it deserves philosophical attention in that it displays the “creative involution” through which novelty is produced.

**KEY WORDS:** Gilles Deleuze; Jack Horner; palaeontology; Chickenosaurus; Body without Organs; egg



In 2009 palaeontologist Jack Horner published a book about his ongoing project and lifetime dream: building a flesh-and-blood living dinosaur (Horner and Gorman). His aim is to recreate an animal displaying the typical features of those non-avian dinosaurs who went extinct 66 million years ago and whose descendants are avian dinosaurs, i.e. modern birds (Chiappe). Horner's idea is to take advantage of the evolutionary connection between the dinosaur and the bird in order to 'reverse-evolve' the latter into an animal with dinosaurian characteristics, such as teeth, clawed hands and a long tail. What would hatch from the egg would be a "Chickenosaurus." According to Horner, such a goal would be achievable by intervening in the development of a chicken embryo through experimental atavism: researchers could chemically nudge the embryo as a means of producing ancestral traits.

However controversial Horner's figure may be, and however sceptical towards his project many scholars are, the idea is rich in theoretical potential. It is not the aim of this paper to discuss whether the 'build a dinosaur project' should or should not be carried on: the ethical debate around de-extinction in general is broad and indeed interesting (Cohen), but it is not the object of these pages. The Chickenosaurus as is regarded here is a virtual animal; its existence belongs both to fiction and science, to scientific laboratories and artists' studios: the project might be seen as speculative zoology (e.g. Dixon), or as bioart (Kac), or as one of Donna Haraway's speculative fabulations.

Regarded from a theoretical and aesthetical perspective, the Chickenosaurus could be interpreted as a display of Deleuzian "becoming" or as a case of "creative involution." Deleuze's idea of involution must not be understood in terms of regression nor as the opposite of evolution, but rather as the process that takes place in an intense, non-linear dimension of temporality in which filiation is replaced by alliance and boundaries between species become blurred. The Chickenosaurus, crossing species borders, shall no longer be seen as an anthropocentric project (Horner exerting a violent dominion on chicks); on the contrary, the present perspective aims at showing how all agents involved in the project are caught up in a common becoming—or a "becoming-with" (Haraway 12-13). This results in a morphology of creative involution: a performative morphology in which animals and human beings cannot maintain an intact identity with predictable features. Morphogenesis, here, is not a matter of reproduction: it becomes a performance of invention in which organs are never consistent and individuals are, from the very beginning, plural.

In what follows, I will discuss the project in its scientific detail, and then I will offer a theoretical perspective on the topic, mainly by resorting to concepts developed by Gilles Deleuze.



## THE CHICKENOSAURUS PROJECT. A DESCRIPTION

Non-avian dinosaurs are extinct. Bringing them back would mean performing de-extinction. Among de-extinction practices, the most popular one is artificial cloning (SCNT: somatic cell nuclear transfer technique), in which the resulting organism is an exact copy, at the genome level, of the somatic donor's cell (Shapiro). Cloning, however, requires undamaged DNA, which is generally not retrievable for species that went extinct a long time ago. Moreover, SCNT is at the moment not feasible for egg-laying species. This is why cloning is not an option for bringing non-avian dinosaurs back to life.

However, birds are dinosaurs: most of the genetic 'program' for dinosaurian features is already in their DNA—even if it is not expressed. A chicken embryo, for instance, starts developing the long dramatic tail that we all are acquainted to imagine within non-avian theropods; nevertheless, at a certain point the buds (anlagen) of the eighteen vertebrae forming the tail stop growing and the developing shape of the animal turns into that structure made of five vertebrae and the pygostyle that we are used to see in modern birds. The transition from bird to dinosaur does not require a complete new set of genes: rather, one should take control of the expression of those genes that regulate growth. This is the Chickenosaurus strategy.

If cloning appears to be more accurate, it is because it works according to a mimetic logic: it aspires to the complete transparency of representation. Being—at least in theory—a repetition of the identical, cloning does not aim at the production of novelty. On the contrary, Horner's method is interesting precisely in that the resulting animal does not aim at reproducing the original one: it perturbs and subverts its morphological features on the basis of a creative rewind of evolution. The Chickenosaurus, otherwise said, is neither dinosaur nor bird: it is the unstable result of a performative process that takes place between them.

## FROM DINOSAURS TO BIRDS: AN EVOLUTIONARY PATHWAY

In such scenario, we as human beings cannot play a role of neutral spectatorship. We are entangled in the story of birds and dinosaurs, at least as it regards the imaginative processes through which investigation on them is carried on. Not only, evolutionarily, certain dinosaurs became birds, but also birds, from the human perspective, became dinosaurs. Evolution as we reconstruct it is never objective nor exhaustive; on the contrary, these narratives are always performative ones, as they shape the animals we interact with—be they common chickens or mythical critters that dwell in the deep past and in our cultural imaginary.

