Routledge Studies in the Philosophy of Science

WHEN METAPHYSICS MEETS BIOLOGY

KANTIAN APPROACHES TO THE CONCEPT OF ORGANISM

Philippe Huneman

ROUTLEDGE

When Metaphysics Meets Biology

This book explains the background and meaning of Kant's account of the life sciences in the *Critique of the Power of Judgement* by reading the development of Kant's ideas on the living since his 1763 precritical essays, in parallel with analyzing several milestones in the constitution of the concept of organism as a self-organized totality, studied by biology.

This parallel reading frames Kant's account of biology against influential theories developed by earlier scientists and naturalists, including Leibniz, Stahl, French vitalists, Albrecht von Haller, Caspar Wolff, and Buffon, as well as his almost contemporaries such as Goethe and Cuvier. It reveals that Kant's inquiry about *teleological judgment* ties in with important advances in his time about the organism as an integrated, functioning, and self-organizing entity. It explains how Kant's idea of *purposiveness,* formulated in the context of a metaphysical inquiry about the order of the world and its knowledge, hence of contingency *generaliter*, became detached from the notion of *intention*, thus ascribing it a new meaning tied to autonomous biological practice. Then, considering 19th-century biologists, it provides the genealogy of a post-Darwinian theoretical space in which biologists formulate complementary or competing accounts of organisms as developmental systems in evolution and within which theoretical cleavages are generated. It thereby explains how the two theoretical trends known as form-centered and function-centered biology, now defined as "developmental" and "adaptationist" viewpoints, emerged as two distinct perspectives from a concept of "natural purposiveness" unified by Kant's transcendental perspective; then it unravels the way they currently articulate, against the background of their genesis.

When Metaphysics Meets Biology offers a philosophical interpretation of the emergence of biology in relation to Kant's thinking and sheds light on the philosophical issues currently embedded within the conceptual structure of biology. It is of interest to philosophers of biology and philosophers interested in metaphysics and its history.

Philippe Huneman is a philosopher of science Research Director at the Institut d'Histoire et de Philosophie des Sciences et des Techniques (CNRS/Université Paris I Sorbonne). He authored *Why? The Philosophy behind the Question* (2023), *Death: Perspectives from the Philosophy of Biology* (2023), and *Profiling: How Predictive Algorithms Shape Identity and the Social Fabric* (2025).

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Kantian Approaches to the Concept of Organism

Philippe Huneman

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“An organism, however, is very far from being a mosaic of unit characters.”

Sewall Wright, “Character change, speciation, and the higher taxa,” 1980, *Evolution. Selected papers*, p.622.

“Such an object, in which the process is present in the *simplicity* of the Concept, is the *organism*. It is this absolute fluidity in which the determinateness, through which it would be only *for an other*, is dissolved. The inorganic thing has determinateness for its essential nature, and for that reason constitutes the moments of the Notion in their completeness only together with another thing, and therefore is lost when it enters into the process; in the organic being, on the contrary, every determinateness through which it is open to an other is controlled by the organic simple unity. None of them shows itself as essential, as free to enter into relation with an other, and consequently what is organic maintains itself in its relation.”

G.W.F. Hegel. *Phenomenology of the Spirit*. §254

“Me: I have the idea—perhaps a mistaken one—that eighteenth-century physiology was less. . . particularistic than ours. . .

The Doctor: But they were doing metaphysics. . .

Me: Rather ‘Méchanique’. . . Barthez. . .

The Doctor: Metaphysics, metaphysics. . .

Me: Thinking—naïvely—of a living being in operation; observing that this functioning breaks down into modifications, the most apparent of which are of the reflex type, I have often said to myself that if I were to make my study, my specialty, the study of living beings, I would want to have that table (of reflexes), to meditate on it, to try to follow in my subjects the effects of combinations, of conflicts, etc., of those remarkable elementary acts. . .

It is a very particular kind of mechanics, where questions of time play an essential role. . .

