# SYMPOIETIC ASSEMBLAGE

## FROM BIOMIMETICS TOWARD A MORE-THAN-HUMAN ECOLOGY OF FASHION

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**Abstract**

Fashion has long engaged nature as both a formal and material field, a reservoir of forms through which the discipline negotiates its relationship with matter and time. This contribution investigates the progressive transformation of this condition, tracing a shift from an initial conception of nature as a formal referent to be imitated, toward the operationalisation of biological principles and behavioural logics, until nature itself emerges no longer as a passive referent, but as an active co-agent within contemporary design processes. Through the analysis of selected fashion practices, the contribution traces a trajectory from digitally mediated forms of computational biomorphism to functional biomimesis, and toward post-anthropocentric forms of ontological design in which non-human agencies increasingly participate in the constitution of the project itself.. The concept of *Sympoietic Assemblages* serves as a critical lens through which these developments are interpreted. Drawing on Deleuze and Guattari's notion of assemblage and Donna Haraway's theory of sympoiesis, the contribution outlines the emergence of a relational ecology of design in which form, meaning, and agency emerge through processes of co-constitution.

**Keywords**: Fashion ecologies; Sympoietic design; Material Agency; Biomimicry; More-than-human practices

## INTRODUCTION

Design has always been a way of thinking with the world, a practice of attuning to its forms, rhythms, and vital forces. Within this relational field, nature has historically operated as a source of formal inspiration and as a dispositive through which the human imagination interrogates its own limits and possibilities. This dynamic is particularly resonant with fashion design, where the encounter between living matter and material-aesthetic configurations destabilises distinctions between biological processes, cultural imaginaries, and technical systems.

While the impulse to imitate nature is as old as human creativity itself, it was not always approached equally. Primarily positioned as an external referent, nature was valued for its morphological richness and expressive potential, with particular emphasis placed on stylised, often surreal organic forms that translated the vitality of the living into new visual and material expressions. This practice is associated with *biomorphism*, understood here as a modelling system through which design elements are generated from natural morphologies and formal configurations. From the second half of the twentieth century, with the rise of *biomimicry* as an autonomous scientific and design field capable of translating biological processes into operative strategies, a new trajectory of inquiry based on functional transposition is inaugurated (Schmitt, 1969). The publication of Janine Benyus' *Biomimicry: Innovation Inspired by Nature* gives this field a more articulated epistemological status, positing nature as "Model, measure, and mentor" (Benyus, 1997, p.6). The focus thus shifts to adaptive strategies, ecological principles, and optimisation processes embedded within ecosystems. From the early

2000s onward, biomimicry gradually intersects with computational design, algorithmic morphogenesis, digital fabrication, and material engineering, contributing to the emergence of hybrid fashion paradigms (Hensel, Menges & Weinstock, 2014). The ability to extract, encode, and systematize data from nature has contributed to the transformation of fashion design into a situated computational environment, in which generative software, machine learning tools, and digital platforms redefine modes of interaction. Within a broader epistemic shift, critical reflections emerging from post-anthropocentric design discourse begin to challenge the separation between human and non-human, destabilising conventional understandings of nature as a passive external entity. (Escobar, 2018; Haraway, 2016; Akama et al., 2020). The act of designing is conceived as a relational outcome of heterogeneous interactions between technologies and environments. In this transition, the epistemological evolution that, originating in biomorphism and traversing biomimicry, culminates in an ecological and relational vision of design, wherein nature actively participates in the act of producing forms.

The present contribution critically examines this shift within the field of fashion, framing sympoietic design practices as a paradigmatic reorientation in which agency is articulated across biological and computational assemblages.

