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The Concept of the Organism in Current Biology. Beyond Gender Binarities?

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Palestine – Israel – Germany

LIT

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Christopher Street Day 2004

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The Concept of the Organism in Current Biology. Beyond Gender Binarities?

Kerstin Palm

Whoever wants to learn about European scientific concepts of the body in relation to the gender order will generally turn to the renowned study by American historian Thomas Laqueur on the history of the body in Western culture from antiquity to the early twentieth century. In *Making Sex. Body and Gender from the Greeks to Freud*, Laqueur shows how a fundamental reinterpretation of sexed bodies took place when the natural sciences emerged in the eighteenth century. He interprets this change as a shift from a one-sex model to a two-sex model. According to Laqueur, until the eighteenth century the female body was regarded as an inferior version of the male body on the basis of the prevailing cosmological humoral system. Accordingly, the female body was unable to produce life-giving semen and to expel the reproductive organs from the inner space of the body to its surface because of a lesser vital heat. This model from the ancient world assumed the existence of only one sex, which appeared, according to the extent of perfection, in different modes, which were isomorphic to each other. The different body characteristics were merely places of resonance of a reality from outside the body; they only showed metaphysical hierarchies between the genders, but were not the basis for gender difference.

The two-sex model introduced in the eighteenth century turned round this structure of arguments and explained, on the basis of the repositioning of nature as the source of all knowledge, that the reproductive organs themselves were fundamental to the profound difference between the genders. Female and male bodies were now no longer arranged on a vertical axis of a hierarchy of perfection, but on a horizontal axis at opposite poles in radical difference to each other. From these different bodies, as Laqueur describes it, physicians and anthropologists read references to the characters of the genders and the associated gender-specific division of labor.

Laqueur emphasizes the ideological aspects of the two gender orders. The one-sex model was a means for the cultural dominance of the patriarchy, since it provided arguments to counteract the obvious priority of the maternal contribution to reproduction. This model not only made clear the essential role of the

male in the procreative act because of the ability assigned to him of animating material with his semen, but also showed the superiority of the invisible, male-connoted principle, that is, the intellectual principle, over the female-connoted sensuous and material principle. Moreover, in the context of the egalitarian natural law of the Enlightenment, the two-sex model provided a theory that arranged men and women on the same level side by side, but still stressed a radical difference, which made it possible to justify and naturalize their different social positions.

Laqueur gives a detailed and rich description of the change in the interpretation of the body with its consequences for the gender order, but he fails to examine the concept of the organism which underlies the sex model. In my view, however, this is crucial for understanding the relationship between science and the gender order, not only ideologically, but also with regard to the gendered structure of the concept of the organism itself, as I will elaborate in the following.

Another study covering similar ground as Laqueur's book (and which to date has only been published in German) is Claudia Honegger's book *Die Ordnung der Geschlechter* (The Order of the Sexes). Honegger concentrates on historical developments since the eighteenth century and explores the changing concepts of organism in greater detail. She describes how a mechanistic, Cartesian division of body and mind still prevailed in the eighteenth century, which understood the mind as being not influenced by the body and therefore not sexed.

But in the mid-eighteenth an anti-Cartesian, Romantic movement emerged, which rejected the mechanistic model of the body and aimed at the overcoming the dualism between body and mind. It drew up a holistic model with two essential characteristics. First, the body was perceived as an independent living unit which was categorically differentiated from the inanimate sphere. The body was now marked by a special teleological organization which could no longer be explained by physical and chemical laws, but required specific biological explanations.