The pivotal moment in the current understanding of dinosaurs' evolution took place in the late 1960s, when the "Dinosaur Renaissance" began and the outlook on dinosaurs as slow, non-sociable, cold-blooded reptilian beasts was gradually dismissed. In the 1970s Horner and Robert Makela found proof supporting the hypothesis of



nesting behaviour among duck-billed dinosaurs, endorsing the thesis according to which they lived in herds and adults cared for juveniles and eggs (Horner and Makela); in the 1980s, thanks to significant enhancements in palaeohistology, findings of small tunnels for blood vessels (Haversian canals) within some fossilized dinosaur bones encouraged palaeontologists and biologists to link some dinosaurs' metabolism to homeotherms, such as birds, rather than to "cold-blooded" reptiles (Horner and Gorman 67).

A paramount role in this shift in paradigm has been played by John Ostrom: his work on *Deinonychus* and on *Archaeopteryx* led him to argue for the descent of birds from dinosaurs. Such a thesis was not completely new, as Thomas H. Huxley had already supported it one century earlier; nevertheless, Ostrom's results were ground-breaking: certain features that both the collective imaginary and the majority of scholars attributed exclusively to birds, such as feathers or the wishbone (furcula), suddenly pertained to some dinosaurs too. Abundant evidence for this was found in the 1990s, when many feathered dinosaurs fossil records were discovered from Early Cretaceous deposits located in the Liaoning Province, China. Included among the astonishing specimens was also a small dromaeosaurid, *Microraptor*, that was probably a tree-living glider (Horner and Gorman 127-128).

Lastly, crucial to this reconstruction has been the adoption of cladistic methodology (Xu 4), which focuses on the appearance of new characteristics as a way to keep track of evolutionary changes. In cladistic diagrams, groups (clades) are set on the basis of a number of shared derived characters. With feathers and wishbones found within the fossil records, and with *Microraptor* arguably being a paravian gliding dinosaur, powered flight seems now to be the only truly innovative characteristic belonging to birds (Prum), defining them precisely as avian dinosaurs. Acknowledging that birds and dinosaurs share a great number of traits, today's classification establishes *Coelurosauria* as a clade containing various theropod dinosaurs, including *Maniraptora*, the clade in which modern, living birds are currently classified.

Horner's challenge is to dig into living birds and look for traces left by evolution at the molecular level. Such molecular genetic signatures will not reveal anything, of course, unless they are questioned and interpreted—as it is the case for every genuine trace (Krämer 16), being it a fossil or a genome.

## REVERSE-EVOLUTION

Turning to developmental biology, there are questions to answer that concern individuals' shape. How is form generated? What are the morphogenetic mechanisms underlying the emergence of a specific trait?

An animal cell shares the same genetic information with any other cell composing that organism: they all have the very same DNA, but they differ from each other in that they express just a portion of such genetic information. They produce a specific protein



and play a specific role. Understanding how the expression of the genome is regulated is then of crucial importance.

To simplify a bit, the genes that are going to be expressed are transcribed into RNA, a single strand with a mirror genetic code, which then directs the protein synthesis: "DNA is a template for the making of RNA, and RNA is in turn the template for the making of proteins," Sean B. Carroll (55) explains. On the other hand, some of the genes that do not go through the process of transcription remain silent and unexpressed. As organisms are basically built of proteins in which RNA sequences are translated, not only mutations in the DNA but also mutations in the regulation of the genetic expression result in significant changes of the organism's external characteristics (Horner and Gorman 143).

In this framework, there is a set of genes that have an important architectural role in morphogenesis. These are the *Hox* genes, a group within the wider category of homeobox genes, and their peculiarity consists in the nature of the proteins they encode: these proteins are transcription factors; they are able to interact with other genes, turning them on or off during the embryonic development (or, more technically, allowing or preventing their transcription first and their translation into proteins later). Since the expression of some non-*Hox* genes relies on the expression of a *Hox* gene (or on a combination of many *Hox* genes), it is easy to see why the latter are so relevant in the development of a certain organ rather than another (Carroll 59; Minelli 49). Homeodomains, i.e. the homeotic proteins produced by *Hox* genes, were first found in *Drosophila melanogaster* (the fruit fly) at the end of the 1970s; but it did not take much time to find the same genes and proteins in a number of other animals—including vertebrates, mammals, human beings. Such astonishing similarity between the genome of, say, flies and mice (whose evolutionary lines diverged even before the Cambrian Explosion) suggests that these genes have not changed for more than five hundred million years (Carroll 63).