## EPISTEMOLOGICAL AND INTERPRETATIVE FRAMEWORK

This study adopts a qualitative and theoretical methodology situated within critical fashion studies, design research, and posthuman theory. The contribution is conceived as a conceptual and epistemological inquiry aimed at clarifying how the role of nature in fashion design has shifted from biomorphic representation to biomimetic optimisation and, ultimately, to sympoietic co-agency. The method is grounded in the critical reading of theories and practices inherent to fashion design, selected through a purposive logic for their capacity to materialise distinct ontological approaches to the nature-design relationship. The analysis is conducted through secondary sources, including designer statements, exhibitions, and academic literature; the selected cases study are treated as situated instances that render visible the material-discursive articulations that manifest the relations between data, matter, and living systems. The analysis of these fashion practices offers a comparative perspective on how nature is variously enacted across contemporary design practices. The proposed methodological framework is intended as a transferable interpretative tool for analysing fashion practices in which design emerges from its multi-level entanglement with planetary ecosystems.

## GENEALOGIES OF NATURE IN FASHION DESIGN

As previously mentioned, an initial approach to the relation between nature and fashion design is undoubtedly tied to *biomorphism*: nature functions as a symbolic catalogue and morphological archive, materialising in ornamental and stylised motifs that are inspired by floral and zoomorphic morphologies. Alfred H. Barr Jr. was the first to articulate the term *biomorphism* in 1936. The preference for indeterminate, organic forms suggestive of dynamism, often evoking the amorphous and quasi-spherical configurations of germs, amoebae, and embryonic life, can be understood as rooted in the vegetal imaginary of the late nineteenth-century Art Nouveau. Within the architectural and aesthetic and aesthetic milieu, the extensive production of of Henry van de Velde, Victor Horta, and Hector Guimard stands as one of the most significant expressions of the Art Nouveau giving rise to fluid spatial and decorative systems informed by vegetal morphologies. In fashion design, biomorphism has historically operated less as a functional strategy than as a formal and symbolic language through which the vitality of nature was transposed into silhouette, surface, and movement, privileging organic continuity over structural rationalisation. Its early stands as one of the most significant expressions of the Art Nouveau giving rise to fluid spatial and decorative systems informed by vegetal morphologies, designers such as Paul Poiret and Mariano Fortuny experimented with forms inspired by marine and floral motifs through soft geometries, pleats, and draping (Evans, 2003). Over the course of the twentieth century, biomorphism developed into increasingly complex sartorial articulations, exemplified by the sculptural volumes of Balenciaga's garments and the pleated architectures of Fortuny's *Delphos* dress. In these works, a plastic and organic sensibility aligned with modernist formal experimentation gives rise to early biomorphic translations of natural growth and fluidity into sartorial form, wherein nature operates as a morphological archive. The advent of parametric modelling has enabled biomorphism to expand into three-dimensional space, allowing for the materialization of homothetic structures inspired by natural systems. Software environments capable of generating forms through algorithms, mathematical functions, or an iterative set iterative set of rules, have significantly extended the morphogenetic repertoire of design, making it possible not only to emulate existing patterns but to create entirely new, plausible formations. This shift marks the transition from geometrical design systems to algorithmic and systemic modes of form generation, in which form emerges through procedural logics. Data extracted from the observation of nature, now accessible across microscopic scales, acquire a new epistemic status, operating as computable parameters that activate generative matrices and recursive units

within open-ended design systems. This transformation resonates with the digital turn identified by Mario Carpo, whereby natural natural forms are translated into algorithmic logic and variable-driven processes (Carpo, 2011). This convergence of nature and algorithms marks the beginning of biologically informed design, where form and function co-emerge as the outcomes of dynamic systemic processes.

## BIOMIMESIS: NATURE AS OPERATIVE AND PERFORMATIVE SYSTEM

The formalist conception was gradually accompanied by the idea of nature as an operative and optimised system, giving rise to the concept of *biomimesis* (or *biomimetics*), a design strategy oriented toward replicating the functional and systemic principles of the living world. This trajectory has been fostered by the refinement of methods for observing nature across scales ranging from the nanometric to the macroscopic, enabling the dynamics and organizational logics of living systems to be rendered legible and translated into design data (Vincent et al., 2006).

The term *biomimesis*, introduced by biophysicist Otto Schmitt, derived from the words βίος (life) and μίμησις (imitation) and consists in observing and reproducing mechanisms found in nature to develop projects that incorporate their functional, systemic or behavioural characteristics (Vincent et al., 2006). Janine Benyus (1997) formalised this approach in her seminal work *Biomimicry: Innovation Inspired by Nature*, where she argued that nature should be observed in its engineering perfection.