Second, mind and body were integrated in an analogical and coherent relationship with each other. This integrative connection was very important for the emergence of the bourgeois gender order, as Honegger convincingly shows, because it laid the foundation for a resexualization of the mind. With this moral-physiological monism, and by means of analogical argumentation, it could now be "proved" that the whole female organism was, physically and mentally, exclusively assigned to the duty of motherhood because of the prominence of its reproductive organs and childbearing capability. At the same time this capability required a weaker physical and mental constitution and a greater degree of sensibility. The male body was read as being not very involved in reproductive duties due to the small proportion of the reproductive organs in

the body as a whole. Moreover, because these organs were largely external to the body, they were seen as a reference to a man's natural field of activity in the official sphere, in culture and politics. The inner reproductive organs of the women, however, were interpreted as a reference to the domestic sphere. In this way, modern individualization became the anatomical privilege of the man, while motherhood, associated with a particular kind of morality, was elevated to the position of a dominant ethical imperative, and at the same time to the essence of female nature. It was, however, rather difficult to apply this monistic argumentation to the male, because it resulted in serious contradictions to the notion of the modern autonomous, self-identical subject.

Honegger shows that this dilemma was increasingly solved by using a double argumentation: that is, on the one hand the generalization of the man as the rational human as such, and on the other hand the special treatment of the woman as the object of the social, psychological, physiological, and anatomical thinking of integrative gynecology. What Honegger does not follow up on is the further discussion of the organism in biology and medicine in the nineteenth century, which, in my view, also showed a process of generalization.

I would like to deal with these concepts of organism in their relation to the gender order in more detail in the following. In conjunction with this I want to introduce another method for analyzing scientific visualizations from a gender perspective that goes beyond the contentive and ideological aspects of body descriptions by looking at the structural aspect of the organism models. In this way I wish to show that the living body in the European modern age represents an important place for discussing different aspects of the gender order, which do not appear very obvious at first sight.

In the nineteenth century comparative zoology increasingly placed the human body parallel to the animal body, and the theory of evolution ultimately located it in a relationship of kinship with all living beings. As a result, the human being was divided not only into the general male and the particular female, as Honegger describes it, but also into the spheres of reason and psyche, the subject of the emerging humanities, on the one hand; and the sphere of the zoological body, the subject of biology and medicine, on the other hand.

Whereas the integrative Romantic concept of the organism came to have less and less significance for biology and medicine in the mid-nineteenth century, this concept continued to predominate in gynecology. There was a renewed mechanistic trend in zoology and medicine, which again conceived of the organism as a machine. But this machine no longer resembled machines driven by the Newtonian laws of mechanics, as in the seventeenth and eighteenth centuries, but was now like the steam engines that had become widespread in nineteenth-century European industry.

In the seventeenth and eighteenth centuries the living body appeared to be the mimetic embodiment of a mechanical engine provided with both mechani-

cal functions and a capacity for autonomy. Like Newton's universe, which they mirrored, these machines were driven by various natural forces, including the mind and gravitation in particular. With the development of a new concept of force in the physics of the 1820s, all forces suddenly seemed to be variations of one force, called energy ever since. This new thermodynamic view made it impossible to conceive of a self-moving force, because a force could no longer come into being of its own accord but instead existed in a fixed reservoir from which it could change into different kinds of energy.

In this context the organism became an energy-transforming machine which could be described in terms of the production of mechanical work and heat. All life processes were seen as taking place on the basis of division of labor and cooperation, as in a well-organized state, controlled by one central instance, the brain, which sent its commands through the whole body with a system of nerves like a telegraph network. Haeckel, for instance, described this concept of the body that emerged toward the end of the nineteenth century as follows:

> The arrangement and activity of this apparatus of the mind can be compared with an electrical telegraph system; the nerves are the transmitting wires, the brain is the central station, the muscles and sensory cells are the subordinate local stations. The motory nerve fibers transmit orders or impulses centrifugally from the nerve center to the muscles and cause them to move by contracting; while the sensitive nerve fibers transmit various perceptions centripetally from the peripheral sensory organs to the brain to report on their received impressions of the outside world. (168)

In summary, the late nineteenth century saw the living organism as a steam engine controlled by a driver, and as a state organization of cells with a clear economic and political order. It was a consistently organized system characterized by identity, capacity for action, division of labor, and hierarchy of functions.