Not only do the *Hox* genes play a topological role in defining the architecture of the organism, *Hox* genes are also tied to a specific chronological order of expression. Considering this double characterization of the genome, both spatial and temporal, neurobiologist Alain Prochiantz underlined how time is a great inventor of forms (qtd. in Gualandi 126), and Stephen Jay Gould stressed the fact that changes in timing of embryonic development result in dramatic changes in evolution (qtd. in Horner and Gorman 140). Prochiantz shares with Gould the idea that the paradox of the variety of shapes within different animal species resulting from almost similar genomes could be solved by taking into consideration the different timings in the switching on and off of the same genetic elements (heterochrony, which may result in neoteny as it is the case for *Homo sapiens*, Gualandi 120). Although not sharing with Gould and Prochiantz the metaphor of the *Bauplan* as the embryo's "plan of construction," Carroll's theory endorses the same idea of a spatio-temporal dimension of genome explication (Gualandi 124): the "dynamic map of the geography of the growing embryo" (Carroll 84).



According to Carroll (74), all these facts make possible to assemble a full-fledged “genetic tool kit” for an animal’s development: it is sufficient to put this family of regulatory genes together with other “master control genes,” i.e. homeotic genes and related proteins involved in organogenesis. Within this tool kit we can also find the so-called “signaling pathways,” denoting those proteins (*Hedgehogs*, for instance) sent as signals from one cell to another: by activating or repressing genes they are able to alter the cell behaviour, movement, rate of growth etc. If one were patient enough to keep track of every gene activation or deactivation, of every chemical event, and of the exact order and location in which they take place throughout the embryo’s development, the final result would be a proper set of the instructions required to build that organism. A set of instructions that would very much appeal to Horner.

#### FROM THE CHICKEN BACK TO THE DINOSAUR

According to Horner, this deeper understanding of how embryonic morphogenesis works sheds light on how animals’ forms change diachronically: “For each new shape and form, there is no new suite of genes [...]. Changes in regulation reverberate through the system of switches and feedback loops to create new forms” (Horner and Gorman 149). The transition from non-avian dinosaurs to birds is not a change in substance: given the same genetic material, the relevant changes take place at the level of the relations between these genetic elements. By mapping the pattern of gene expression changes it is possible to grasp the old paradigm of genetic regulation, and to reverse-evolve the embryo of a bird in order to hatch something similar to a non-avian dinosaur (Horner and Gorman 191). Horner does not suggest changing the genes: he suggests manipulating the embryo by switching genes on and off at different times during development. Genetically, the *Chickenosaurus* would still be a domestic chicken (Horner and Gorman 209); it would not be able to reproduce in kind, as any possible offspring would be just a common chick (Horner and Gorman 175).

These results could be attained by means of experimental atavism. As atavism consists in the appearance of an ancestral characteristic within what would otherwise be a normally developing embryo, experimental atavism refers then to those techniques, performed in a laboratory environment, that aim to reassess such ancestral features that have been dismissed through evolution (Horner and Gorman 176-177). Interventions in development regard the reactivation of dormant genes or a different regulation of still active genes by means of pharmacological agents, or by injections of those proteins that the dormant genes were supposed to encode. Let us take a closer look at these techniques, examining a spectacular trait that avian descendants of dinosaurs have lost: teeth.<sup>1</sup>

---

<sup>1</sup> To be sure, there are many other manifest differences between avian and non-avian dinosaurs. On hands and wings see Larsson and Wagner. On the transition from birds’ opposable hallux back to the non-opposable hallux of early theropods see Botelho *et al.* On the molecular mechanisms underlying the



Already in the 19th century Étienne Geoffroy Saint-Hilaire observed the formation of transient structures on the jaw of birds' embryos; he claimed that they represented an early stage in what looked like the making of rudimentary reptilian teeth. Émile Blanchard, later on, argued for the same thesis, followed shortly after by Edward G. Gardiner. Nevertheless, the hypothesis was rapidly dismissed, to be recovered during the first two decades of the 21st century.

In 2002 Matthew Harris found a row of teeth-like structures running along the jawline of a *talpid*<sup>2</sup> chicken embryo preserved in glycerol. The mutant displayed teeth-like buds, which failed to be noticed earlier because they were hidden beneath the rhamphotheca, i.e. the outer keratin beak, which came off when Harris took the specimen out of the glycerol solution (Hayden 40). This event led Harris to keep working on the topic of chicken's teeth, experimenting with atavism and *talpid*<sup>2</sup>.<sup>2</sup> The results came in 2006, when he and his team published a paper in which they demonstrated the initiation of tooth developmental programs in non-mutant embryonic birds, being both the teeth buds and the developmental process homologous with the formation of first rudimentary teeth in alligators (Harris *et al.* 371). Although these first steps were not followed by the invaginations that are typically associated with proper dental formation, they were evidence of the fact that birds' loss of teeth did not go together with the loss of tooth developmental potential. The research also showed that by stimulating the production of a certain protein ( $\beta$ -catenin) in chick embryos, they went on to develop their teeth-drafts both on the upper and the lower beaks (Harris *et al.* 374-375). Following this line, one could restore ancestral teeth within a possible Chickenosaurus.