Within the textile sector, biomimetic strategies enable designers to integrate functional properties such as self-cleaning, self-repair, energy efficiency, friction reduction, dry adhesion, and superhydrophobicity (Bar-Cohen, 2006). These innovations have led to the development of bio-inspired fabrics with functional surfaces, structural colouration, self-healing capacities, and thermal insulation properties. The development of biomimesis was further consolidated with the advent of computational and generative design, which enabled the algorithmic simulation and modelling of complex biological behaviours (Weinstock, 2010; Hensel, Menges & Weinstock, 2014). Nature is approached as a dynamic reservoir of performative and systemic data that can be empirically extracted. Through the use of biosensing technologies, high-resolution microscopy, finite element analysis (FEA), and AI-driven material simulations, such data are interpreted computationally and consequently translated into design strategies. Nature is rendered intelligible and operative through a logic of extraction and transposition where biological processes are emulated by algorithmic models. As Neri Oxman observes: “Computational design enables us to think like nature, rather than about nature” (Oxman, 2010, p. 12), encapsulating the shift from a mimetic conception of nature to a design paradigm that embraces its systemic and generative logics.

## EXAPTATION AND THE RECONFIGURATION OF NATURAL AGENCY

Such a framework introduces a teleological and optimisation-oriented rationality into the reading of nature, a perspective that tends to marginalise the contingent and emergent dynamics constitutive of living systems (Vincent, 2009). Within this horizon, the evolutionary concept of *exaptation* provides a critical lens for rethinking the assumptions underpinning biomimetic approaches. As emphasised by architect and theorist Alessandro Melis, and articulated through his curatorial direction of the 2021 Venice Architecture Biennale *Resilient Communities*, exaptation foregrounds processes of adaptive reuse, redundancy, and improvisation as intrinsic dimensions of natural evolution. Originally introduced by Stephen J. Gould and Elisabeth S. Vrba, exaptation designates evolutionary processes through which traits developed within one functional context are subsequently redeployed within different and unforeseen domains (Gould & Vrba, 1982). Canonical examples, such as feathers initially associated with thermoregulation and later implicated in flight, illustrate how innovation emerges through the reconfiguration of existing structures and latent capacities. From this post-Darwinian perspective, nature appears as an entropic and open-ended system, characterised by the capacity to activate alternative pathways of transformation (Melis & Pievani, 2022). When translated into the field of fashion, exaptation supports an epistemic orientation attentive to contingency and emergent function. Design practices informed by this approach engage processual configurations, in which unintended outcomes and performative reinterpretations acquire generative value. This methodology fosters a speculative design culture that accommodates complexity and uncertainty while cultivating aesthetic and material practices aligned with open-ended modes of becoming (Pigliucci & Müller, 2010; Arthur, 2009).

## RELATIONAL AND SYMPOIETIC ECOLOGIES OF DESIGN

Beyond the dialectic between form and function, a new ontological stance emerges in which nature becomes a co-agent in design processes. The focus shifts from *representation* to *intra-action*, a key concept introduced by Karen Barad, who states: “Relata do not pre-exist relations; rather, relata-within-phenomena emerge through specific intra-actions” (Barad, 2007, p. 140).

Aligned with this orientation, fashion design is intended as a relational and performative practice, where nature and technology co-emerge. Donna Haraway, with her notion of *sympoiesis*, insists on the need to *make-with*: "Nothing makes itself; nothing is really autopoietic or self-organizing. The smallest unit of analysis is always a relation" (Haraway, 2016, p. 58). Within this sympoietic paradigm, data mutually constitute through the continuous interaction between environmental and computational systems. Such data are situated, dynamic, and multispecies and encompass environmental inputs (light, $CO_2$, humidity), biological signals (growth, cellular stress), and relational parameters (use, care, temporality). Their acquisition relies on environmental sensors, bio-digital interfaces, machine learning algorithms, and real-time feedback loops that enable the project to unfold as an interactive system, where data are the actors of operative events: the contingent expressions of an ongoing co-existence. The entangled design practices proposed by Keune substantiate an epistemic shift wherein material and living systems are brought into relation according to logics of "aesthetics of interdependence and vulnerability" (Keune, 2017, p. 65). In fashion design, these instances take form in projects such as Neri Oxman's *Wanderers* (2014), where generative materials and biologically inspired forms are co-created through additive technologies and environmental data. Fashion liberates itself from its role as representational surface and becomes a reactive onto-political dispositive (Foucault, 1980)[1] capable of activating multispecies worlding processes in which design is configured as a gesture of care and openness to non-human alterity (Puig de la Bellacasa, 2017).