Where do you see metaphysics in that?

The Doctor: In your very eyes, Monsieur—you connoisseur of reflexes!”

Paul Valéry. *L’idée fixe*.


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Acknowledgments

I started this research as a PhD dissertation, defended in 2000, and supervised by Gérard Lebrun. After much reworking, it became a book, published in 2008 under the title *Métaphysique et biologie. Kant et la constitution du concept d'organisme* (Paris: Kimé). My debt to Gérard Lebrun, who, for me, as well as for many colleagues, was a major philosopher of the 20th century, is not quantifiable.

I continued working on the topic ever since.

Until he unfortunately left us in 2018, the support from the late Professor Jean Gayon was crucial, as well as his intellectual stimulation. He honored me with the preface to my 2008 book in French. My gratitude is still alive.

I am immensely grateful to Bob Richards, who invited me in winter 2005 to teach in the Fishbein Center at the University of Chicago, and held at this occasion an inspiring seminar on Kant and biology; this stay, as well as his knowledge and his philosophical attitude in general, have been decisive in my understanding of the topic.

Over the years, my work on this topic has benefited from frequent discussions with many friends, some of them being my former PhD students. Since 2008, I have been working in constant relation with several of them, which occasioned several co-publications, and allowed me to improve my understanding of the philosophical and biological issues involved, and, hopefully, progress in my writing on this topic. Thus, I would like to thank at least Christophe Bouton, Sylvain Bosselet, Mark Bedau, Hugh Desmond, François Duchesneau, Daniel Dumouchel, Andy Gardner, Michel Morange, Pietro Corsi, Claude Piché, Mai Lequan, Anne-Lise Rey, Sophie Grapotte, John Zammito, Peter McLaughlin, Tim Lewens, Joan Steigerwald, Jean-Claude Dupont, Philippe Jarne, Eric Bapteste, Michel Veuille, Patrick Singy, Katie Tabb, Laura Nuno de la Rosa Garcia, Trevor Pearce, Stéphane Schmitt, Thomas Teufel, Denis Walsh, André Ariew, Michael Strevens, Carl Craver, Michael Dietrich, Lindley Darden, Jonathan Birch, Samir Okasha, David Depew, Dick Burian, Marshall Abrams, John Symons, John Beatty, Robert Brandon, Alex Rosenberg, Charles Wolfe,

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Preface

It is with deep respect and admiration that I introduce this important study by French philosopher and philosopher of life science, Philippe Huneman, Director of Research at the Institute for the History and Philosophy of the Sciences at the CNRS in Paris and the Sorbonne. Since receiving his doctorate in 2000, Huneman has displayed a remarkable rise in the profession and has taken his place as one of the most important interpreters of the history and philosophy of life science. This work, a major revision of his Sorbonne doctoral dissertation carried out under the direction of Gérard Lebrun, subsequently published in French in 2008,[1] now appears in English.

Reflecting the similar combination of approaches of one of his primary mentors, the late leading French philosopher of biology, Jean Gayon, Huneman brings to the discussion of theoretical philosophy of life science a deep and broad grounding in "Continental" philosophical discussions against which he engages issues that are currently treated in Anglophone literature. The latter collection of inquiries is typically categorized as "analytic" philosophy of biology as this approach has been defined and pursued by David Hull, Michael Ruse, Kenneth Schaffner, Alexander Rosenberg, Kim Sterelny, Peter Godfrey-Smith, and many others. This line of interpretation has traditionally been centered around issues of interest to working life scientists, with emphases on genetic and populationist approaches to evolution, known as the "Evolutionary Synthesis"; biophysical reductionism motivated by molecular biology and molecular genetics; the discussions of "emergence" in relation to a physicalist closure in the philosophy of physics; and the biophysical analysis of the phenomenon of consciousness. Huneman is fully conversant with these issues in Anglophone philosophy of biology and has published widely in English on several of these topics.[2] At the same time, he brings to the conversation a different set of philosophical perspectives and points of departure that reflect his deep familiarity with Existentialism, Phenomenology, and the long heritage of philosophical discussion flowing from Kant that characterizes "Continental" philosophy of life science.[3] The result is a remarkable synthesis of issues in the philosophy and history of life science