At this point it can be noted that the mechanistic concepts of the organism, in my view, were fundamentally guided by projections of two organizational abilities claimed by the male self in a specific historical situation: first, a technical ability to produce something that can work, like a machine; and second, a political and economical ability to guide and preserve state machinery. This production and preservation of an expediently structured and functioning whole, the organism, was in this way committed into the hands of a subject-like authority, which was not the male subject itself, but appeared as its mirror image, its double, in terms of its capacity for construction.

Then, in the late nineteenth and early twentieth centuries, there was an increasing shift away from the idea of a solid-matter aggregate functioning economically, circulating goods, and controlled by a communication network like a telegraph system, toward a fluid model which imagined the inner sphere of

the body as a liquid medium, which facilitated the transport of chemical messengers (see also Tanner). In 1905 these messengers were named hormones.

This shift was initiated by the discussions on self-regulation which emerged at the end of the nineteenth century. In 1865 the French physiologist Claude Bernard introduced the term self-regulation to characterize the specific processes of a living organism as an autonomous whole ("Introduction," Bernard). According to the historian Jakob Tanner, this set off the substitution of the heteropoietic concept of the mechanical and energetic machine models with the biological autopoietic principle (138). In 1878 Bernard imagined the regulation of the organismic whole—quite in the tradition of the conceptualization of architect and head of state—as follows:

> For every living being and every organ there is something like a predetermined blueprint, so that every phenomenon, taken singly, is in its economy dependent on general natural forces, but in its relationships to others a particular bond becomes apparent; it seems as though it were held to its particular path, having once embarked upon it, by an invisible leader and led to the place it finally occupies. ("Leçons," Bernard 50f)

Until then, neuronal control, with its exact spatial and temporal nerve commands, had held center stage. Associated with the notion of the primacy of the brain in controlling physical processes, its operation inspired the metaphors of wiring and electrical potential. Now, in the early twentieth century, attention turned to the fluid control system, with an inner secretion of hormones from various organs and no central guidance system. Control was now—via a more interactive communication between the parts of the body—ensuring structural and functional integration in a more decentralized and diffuse way. The inner body space had thus become a fluid space of communication. Furthermore, it had become conspicuous that fluid control, like neuronal control, was of an increasingly unstable consistency.

At the beginning of the nineteenth century the neuronal control system, a great nervous system centralized on the brain, still referred to a unity of body and mind. But in the mid-nineteenth century more and more nerve centers were discovered in the autonomic nerve system, so that the nervous system increasingly came to resemble an unstable state at whose periphery numerous autonomous and semiautonomous regions were making trouble (Radkau). Moreover, at the end of the nineteenth century, general nervousness, associated with growing industrialization, speed of life, noise, piecework, and pressure to perform, seemed to be on the rise. Nerves were no longer only the guarantors of the vigor of mind and body but could now become overexcited and shattered, or work in systems not subject to the central consciousness.

The concept of the fluid control system on the other hand was shattered by the observation that hormones declared to be female were also found in male

bodies, and vice versa (Oudshoorn). Sex hormones, localized in the tradition of different reproductive organs and at first regarded as the very chemical essence of masculinity and femininity, thus signaled a break with the familiar sex dualism and called into question a male identity defined as an entity separate from the female body. At the beginning of the twentieth century, this idea of chemical messengers floating through a liquefied body seemed for the time being to have put paid to mechanical metaphors for describing the organism. Against this backdrop Ludwig von Bertalanffy stated in 1928 that he categorically rejected any recourse to machines to illustrate organismic functions and structures: on the one hand because machines always point to a constructing agency and are therefore teleological and metaphysical models, and on the other hand because machines cannot provide models of organismic processes such as regeneration, adaptation, self-preservation, growth, self-development, and reproduction. Likewise, a return to vitalistic notions with their postulation of vague cryptic forces would provide no solution. Instead he suggested that an organism be interpreted as an open system with a hierarchical order of functions and structures and specific relations between the single parts, which maintains itself by exchanging compounds with the environment while keeping its system characteristics constant.