## MATERIAL PRACTICES AT THE INTERSECTION OF BIOMORPHISM AND BIOMIMETICS

This section examines contemporary fashion practices that engage nature as both a formal and morphological archive and a source of functional and performative principles. The selected case studies reconstruct a trajectory from formal experimentation toward co-emergent design conditions, foregrounding different ontological configurations of the relationship between nature and design. Particular attention is given to projects in which natural morphologies, biological processes, and environmental dynamics assume an operative role within the design process. Attention was also given to the use of computational, material or bio-digital infrastructures that enable relational and processual modes of making, as well as to practices in which agency is redistributed across human and more-than-human actors.

Historically, and within the analytical framework of this study, biomorphism emerges as an early form of design engagement with nature. In contemporary fashion, this practice moved beyond the representational role of nature it toward the generation of hybrid sartorial morphologies suspended between reality and imaginary worlds. This posture is evident in Alexander McQueen's *Plato's Atlantis* (Spring/Summer 2010), where digitally generated reptilian and aquatic morphologies informed prints and material transformations, translating evolutionary and biological imaginaries into computationally mediated form. A similar approach can be observed in Hussein Chalayan's *One Hundred and Eleven* (Spring/Summer 2007), in which garments mechanically and morphologically transform on the runway, evoking processes of organic growth, adaptation, and temporal mutation through technological orchestration. The Dutch designer Iris van Herpen is recognised worldwide for her collections inspired by nervous systems, corals, neural tissues, and cellular formations. In the *Voltage* collection (2013), where she references bioelectric patterns and magnetic fields, while in *Sensory Seas* (2020), she reproduces marine coral structures and synaptic tissues (Fig. 01). These collections are developed through the use of computational simulation tools, in particular, the use of tools such as Grasshopper, Houdini, and fluid dynamic simulations that enables the translation of biological information into complex visual structures, reinforcing the bond between natural data and aesthetic composition. In this sense, it is possible to speak of *computational biomorphism*: an aesthetic that celebrates mutation, morphological fluidity, and the hybridisation of nature and artifice. These algorithmic simulations are subsequently materialised through digital fabrication processes, which enable the translation of computational geometries into physical garments via additive manufacturing, laser cutting, and hybrid craft–technological techniques. The use of hybrid materials and the application of fluid-dynamic textures generate a visual effect that evokes cellular porosity and plasticity (Quinn, 2002; Bolton, 2016). These approaches do not take nature as a systemic model: nature is not imitated in its function but transformed into visual and volumetric patterns that chart a path toward an aesthetics of organic becoming (Quinn, 2002).

Design strategies associated with biomimicry, by contrast, do not directly affect the aesthetic aspects of design; rather, they are guided by biological structures with the goal of transferring the functional properties of biological "mechanisms" into the artificial world. As Vincent et al. clarify: "Biomimetic design is not about copying appearances, but about extracting principles that make biological systems work" (Vincent et al., 2006, p. 471). A paradigmatic example of this approach is the adoption of the microstructure of