that are interfaced with an extended discussion of the emergence in Kant's thought of the concept of "organism" and the historical conjunction of this idea with the notion of an autonomous "science of life"—Biology—a concept that becomes current in the literature around 1800. It is this conjunction, captured in the significant title, Metaphysics Meets Biology, that the deeper thematic of this study develops.

In his expansion of the insights developed in his 2008 monograph, Métaphysique et biologie, this revised new work reflects his intervening research and his engagement with the more recent works of John Zammito, François Duchesneau, Stéphane Schmitt, Peter McLaughlin, Robert Richards, Tobias Cheung, Hannah Ginsborg, Marcel Quarfood, and several others who have dealt with 18th- and 19th-century biology and philosophy with a particular reference to Kant's importance for these discussions. The result is a major analysis of the general issue of Kant's fundamental role in the conceptualization around 1800 of an autonomous "science of life."

As Huneman states his intent, "my study proposes an archaeology of the concept of organism. . . undertaken from the viewpoint of the Kantian critique of metaphysics." This is developed by an analysis of the connection between metaphysics and epistemology in Kant's critical understanding. The connection of these issues to his formulation of a teleological concept of "organism" is detailed in discussing Kant's concept of "natural purpose" *(Naturzwecke)*. This focus provides the central trajectory of the book, and in my reading, this constitutes Huneman's most novel contribution.

Huneman's central argument is that Kant, in carrying out this project, created the conceptual possibility of a "science of life," grounded on a novel concept of "organism," which Kant freed from its prior conceptualization within natural theology and substantive metaphysics, particularly as these were developed by Leibniz. In this trajectory, Kant also moved beyond the long-standing opposition between deterministic physical law, grounded in a "universal mathematics," represented for Kant by Newtonianism, and the organic purposiveness that is manifest in nature, which displays contingency and freedom from strong determinism. Overcoming this opposition, as it had been inherited from the 17th century, is seen as being crucial in freeing a conception of life science from the traditional dualism of body and soul, central to the long heritage of Cartesian mechanistic biology. This also moves it beyond the metaphysical solution to this problem, offered particularly by Leibniz. This assumption grounded an "organic" mechanism on divine workmanship.

The development of these themes is carried out through 12 substantial chapters in three main parts.

In Part 1, we are engaged with a summary of some key developments in the history of 18th-century life science as they formed a context within which Kant first treated in a substantial way issues of living nature. Central to this analysis is Kant's development of his critique of Leibnizian metaphysics in his pre-critical

The Only Possible Argument for the Existence of God of 1763, a text which will be engaged several times in Huneman's discussion. In this early text, we encounter Kant still within a larger framework of the Leibnizian philosophy that accepts an opposition between the "technical" design of nature, one that imposes structure and order from outside through divine ordering, and the spontaneous activity seen in living beings that goes beyond normal scientific law. These early Kantian reflections are contextualized against the controversies surrounding the "animism" of Georg Ernst Stahl, the reflections of Albrecht von Haller, with his distinction of "sensibility" and "irritability," and the important theoretical developments by the "vitalists" of the Montpellier medical school and their disciples who put forth the image of the body comprising a vital material. These developments within 18th-century vitalism established a concept of "life" that neither required a theory of mechanistic preformationism, nor a conception of a separable soul to explain organic action and development. But they did not, for Kant, constitute an adequate solution.