## THE CHICKENOSAURUS PROJECT. A THEORETICAL OUTLOOK

The Chickenosaurus project offers a number of insights that may elicit fruitful theoretical investigations. Before focusing on those, however, some of its critical points need to be discussed. Not only does the project imply a naïve understanding of organogenesis, but the excessive importance it attributes to genes also may lead it to espouse genetic determinism. Both problems rely on the underestimation of the role played by relations—relations between the different parts of the organism, in the first case, and between the organism and its *milieu* in the second one.

---

formation of avian rostrum instead of the dinosaurian non-beaked facial morphology see Bhullar *et al.*, showing how it is possible to obtain birds' embryos with a dinosaurian snout.

<sup>2</sup> It might be worth noticing that *talpid*<sup>2</sup> mutant embryos rarely survive after the 12<sup>th</sup> day of development (E12) (Harris *et al.* 372): from the point of view of nature, these mutants are a dead end. On the contrary, human beings can regard them as full of theoretical and practical potential. This fact can solicit questions concerning the relationship between nature and artificiality. In our case, artificiality prolongs nature by "Taking a detour": it thematizes the interruption in the evolutive process as a point of departure for a parallel process of comprehension and further genesis.



The risk of picturing a determinism on a genetic basis arises when the metaphor of development as execution of the genetic program is not balanced by the consideration of the decisive role played by the environment in shaping the physical appearance of the organism. Given a certain genotype, many different phenotypes can be produced depending on the surrounding conditions; conversely, very similar phenotypes can be the result of different genotypes, since the “relationship between gene and phenotype is neither simple nor unilateral” (Minelli 207). Not only must the idea of the omnipotence of genes be abandoned (Minelli 61-62), but also the understanding of genome as a linearly hierarchical system, with “master genes” at the top, should be questioned in favour of a reticular model of description which would depict interrelations between different genes and their products. The totality of these relations would result in a network (Minelli 53-55).

Concerning the formation of organs, even though the focus is, case by case, on a particular component of the body, one should not forget that a site-specific change will always affect the organism as a whole. The point has been brought up by Carroll, for instance, who has mentioned the coordination difficulties a *Chickenosaurus* would very likely encounter (qtd. in Hayden 41). Additionally, organogenesis should be understood as a mere epistemological category that we employ for explicatory purposes (Minelli 129). There are indeed distinct sequences of morphogenetic events that contribute to the formation of one or more organs and that proceed autonomously for a while, but they are not organogenetic events—they are “modules” (Minelli 208-209). In order to understand development, the focus should not be placed on the modules themselves but on the mutual interrelations between them. The emergence of novelties throughout evolution could therefore be better explained by considering changes in this complex system of relationships.

On the other hand, Horner’s project does have some positive traits: firstly, it contributes to dismiss various forms of the implicit finalism that—more often than expected—undermines biology. It is in fact true that most evolutionary biology has abandoned any teleological outlook on evolution; nevertheless, the idea that evolution only proceeds forward, in a unilateral direction, is still a hegemonic, yet often implicit, perspective. Horner’s eccentric idea lets us conceive something different from the one-way path we are familiar with: it makes us think of evolution as capable of going backwards while still moving ahead; it can even endorse an account in which evolution goes neither forward nor backwards, but rather moves sideways.

Moreover, developmental biology is frequently vitiated by an even more subtle kind of finalism, what Alessandro Minelli calls the “adultocentric” outlook on development (Minelli 93). According to this tacit assumption, adults represent the true shape and legitimate condition of the organism. Eggs, juveniles (and human children among them) are often seen as transient steps to the adult form; they are regarded as if they were teleologically tending to such more perfect shape (and social status) (Minelli 77-78). However, even defining adulthood may well prove itself to be more complicated than expected (Minelli 109-113), as boundaries between life stages are not as sharp as one could believe.



Horner's project, albeit flawed under many respects, restores dignity to those alleged preliminary phases that the egg and the dinosaur are too often considered to be. Rethinking the theoretical meaning of the 'build a dinosaur project' does not merely entail the appreciation of the role played by such 'minoritarian' entities, but it also leads to consider species as porous, permeable concepts that can merge with one another, rather than as rigid, static categories. The betweenness in which species meet is the peculiar, thick space in which the Chickenosaurus can happen.