1 A thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements" (Foucault, 1980, p. 194).

Fig. 01

shark skin in the development of technical fabrics, as in the case of Speedo's *Fastskin*™ swimsuit: here, the micro-ribbing inspired by shark dermal denticles was replicated to reduce water resistance, without any intention of evoking the animal's aesthetic (Vincent et al., 2006) (Fig. 02). Moussavi's reconceptualisation of form as a product of performance rather than predefined function enables a reading of biomimicry that foregrounds behavioural and operational logics over static functional equivalence (Moussavi, 2014). Yet, while form may follow function, it does not always render it visible. Similarly, Dawson et al. developed a textile prototype inspired by the mechanism of pinecone opening and closing, capable of increasing its air permeability in response to rising relative humidity in the local microclimate (Dawson et al., 1997). A similar concept was recently implemented by Nike in a clothing system commercialised under the name *Macro React*™. This technology was integrated into a tennis dress worn by Maria Sharapova during the 2006 US Open. The garment featured a back panel composed of a fish-scale pattern, which opened as the athlete perspired, thereby increasing localised ventilation and enhancing wearer comfort.

These applications are based on the analysis of biological data obtained through electron microscopy techniques and physio-behavioural simulations, which are translated into textile configurations via algorithmic modelling software. The use of parametric technologies and smart materials thus enables the transfer of functional properties observed in nature into responsive ecologies of fashion.


Fig. 02

## MORE-THAN-HUMAN ECOLOGIES OF FASHION

Beyond biomimicry, contemporary fashion increasingly engages with speculative and experimental practices that reconfigure the relations through which human and more-than-human actors coexist and co-evolve within design processes. The evolutionary trajectory of the nature-design symbiotic relationship in fashion finds its highest expression in the work of Paula Ulargui Escalona (Ulargui Escalona, n.d.). In collaboration with Loewe, the designer creates garments integrated with living plant systems in which nature is neither represented nor simulated: it just becomes an integral part of the garment's life cycle (Fig. 03).

The plants, germinated and cultivated within the fabrics, require constant care from the wearer, establishing an increasingly entangled relationship between the human and the vegetal realm. As Escalona herself states, "we have to care for our garments in order to care for our environment" (No Kill Mag, 2023), thereby subverting the throwaway logic and establishing an ethics of care, as theorised by Puig de la Bellacasa (2017). These performative practices reveal the possibility of a fashion that does not merely speak *about* nature, but *with* nature, in a shared process of worlding (Haraway, 2016).

*ChromaPhy,* a speculative project developed at the Textile Futures Research Centre at Central Saint Martins, brings this reflection into the field of synthetic biology. By integrating genetically modified bacteria capable of reacting to the skin's pH and changing colour, the garment becomes a living interface between biology, environment, and corporeal identity (Collet, 2012). At this stage, fashion configures itself as a bio-sensing medium, in which intelligence is distributed across living systems and genetic protocols. At the same time, innovations linked to self-growing materials such as *Mylo*™, a mycelium-based material developed by Bolt Threads and adopted by Stella McCartney, demonstrate how biofabrication may become a tool for the ethical reconfiguration of material use in fashion: these materials no longer imitate nature; they are nature.

A more speculative direction that redefines fashion design systems as entangled, is manifested in the projects of the London-based brand Auroboros. Their creation, *Biomimicry Dress*, represents a paradigmatic example of hybridisation between digital aesthetics and biological simulation (Zwieglinska, 2021) (Fig. 04). The dress, capable of changing colour and shape in real time, was worn by the artificial intelligence (AI) robot Ai-Da during the 2021 London Design Festival. The gown was designed using parametric drawing tools, its structure sculpted from

Fig. 03

Fig. 04

recycled plastic, while the garment's stratigraphy follows a performative logic: the outer surface is chemically programmed to react, evoking metabolic and morphogenetic dynamics typical of living systems. This approach aligns with Oxman's notion of material-based design computation, wherein biological and digital processes converge into a continuous design-technology paradigm (Oxman, 2010). The dress operates as a hybrid autonomous system, in which visual transformation is triggered by external environmental conditions (humidity, air, oxidation). *Biomimicry* thus presents itself as a post-digital artefact that integrates nonhuman generative systems, chemical synthesis, parametric modelling, AI, and responsive materials, transcending the dichotomy between nature and technology (Parisi, 2019).