In beginning his extended treatment of Kant with the "precritical" Kantian treatise of 1763, Huneman analyzes how Kant developed his original views not simply around theological issues but also engages the status of living organisms and the notion of purposiveness these display. Here, Kant first engaged the issue of the presence of natural order, particularly displayed by living beings, in relation to the notion of technical design, two concepts that were linked in traditional natural theology. This linkage Huneman positions against Kant's departure from Leibnizian metaphysics and from the mathematical conception of nature inherited from 17th-century mechanical philosophy that had resulted in the opposition between traditional mechanism and teleology. Kant's early position regarding the "technical" understanding of biological order emphasized by Leibniz opens the question about the origins of this order that Kant would explore subsequently. It is in the 1763 treatise that Kant first develops thematics that reappear in the Third *Critique* which will link in a new way the notion of purposiveness and law-obedience.

A novel insight that drew my attention in this section was the way Huneman analyzes in substantial discussion the importance of the work of embryologist Caspar Friedrich Wolff (1733–1794) for Kant's reflections, whose University of Halle MD dissertation, Theoria generationis of 1759, is often identified as the beginning point of modern "epigenetic" embryology. This involves Huneman in an extended discussion of the "Preformation- Epigenesis" dispute of the 18th century against which he positions Kant's initial discussions in the *Only Possible Argument*. Central in this argument is the explanation of the perpetuation of organic form in the wake of the abandonment of strong preformationism, with C.F. Wolff developing the concept of an "essential force" to explain the phenomenon of vitality and serial temporal embryonic development. Wolff's particular meaning of a vis essentialis differentiates it from Newtonian and mechanistic forces in the way in which it produces organic specificity through a temporal

process. This goes beyond the "mechanistic" epigenetic arguments that had shaped the discussions of Maupertuis and Buffon in the 1740s.

Part 2, consisting of four long chapters, develops Kant's post 1770 "critical" engagement with the issues of teleology and the concept of the unity of nature as these are particularly treated in the "Appendix" to "Transcendental Dialectic" of the CPR. In this extended discussion, Huneman highlights the unresolved aspects of Kant's solution in the First *Critique* to the problem of the "organism" in relation to natural purposiveness. This incompleteness is seen as a consequence of Kant's formulation of the issue in terms of the transcendental Ideas of Reason *(Vernunft)*, which could only treat purposiveness as a regulative concept. In Huneman's analysis, it is Kant's move beyond this position of the First Critique to a grounding of teleological reasoning in Kant's new concept of "reflexive" judgment, rather than in the Ideas of Reason, that underlies the novelty of the *Critique of the Power of Judgment* (CJ).

As readers of the CJ know, the second half of this work is developed around a new set of concepts used to present Kant's mature solution to the issue of teleological purposiveness and the status of the living being in nature. "Reflexive" rather than "determinate" Judgment is introduced as a subjective power (Urteilskraft) that links subjective judgment to the empirical experience of objects showing evident teleological purposiveness and directionality, properties that do not seem to have an explanation in the categories of physical science. This reflexive judgment is a "transcendental" concept that is now made immanent in human subjectivity rather than simply functioning as a regulative idea of reason, departing from the treatment of teleology in the CPR. This allows the evident purposiveness of organic life to be "naturalized" to a condition of human knowing with a specificity not captured by the regulative status allowed by the CPR. It also grounds the contingency of living nature in human thought and prevents its subsumption under deterministic physical law.

This "naturalizing" of purpose, argues Huneman, is the deeper meaning of Kant's introduction of the concept of natural purpose *(Naturzwecke)* in the CJ. It is not a metaphysical claim about things an sich, but it is a condition of knowing that then underlies the concept of "organism" or "organized being" as Kant defies it, a conception of the relation of wholes to parts that suggests a downward causation. But this is to be understood within the limits of the critical philosophy. The Idea of the Whole is a transcendental Idea in the sense of the First *Critique*, and it is in this sense that the Idea of the Whole functions as "a principle of knowledge for the object judged as a natural purpose." Thus, there is now a linkage developed between a concept of the reflexive judgment—the concept of a natural purpose—and a regulative Idea of reason—that of the holistic organism.