#### BEYOND ORGANS: THE EGG

Biology tells us that behind the formation of organs there are smaller morphogenetic events. In Deleuze and Guattari's vocabulary, one could say that the dimension of organisms and forms relies on an intense dimension of reality that lacks extension, although being perfectly immanent: the former level is defined as the *molar* plane of organisation, the latter as the *molecular* plane of consistency. Within the "molecular" dimension is located what Deleuze and Guattari call, borrowing the expression from Antonin Artaud, the Body without Organs (BwO). The BwO is the "intense fact of the body" (Deleuze, *Bacon* 45-46) that takes place beyond the organism: more than being opposed to organs, it is opposed to the organism conceived as organs organisation (Deleuze, *Bacon* 44). The BwO could be depicted as "a non-organismically ordered body" (Protevi 257), as it does not really lack organs: it rather lacks their fixation that prevents intensities from crossing its surface (Deleuze, *Bacon* 47). Organs may even appear (as pure intensities) by "crossing thresholds" or "changing gradient" (Deleuze and Guattari, *Plateaus* 153): as William S. Burroughs states, "no organ is constant" (qtd. in Deleuze, *Bacon* 47). Organs intensively distribute themselves over the body, regardless of the form of the organism.<sup>3</sup> In order to reach the powerful, inorganic life that the organism imprisons, it is necessary to dismantle the organismic structure in favour of the body (Deleuze, *Bacon* 45). This is not a call for annihilation: on the contrary, this operation aims at gaining life and it needs to be carried on cautiously. As Deleuze and Guattari explain, "dismantling the organism has never meant killing yourself, but rather opening the body to connections" (Deleuze and Guattari, *Plateaus* 160). The BwO is not the negation of the form *tout court*: it is its radical openness to the field of the intense and the virtual, the re-declension of form as derived, multiple, moving, modifiable entity (Buydens 35).<sup>4</sup>

"The BwO is the egg," Deleuze and Guattari (*Plateaus* 160) write. The egg is a powerful conceptual image that has been widely employed by Deleuze. Although being

---

<sup>3</sup> Recalling the 1830 debate between French anatomists Étienne Geoffroy Saint-Hilaire and Georges Cuvier, Deleuze and Guattari decidedly side with the former since they "go beyond organs" just like Geoffroy Saint-Hilaire did (see Zdebik 158; Ansell Pearson 159-160).

<sup>4</sup> For a different perspective on the topic see Hansen, who reproaches Deleuze and Guattari the complete dismissal of the organism as the molar form that limits life and arrests forces. According to Hansen, Deleuze and Guattari's anti-organicism is at odds with their own scientific sources.



a multifaceted notion, the egg can ultimately be said to be the field of intensity *par excellence*: it is the “body ‘before’ organic representation” (Deleuze, *Bacon* 45), crossed by movements that do not stabilize into any definitive form. The egg should not be mistaken for the symbol of an alleged origin: if it ever is a place of birth, such birth could only be the creative repetition of the first natality that never takes place. The egg is therefore better described as “an egg of germinal intensity” (Ansell Pearson 9), always crossed by forces in a never-ending reconfiguration.

The Chickenosaurus is the egg. The Chickenosaurus literally is an egg, since it cannot hatch: the genetic manipulations previously discussed regard the chick’s embryo. At present, hatching a Chickenosaurus is not feasible mainly because of legal and bioethical reasons; but hatching a Chickenosaurus as we have conceived it would prove itself to be outright impossible: “Chickenosaurus” is the name by which we refer to the process of making such an animal, rather than the animal itself. In this respect, the Chickenosaurus is not detachable from those morphogenetic events that keep dismantling and producing its body, by means of a disorganisation of the organs that makes them transit topologically through the Chickenosaurus’ anatomy and chronologically through dinosaurian history. The Chickenosaurus is a process, a permanent morphogenesis: a Body without Organs.

The Chickenosaurus is not possible. At best, if someday in the future it will actually hatch, it *will have been possible*. The point, made by Bergson first and embraced by Deleuze later, is that there is a “retrograde movement of the true” (Deleuze, *Bergsonism* 18), according to which possibility arises only retrospectively, as it is projected on reality while however claiming that it had always preceded reality itself. Currently, the Chickenosaurus is not possible: it is virtual. This means that it is not actual, but it indeed belongs to reality—to the intense, unextended domain of reality in which BwOs are “located” and in which Deleuzian events and becomings take place.