## SYMPOIETIC ASSEMBLAGES

The concept of sympoietic assemblage emerges as one of the most promising lenses to read these design approaches, offering a conceptual lexicon capable of accounting for multispecies alliances and distributed processes. It is from this notion that the following theoretical investigation unfolds.

Karen Barad's (2007) concept of *intra-action* deconstructs the distinction between subject and object, asserting that identities emerge from material and discursive entanglements. The concept of vibrant matter (Bennett, 2010), on the other hand, attributes agency to what has historically been considered passive, promoting an aesthetic of co-agency. Within this framework, design becomes an ontogenetic event in which it is necessary to "stay with the trouble" (Haraway, 2016), cultivating provisional alliances with nonhuman, material, and environmental entities. Tim Ingold (2011), in this regard, proposes understanding design as a continuous dialogue between materials and trajectories of growth, embracing the concept of relational ecology, a notion also central in the work of Anna Tsing (2015), who, through the lens of precarious assemblages, reveals how modes of coexistence between species, environments, and infrastructures challenge linear and modernist narratives of design. Complementary to these perspectives is the work of María Puig de la Bellacasa (2017), who argues that design must take the form of speculative care: a practice that attends to the interdependencies and vulnerabilities of the actors involved.

The concept of sympoietic assemblage proposed in this contribution is situated within the broader field of ontological design, as articulated by Arturo Escobar, who maintains that design configures modes of being, perceptions, affects, and worlds: "we design the world, and the world designs us back" (Escobar, 2018, p. 4). The term *assemblage* was introduced by Deleuze and Guattari in *A Thousand Plateaux* as a heterogeneous, dynamic, and contingent entity composed of both human and nonhuman elements: "An assemblage [...] is a multiplicity which is made up of heterogeneous terms and which establishes liaisons, relations between them" (Deleuze & Guattari, 1987, p. 22). While the idea of *assemblage* introduced by Deleuze and Guattari (1987) breaks with the logic of organic unity and linear causality, it is with Haraway (2016) that this multiplicity becomes radically co-productive. Drawing on and reworking this intuition through a posthuman lens, Haraway coins the notion of *sympoiesis*, literally, "*making-with*." Unlike autopoiesis, which presupposes a closed and self-producing system, sympoiesis is open, relational, and situated.

In the context of fashion design, speaking of sympoietic assemblages entails shifting away from a teleological and anthropocentric conception of design toward an ecological and interactive process, where matter itself, living organisms, responsive materials, algorithms, technologies, and environments partake in the formal and functional invention of the project. Data and technologies likewise become co-agentive and co-productive elements through the elaboration of environmental inputs involving sensors, bio-digital interfaces, and generative algorithms. Data functions as a living interface between matter and body: through the deployment of generative algorithms, bio-digital interfaces, and machine learning, design becomes a situated and relational event in which living matter, environmental stimuli, and corporeal behaviours co-emerge according to an intra-active logic. This approach is particularly evident in fashion tech projects that integrate responsive materials and biosensing textiles, where biometric information actively participates in the aesthetic and functional formation of the garment (Berzowska, 2005; Seymour, 2009). The idea of sympoietic design thus manifests itself in the dissolution of the subject-object divide, wherein data co-constructs the interaction between human and nonhuman actors.

## CONCLUSION

The analysis developed in this contribution articulates a sequence of conceptual shifts through which the relationship between fashion design and nature is progressively reconfigured. From early biomorphic imaginaries, in which nature operated as a morphological and symbolic archive, to biomimetic approaches grounded in functional translation and systemic modelling, further informed by notions of exaptation and more-than-human relationality, the paper delineates a constellation of fashion design paradigms. Although these configurations have been discussed along a progressive and sequential trajectory, they persist within contemporary fashion practices as often coexisting modes of engagement with the living. Nature takes shape within this stratified horizon, as a plural and dynamic construct, articulated through shifting roles of

form and relation. The concept of exaptation contributes to this articulation by foregrounding processes of latency through which existing structures acquire renewed significance, fostering a specific epistemic attunement (Gould & Vrba, 1982; Melis & Pievani, 2022). More-than-human perspectives further extend this sensibility, situating fashion within relational ecologies in which, biological, and technological agencies participate in shared processes of becoming (Haraway, 2016; Puig de la Bellacasa, 2017). The act of designing for fashion thus takes shape as a situated process unfolding through co-emergent materialities. Fashion, positioned at the intimate interface between body, technology, and nature, offers a sensitive site for observing how material, biological, and computational agencies are configured through practice (Barad, 2007).