The interaction of these two epistemic levels constitutes the relation of the teleological character of the reflexive judgment in relation to particulars and to the transcendental ideas that together constitute a new meaning of "organism." This links " the reflective character of the judgment concerning natural purposes

to the epigenetic character of the object that is to be judged in this way." This allows the development of the concept of a self-organizing being as a natural purpose acting within the Idea of an organic whole. In this analysis, Kant is seen as distancing himself both from mechanism as an explanation of original organic order and also from a substantive meaning of teleological purposiveness as a real property of nature. This clarifies his relation to the "vital force" arguments of both Caspar Friedrich Wolf's epigenetic embryology and the *Bildungstrieb* arguments of Johann Blumenbach. Kant is not a "vitalist" in their sense, but an epistemologist who places the issue of teleology and organism in their relation to the faculty of reflexive judgment and the regulative Ideas of Reason. Natural purpose is a pre-condition of a science of life, rather than an empirical datum deduced from phenomena. It is this location in the act of knowing, rather than in empirical inquiry, that now opens the cognitive space for a conception of a naturalized "science of life"—biology—that comes on the scientific scene around 1800. In this novel interpretation, Huneman sees Kant giving an epistemic grounding to the concept of "organism" which is related to the "naturalization" of human knowing through the project of Kant's critical philosophy.

To reach this point, we are led through Kant's discussions of human races and his analysis of the concept of species as this was being discussed after Buffon revolutionary discussions of the concept. These begin with Kant's anthropological essays of 1775–1777, which Kant then picks up again with a new vigor in his essays of 1785 and 1788.[4] In his interesting analysis of Kant's complex reflections on human races, reflections that have led many commentators to see him as "essentializing" the concept of race, Huneman draws a contrast between Kant's views and those following from a Buffonian "degeneration" theory. Against the latter, Kant developed his novel thesis of the interaction of "germs" *(Keimen)* and "dispositions" *(Anlagen)* that function in relation to environmental circumstances.

These concepts are seen as providing limits to the degree of change possible within biological lineages, and they ground the perpetuation of traits in a complex relation to environmental circumstances.[5] The point that Huneman emphasizes is that Kant's articulation of his "germ" and "disposition" concepts imposed an inherent limitation on the degree to which an internal formative force, similar to Wolff's vis essentialis, can result in species change, something Kant denies. This also differentiates Kant's use of C.F. Wolff's work from the ambitious employment of Wolff's concepts by Kant's former student, Johann Herder. The conclusion Huneman extracts from this analysis is an understanding of the teleological directionality of living beings as restricted within formal limits. This grounds the teleological directedness of organic life and gives a foundation for his novel concept of organism. This opens up the discussion of purposiveness as it then emerges in the Third Critique in 1790.

Part 3 then moves to an applied framework of Kant's arguments in Part 2; this engages Kant's "moderate" epigenesis and the developments that lead into his

conception of an "archaeology" of nature, discussed in paragraph 90 of the CJ. The reading of this text by Goethe is interpreted to have opened up the comparative anatomy disputes between Georges Cuvier and Etienne Geoffroy-St. Hilaire. The emergence in the CJ of the concept of "organism" as an "Idea of the Whole" is seen as central to establishing the new inquiries of 19th-century life science into physiology, comparative anatomy, paleontology, and embryology.

Although the main focus of Huneman's arguments is directed to the historical and textual analysis surrounding Kant's Third Critique rather than developing positions on contemporary issues in contemporary philosophy of biology, Huneman does see some relevance of his analysis for current inquiries, particularly those engaged with nonlinear dynamics and the issue of emergence. Some of the conceptual difficulties surrounding contemporary discussions of these issues he feels are due to the "loss in translation" of Kant's crucial distinctions between regulative and constitutive principles and the failure to recognize the relation between teleological purposiveness and "reflective" judgment.