#### BECOMING-DINOSAUR: A CREATIVE INVOLUTION

A central concern in Deleuze’s thought is the problem, Bergsonian in inspiration, of *le nouveau en train de se faire* (Deleuze, *Cinema* 3). How does novelty occur?

At first, Deleuze was fascinated by Bergson’s notion of creative evolution. According to Bergson, the absolutely new is produced through invention. Deleuze initially receives these ideas by focusing on the Bergsonian *élan vital* as a way to actualize the virtual through “differentiation as the production of real differences” (Deleuze, *Bergson* 28): between virtual and actual there is no resemblance. Later on, especially in his collaboration with Guattari, Deleuze abandons the concept of creative evolution as it is still too tied to human consciousness and, generally, to humanism (Ansell Pearson 142); he then turns to the notion of “creative involution” (Deleuze and Guattari, *Plateaus* 238).

This shift marks the transition to the non-hereditary, anti-genealogical, rhizomatic and machinic understanding of evolution developed in *A Thousand Plateaus*. Involution



is not regression, being regression the movement that goes from something more differentiated to something less differentiated (Deleuze and Guattari, *Plateaus* 238). Involution does not move forward nor backward: it rather proceeds sideways. Creative involution is the production of novelty through alliance, contagion, communication, as it is the case for anti-natural couplings and symbiotic complexes. Symbiogenesis shows how innovation comes from intersections between different phyla (Margulis); it also displays a way in which living matter is able to evade “genetic destiny” and produce unpredictable configurations of the living being. Involution does not proceed via hereditary transmission and reproduction (filiation on the model of arboreal descent) but by establishing rhizomatic relations that produce something new—a novelty that is more than the mere sum of the terms. Involution as rhizome functions transversally, as a “side-communication” (Deleuze and Guattari, *Plateaus* 53) that cuts across distinct lineages and taxonomic boundaries: it operates in the middles, and it has neither origin nor final purpose. Evolution is not negated: it is differently understood. “Only the involution evolves” (Deleuze, *Repetition* 118).

The notion of creative involution goes together with Deleuze and Guattari’s idea of becoming, as “becoming is involutionary” (Deleuze and Guattari, *Plateaus* 238). Becomings (Penthesilea’s becoming-bitch, for instance, or Captain Ahab’s becoming-whale) are not resemblance nor imitation. Hence, one does not become-animal by playing the animal: “Ahab does not imitate Moby Dick, and Penthesilea does not ‘act’ the bitch” (Deleuze and Guattari, *Philosophy* 173). The becoming-animal is real, without the animal that one becomes being so: reality pertains to “the block of becoming, not [to] the supposedly fixed terms through which [that becoming] passes” (Deleuze and Guattari, *Plateaus* 238). Becomings perform the “unnatural participation” (241) of heterogeneous terms that converge in an assemblage, or block of becoming. Such terms are never mutually commensurable; they can share a productive erotism but no sexuality for reproduction purposes. Through these interkingdom combinations nature operates against itself: “Becomings are [...] phenomena [...] of a double capture, of non-parallel evolution, of nuptials between two reigns. Nuptials are always against nature” (Deleuze and Parnet 2). Dismantling the bodily organization through becomings and creative involution should therefore not be seen as a leap into the undifferentiated: it is rather the way in which innovation and evolution occur. To “make yourself a BwO,” to be caught up in machinic assemblages, to creatively involve—it all means “not regression: invention” (Masumi 85).

Circling back to Horner’s project, the Chickenosaurus appears to be a block of becoming in which chicken and dinosaur are implicated: it is the merging of different entities that are not supposed to meet; it has no origin in the genealogical sense nor possible heredity in terms of offspring. The Chickenosaurus is the becoming-dinosaur of the bird, as well as the becoming-bird of the dinosaur. Being avian *and* non-avian, the Chickenosaurus takes place within a “zone of indiscernibility” (Deleuze, *Essays* 78) peopled by pre-individual singularities that perform alliances between each other: the dimension of betweenness or of the “*entre-deux*” (what Jacques Derrida (29) would call the “limitrophy” between species). However, the becoming displayed by the



Chickenosaurus differs from others in at least one significative respect: the existences of its terms (the bird and the dinosaur) take place at very different moments in time. How are those animals supposed to meet, especially since “becomings belong to geography” (Deleuze and Parnet 2) rather than to history?