It is within this domain of interactions that the contribution proposes a critical framework for understanding the ways in which the negotiation between contemporary vestimentary practices and ontological assumptions about nature takes form in design experiences. The reading advanced here highlights how the different configurations through which fashion design has thought and operated nature constitute a stratified ensemble of projectual postures. That continue to act simultaneously in the present. The originality of the contribution lies in assuming this coexistence as a critical object, rendering legible an epistemic transformation that traverses biomorphism, biomimetics, exaptation, and more-than-human perspectives as articulations of a shared field of inquiry. The fashion field thus emerges as a theoretically productive domain, capable of making visible ontological shifts in the relationship between design, technology, and the living through practices in which nature progressively enters the operative and relational conditions of the project. In dialogue with theories of ontological design and intra-action, fashion is situated today within a relational ontology shaping the very conditions of design and giving rise to systems in which living matter operates as material intelligence and generative force in the production of garments.

## CAPTIONS

[Fig. 01] Iris van Herpen, Sensory Seas, Look 20 (2020).

In this sculptural ensemble from the Sensory Seas collection, Iris van Herpen choreographs a visual and material symbiosis between the neural intricacies of the human body and the fibrous architectures of marine ecologies. Drawing from the anatomical drawings of Spanish neuroscientist Ramón y Cajal, the garment materializes a computational biomimesis in which the aesthetics of the organic emerge through algorithmic layering, laser-cut membranes, and flowing textile stratifications.

[Fig. 02] Speedo Fastskin™ and biomimetic microstructure of shark skin. This diptych illustrates the translation of biological intelligence into high-performance sportswear through biomimetic design. On the left, the Speedo Fastskin™ swimsuit, originally developed for competitive swimming, emulates the drag-reducing microstructures found in shark skin. On the right, an electron microscope image reveals the dermal denticles of a shark: ribbed, overlapping scales that channel water efficiently to minimize turbulence. Rather than aesthetic mimicry, this is a paradigmatic case of functional biomimesis, where material innovation is driven by performance rather than form. In doing so, the garment becomes a technical interface that extends the body's hydrodynamic potential through a silent alliance with nature's evolved morphologies.

[Fig. 03] Auroboros, Biomimicry (2021).

This wearable sculpture by fashion-tech duo Auroboros exemplifies a sympoietic assemblage, where material science, couture craftsmanship, and speculative ecology converge. The garment is grown. Crystals develop organically across a prepared understructure through a self-directed crystallization process, much like plants forming over time on a nutrient-rich surface. This procedure resists full control, producing unpredictable yet materially specific formations. Supported by scientific collaboration with Queen Mary University of London and material partnerships with Swarovski and Tiranti, the process reflects a deep entanglement between biology and design. Rather than acting as a static shell, the garment co-evolves with its medium, embodying an ontological shift from fashion as form to fashion as emergent material ecology. In Auroboros' practice, the boundaries between physical and digital dissolve as both garments are shaped by iterative, collaborative, and non-linear systems of making.

[Fig. 4] Paula Ulargui Escalona x Loewe, Spring/Summer 2023. In this collaboration with Loewe, designer Paula Ulargui Escalona cultivates garments as living systems, integrating germinating plants directly into the fabric structures. Rather than representing nature through symbolic or biomimetic motifs, the pieces enact a literal incorporation of the vegetal. The garments must be watered, tended to, and cared for by the wearer, thus establishing a symbiotic dependency between human and plant. In this sense, fashion becomes a temporal, metabolic, and co-evolving practice—no longer an object to be consumed, but a living assemblage that unfolds relationally over time. The collection offers a radical gesture toward more-than-human design, where dressing becomes a mode of cohabitation rather than adornment.

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