Bertalanffy played a decisive role in introducing system theory in biology, which, as in other disciplines such as sociology, is gradually leading to the disappearance of the idea of the subject. While the system theory in biology has been able to solve the problem of describing complex units with a certain internal order as well as of complex dynamic processes, which could now be represented as being functional-postholistic, that is, technological and no longer as vitalistic-holistic, that is, ontological, it has not been able to explain the regularities underlying system behavior any more than the origin of the living system.

In the twentieth century two main lines of argumentation and research were prevalent, which picked up these two ideas of central control and dispersed self-regulation in order to tackle precisely these unsolved questions regarding the regularity and origin of living systems. One very reductionistic line looked to the molecular level for a singular substance—the biological atom—that could plan, construct, build, and control a living body. This substance was hypothetically called the gene or the genetic substance. Parallel to this, and following nineteenth-century ideas of self-regulation and fluidity, new theories emerged about entities regulated by information circuits and communication systems. The guiding principle was that an organization as complex and dynamic as the organismic order requires continuous organizational communication.

In this spirit the biologist Wolfgang Wieser remarked in 1959 in his book *Organismen – Strukturen – Maschinen*, which reviews the biological research

of the 1940s and 1950s: "without communication no order, without order no whole" (13). In the first half of the twentieth century this organismic communication system was still precybernetically determined by neural transmitters and hormones. In the second half of the twentieth century, concepts of the organism were increasingly formulated in terms of cybernetics and information theory, with reference to new self-regulating or data-processing machines, such as self-guiding air defense missiles or computers. For example, the famous development biologist Conrad H. Waddington remarked in 1971 that "an autopilot, a target-seeking gunsight, and an embryo all show characteristic features of target-orientated behavior" (20).

These new machines now serving as theory models were no longer engines but communication and control machines producing not energy but information and organization. In the nineteenth century, holism and process, seen as central characteristics of organisms, could only be theorized in terms of vitalism and not in terms of mechanics with the machines then existing. But now they could also be theorized in terms of postmechanistic machine concepts.

The metaphysical purpose of vitalistic processes was thus replaced by functional feedback processes and rendered scientific. In the twentieth century structure and organization also took over the central position occupied in the nineteenth century by energy and substance. Thus, for example, Wolfgang Wieser wrote in 1959:

> Organization is a principle that cannot be attributed to either of the two categories force and substance, because it is an independent quality, neither energy nor substance, but rather a third thing, expressed in the scope and nature of the order... in a system. (13)

My interpretation of these two currents—gene discourse and self-regulation theory—is that genetics, aiming for a restoration of the sovereign male double of the self, has increasingly been confronted by the decentralization of this self. This second current, as I will show in the following, became dominant in the latter course of the twentieth century.

In the first half of the twentieth century genes were still only a hypothetical concept as carriers of heredity, and most biologists assumed that genes had a clear, determinable structure and function and acted as a small and powerful life subject, controlling the development and maintenance of organisms. The peak as well as the turning point of gene-centered research came in 1953 with the chemical and physical characterization of DNA as a double-helix macromolecule embodying a code much like a machine language. The gene as a magic entity was gradually demystified.

In the 1950s Watson and Crick proposed the central theory of genetics which describes the linear model of a hierarchical one-way flow of command information from the DNA via the RNA to the final product, the proteins. The

use of metaphors like information, program, and command reinforced the image of one-way communication being directed down from the top. But it was not long before this theory, developed with reference to single-cell organisms, was no longer plausible. Every cell in a multi-cell organism has the same set of genes, since all cells derive from one and the same cell, but differ from one another structurally and functionally in a complex spatial and temporal pattern. The question arose as to how one and the same set of genes "knows" which specific genetic products it is supposed to produce. The answer, which gradually emerged during the late 1950s, was gene regulation.