Not only is the dinosaur-chicken assemblage against nature; it also is against time. By connecting elements that are more heterochronic than heterogeneous, the Chickenosaurus gives rise to a diachronic alliance: nuptials out of time. This aspect sheds light on yet another trait of becoming and involution: the temporality of the molecular plane of consistency is not a chronological one, in which time flows univocally from past to future in a never-ending succession of present moments. Such kind of temporality is *Chronos*, “the present which alone exists” (Deleuze, *Logic* 77), and it finds its opposite in *Aiôn*. Becoming is not a matter of future, as much as involution is not a matter of past: their temporality is *Aiôn*, i.e. “the past-future, which in an infinite subdivision of the abstract moment endlessly decomposes itself in both directions at once and forever sidesteps the present” (Deleuze, *Logic* 77). This intense multi-directional temporality is rhizomatic rather than linear, and it is the dimension of those pre-individual singularities (haecceities) that get involved in mutual becomings. The coupling of chicken and dinosaur could only take place within *Aiôn*, where their chronological inconsistency ceases to matter. In *A Thousand Plateaus* Deleuze and Guattari say, referring to the intensive reality of the egg as BwO: “It is not the child ‘before’ the adult, or the mother ‘before’ the child: it is the strict contemporaneousness [...] of the adult and the child” (Deleuze and Guattari, *Plateaus* 164). The same contemporaneousness belongs to the dinosaur and the bird, that meet in *Aiôn* and on the plane of consistency—since not only the temporality of becoming is an intense one: its geography is intense too, as it concerns *spatium*, not extension.

## FINAL REMARKS

As has been shown, what at first sight appeared as a scientific aberration could be instead regarded as a fascinating display of Deleuzian becoming. A possible criticism to this claim could concern the artificiality of the project: it is not nature operating against itself—it could be argued—, it is rather human beings operating against nature. The comparison between cases of symbiosis in nature and the laboratory-made Chickenosaurus would thus result not so compelling.

From a Deleuzian perspective, this is not a serious concern. Nonorganic life lies at the core of organic life itself; natural and artificial activity are indissolubly imbricated in the play of forces. Just as boundaries between species and borders between individuals are not that sharp, there is no such thing as a clear-cut distinction that parts nature from technology. Human beings are intimately involved within the environment: we are constantly caught up in relationships, we are always becoming-something else. Horner’s gesture perverts nature and thus prolongs it from within: in this sense, “Transcendence is always a product of immanence” (Deleuze, *Immanence* 31). The



"build a dinosaur project" is not at odds with other morphogenetic processes; also, it brings together human and non-human actors in a common becoming. Scholars who work on the Chickenosaurus' implementation cannot be parted from the block of becoming occurring between the bird and the dinosaur; they never cease to become-with the chicken, become-with the dinosaur.

## WORKS CITED

Ansell Pearson, Keith. *Germinal Life. The Difference and Repetition of Deleuze*. Routledge, 1999.

Bhullar, Bhart-Anjan S. *et al.* "A molecular mechanism for the origin of a key evolutionary innovation, the bird beak and palate, revealed by an integrative approach to major transitions in vertebrate history." *Evolution*, vol. 69, no. 7, 2015, pp. 1666-1677.

Blanchard, Émile. "Observations sur le système dentaire chez les oiseaux." *Comptes rendus*, vol. 50, 1861, pp. 540-542.

Botelho, João Francisco *et al.* "Skeletal plasticity in response to embryonic muscular activity underlies the development and evolution of the perching digit of birds." *Scientific Reports*, vol. 5, 2015.

Buydens, Mireille. *Sahara. L'esthétique de Gilles Deleuze*. Vrin, 2005.

Carroll, Sean B. *Endless Forms Most Beautiful. The New Science of Evo-Devo and the Making of the Animal Kingdom*. Norton, 2005.

Chiappe, Luis M. *Glorified Dinosaurs: The Origin and Early Evolution of Birds*. John Wiley, 2007.

Cohen, Shlomo. "The Ethics of De-Extinction." *Nanoethics*, vol. 8, 2014, pp. 165-168.

Deleuze, Gilles. *Cinema 1. Image-Movement*. Translated by Hugh Tomlinson and Barbara Habberjam, Minnesota University Press, 1986.

---. *Bergsonism*. Translated by Hugh Tomlinson and Barbara Habberjam, Urzone, 1988.

---. *The Logic of Sense*. Translated by Mark Lester and Charles Stivale, The Athlone Press, 1990.

---. *Difference and Repetition*. Translated by Paul Patton, The Athlone Press, 1994.

---. *Essays Critical and Clinical*. Translated by Daniel W. Smith and Michael A. Greco, Minnesota University Press, 1997.

---. "Immanence: A Life." *Pure Immanence. Essays on A Life*, translated by Anne Boyman, Urzone, 2001, pp. 25-33.

---. *Francis Bacon. The Logic of Sensation*. Translated by Daniel W. Smith, Continuum, 2003.

---. "Bergson, 1859-1941." *Desert Islands and Other Texts 1953-1974*, translated by Mike Taormina, Semiotext(e), 2004, pp. 22-31.

Deleuze, Gilles and Guattari, Félix. *A Thousand Plateaus. Capitalism and Schizophrenia*. Translated by Brian Massumi, Minnesota University Press, 1987.



- . *What Is Philosophy?* Translated by Hugh Tomlinson and Graham Burchell, Columbia University Press, 1994.
- Deleuze, Gilles, and Claire Parnet. *Dialogues*. Translated by Hugh Tomlinson and Barbara Habberjam, Columbia UP, 1987.
- Derrida, Jacques. *The Animal That Therefore I Am*. Translated by David Wills, Fordham University Press, 2008.
- Dixon, Dougal. *After Man. A Zoology of the Future*. St. Martin's Press, 1981.
- Gardiner, Edward G. "Beiträge zur Kenntnis des Epitrichiums und der Bildung des Vogelschnabels." *Archiv für Mikroskop. Anatomie*, vol. 24, 1884, pp. 289-338.
- Geoffroy Saint-Hilaire, Étienne. "Sur le système dentaire des oiseaux." *Annales Generales des Sciences Physiques*, vol. 8, 1821, pp. 373-380.
- Gualandi, Alberto. "L'individuazione neotenica umana e la genesi exattante e comunicativa del 'senso.'" *Discipline filosofiche*, vol. 19, no. 1, 2009, pp. 117-136.
- Hansen, Mark. "Becoming as Creative Involution? Contextualizing Deleuze and Guattari's Biophilosophy." *Postmodern Culture*, vol. 11, no. 1, 2000.
- Haraway, Donna. *Staying with the Trouble. Making Kin in the Chthulucene*. Duke UP, 2016.
- Harris, Matthew P. et al. "The Development of Archosaurian First-Generation Teeth in a Chicken Mutant." *Current Biology*, vol. 16, 2006, pp. 371-377.
- Hayden, Thomas. "How to Hatch a Dinosaur." *The Best American Science and Nature Writing*, edited by Dan Ariely and Tim Folger, Houghton Mifflin Harcourt, 2012, pp. 35-43.
- Horner, John R., and James Gorman. *How to Build a Dinosaur: Extinction doesn't have to be forever*. Dutton, 2009.
- Horner, John R., and Robert Makela. "Nest of Juveniles Provides Evidence of Family-Structure Among Dinosaurs." *Nature*, vol. 282, 1979, pp. 296-298.
- Kac, Eduardo, editor. *Signs of Life. Bio Art and Beyond*. The MIT Press, 2007.
- Krämer, Sybille. "Was also ist eine Spur? Und worin besteht ihre epistemische Rolle? Eine Bestandsaufnahme." *Spur. Spurenlesen als Orientierungstechnik und Wissenskunst*, edited by Sybille Krämer et al., Suhrkamp, 2007, pp. 11-33.
- Larsson, Hans C.E., and Günter P. Wagner. "Pentadactyl Ground State of the Avian Wing." *Journal of Experimental Zoology* 294, 2002, pp. 146-51.
- Margulis, Lynn. *Symbiotic Planet: A New Look at Evolution*. Basic Books, 1999.
- Massumi, Brian. *A User's Guide to Capitalism and Schizophrenia*. The MIT Press, 1992.
- Minelli, Alessandro. *Forms of Becoming. The Evolutionary Biology of Development*. Translated by Mark Epstein, Princeton University Press, 2009.
- Ostrom, John H. "Archaeopteryx." *Discovery*, vol. 11, no. 1, 1975, pp. 15-23.
- Protevi, John. "Deleuze and Life." *The Cambridge Companion to Deleuze*, edited by Daniel W. Smith and Henry Somers-Hall, Cambridge UP, 2012, pp. 239-264.
- Prum, Richard O. "Dinosaurs take to the air." *Nature* 421, 2003, pp. 323-324.



Shapiro, Beth. "Pathways to de-extinction: how close can we get to resurrection of an extinct species?" *Functional Ecology*, vol. 31, 2017, pp. 996-1002.

Xu, Xing. "Feathered dinosaurs from China and the evolution of major avian characters." *Integrative Zoology*, vol. 1, 2006, pp. 4-11.

Zdebik, Jakub. *Deleuze and the Diagram. Aesthetic Threads in Visual Organisation*. Continuum International Publishing Group, 2012.

---

**Alice Iacobone** is PhD student at the Philosophy Department of the University of Genoa (FINO Consortium) with a project concerning performativity and plasticity in sculpture. Her research lies at the intersection between aesthetics, philosophical morphology and art history, with a strong interest in theoretical biology.

<https://orcid.org/0000-0002-7681-5471>

[alice.iacobone@gmail.com](mailto:alice.iacobone@gmail.com)

---