The first regulation model by Francois Jacob and Jaques Monod suggested the regulation of one gene by another gene. Further models then situated the gene in more and more wide-ranging regulation circuits and loops, involving not only the content of the cell, but also the concrete context of the cell in an organism, and finally the external environment of the organism (Keller). It is now assumed that DNA is not itself active, but needs complex activation, editing, correction, and repair mechanisms to activate it. In the past ten years the term "program" has become problematic, and other terms are being considered to replace it. For example, it may be preferable to describe DNA as a collection of data in a simultaneous computer network embedded in the physical and biochemical structure of the cell (Atlan 335). Or, as another biologist proposed, "[Genes] are passive stores of material, from which a cell can take what it needs" (Nijhout 441).

This decentralization of the gene is just one example of the wide-ranging questioning of the existence of a central life principle. Study of the immune system and the endocrinal hormone system, too, has shown ever more extensive integration of mechanisms into comprehensive regulation systems. Donna Haraway, for instance, summarizes the shift in the visualization of the immune system as follows:

> From the joke of one single central mechanism controlling the harmony of the organism in the symphonic system which is responsible for the integrity of the self came a postmodern pastiche of varied centers and peripheries. (168)

Current biology speaks less and less about central control. The biologist Antonio Garcia-Bellido remarked in 1998, for example, that "development results from local effects and there is no brain or mysterious entity controlling it all. There are local calculations, and they can explain the specific characteristics of a historically determined process" (112). "Historically determined" here means "come into being through evolution."

The organism has become a communications system with a fluid and dispersed cybernetic network of various systems, such as genes, nervous system, hormones, and immune system, without distinct hierarchies or any clear unity, but with many feedback loops and functional fragmentations. Because of its

capacity for communicative self-regulation the organism also resembles an artificial intelligence system which organizes and maintains itself with inherent and unconscious "cleverness." Finally, I quote Haraway again as she compares the organism as visualized in present-day biology with the nineteenth-century organism:

> The body ceases to be a stable, spatial mapping of normalized functions and emerges instead as a highly-mobile field of strategic differences. (174)

It seems to me that the models of the organism, as they shift through the various images, from the mechanical engine to the energy-transforming machine, from the fluid matrix of discrete communication to the fragmentary, multicentered, postmechanical cybermachine, have brought about a radical decentering of the double of the male self reflected in earlier concepts of the organism. In the process, gendered dualisms, principles, and categories such as body and mind or heteronomy and autonomy have lost their clear contours. But findings regarding the structure of the organism should not lead us to conclude that gender binarities as a whole have been eradicated. This has to do with the contingent relation between the structural and the ideological levels of how the organism is visualized. In other words, the ideological arguments put forward in biology to legitimize a certain gender order follow impulses and influences other than those of the structural conception of the organism, which appears to reflect certain gender constellations and takes up, unnoticed, certain processes of reflection circulating among discourses, such as the decentralization of the subject in the modern and postmodern age.

As we can see with the description of various concepts of the organism, whether steam engine, fluid matrix, or cybernetic, the ideological visualization of the gender order still follows a pattern similar to that described by Laqueur and Honegger for various ancient and modern images of the body. Since the mid-nineteenth century a confusing muddle of different arguments has emerged. The more mechanistic or reductionist models prefer the description of the general organism on the one hand, and see the particular female body, subject to reproduction processes, as divergent and defective in relation to the general organism, on the other. The postmechanistic, fluid, and self-regulatory models, which have a more integrative view of the body, find in these self-regulatory processes a wealth of various gender-specific strategies, which give the body a specific structure, defined behavior, and gender-specific role behavior in a community. Changes are taking place on this ideological level too—but that is another story.

Notes

1. My special thanks goes to Catherine Hales for her excellent stylistic advice.
2. Unless otherwise indicated, all translations are my own.

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