Only by working through these substantial discussions can the reader appreciate the detail of analysis and the novelty of Huneman's arguments. The linkage between the concept of purposiveness, the issue of contingency manifest in the biological domain, and the "transcendental" level of analysis that avoids substantive metaphysical claims underlies a larger synthesis that is claimed to "naturalize" teleology without making a "naturalistic reduction" as one could find in materialism, the metaphysics of Spinoza, in bottom-up accounts through natural selection theory, or in the contemporary claims of strong physicalism. These alternatives to his own analysis he treats fairly and sympathetically, but he sees these positions as alien to the "transcendental" presuppositions offered in Kant's solution to the theoretical issues of biology. Huneman also supplies a "Reader's Guide" to assist those who might be interested in his specific discussions of issues of philosophy and history of science.

As should be obvious, Huneman's treatise engages some of the deepest issues in the philosophy of the life sciences. The combination of philosophical analysis and historical discussion pulls together issues that require reflection on both levels and press the theoretical reflections on biology to new levels. To be sure, not all will agree with his conclusions. As an "unrepentant" neo-Aristotelian, I would raise some issues with regard to the adequacy of Kant's solutions to some of the fundamental issues of biology. But the power and depth of this analysis make it a necessary reading for anyone interested in the philosophy of biology.

Michel Foucault made the bold statement in his *Les mots et les choses* (1966) that "there is no life in the Classical period, nor any science of life." This has always seemed to me to be a purely gratuitous claim, based on extremely thin historical evidence.[6] Huneman has in many ways now given some substantial flesh and rationale for a form of this argument, while remaining critical of aspects of Foucault's claims. His deep analysis of Kant, along with the considerable historical detail supplied on the life sciences of the period, presents a new

way of interpreting such a claim. It also serves as a rejoinder to those who deny that Kant's philosophical views in fact had much to do with the development of 19th-century life science.

It is clear that something does happen around 1800 that spurs life science to make its remarkable expansion of inquiry and that grants it an "autonomous" character that opens up theoretical and empirical inquiries into cell theory, experimental physiology, microscopy, comparative anatomy, and reflections on transformism that constitute monumental developments. Huneman's Kant is central to opening up these lines of inquiry, not in the form of empirical contributions, but as supplying a novel epistemic foundation that allows "biology" to "stand on its own" by bringing the analysis of the concept of "organism" and teleological purposiveness into a new focus as a goal of the critical philosophy, rather than a side issue of Kant's larger architectonic. This work should generate considerable further reflection on the issues that opened up the remarkable developments in the 19th century and beyond surrounding the emergence of the dynamic "sciences of life," even if the empirical development of these sciences is not simply an extension of a Kantian program.

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Notes

1 P. Huneman (2008) *Métaphysique et biologie: Kant et la constitution du concept d'organisme* (Paris: Kime).
2 See P. Huneman (2023) *Death. Perspectives from the Philosophy of Biology* (London: Palgrave Macmillan). P. Huneman (ed.) (2007) *Understanding Purpose: Kant and the Philosophy of Biology* (Rochester: University of Rochester Press); F. Bouchard and P. Huneman (eds.) (2013) *From Groups to Individuals: Evolution and Emerging Individuality* (Cambridge, MA: MIT Press); P. Huneman (ed.) (2013) *Functions: Selection and Mechanisms* (Dordrecht: Springer); P. Huneman and D. Walsh (eds.) (2017) *Challenging the Modern Synthesis: Adaptation, Development, and Inheritance* (New York: Oxford University Press).
3 See Pierre-Olivier Méthot (2023) "Analytic and Continental Approaches to Biology and Philosophy: David Hull and Marjorie Grene on 'What Philosophy of Biology is Not'," in G. Bianco et al. (eds.), *Canguilhem and Continental Philosophy of Biology* (Dordrecht: Springer), https://doi.org/10.1007/978-3-031-20529-3_2.
4 These texts are conveniently all available in English translation in Jon Mikkelsen (ed.) (2013) *Kant and the Concept of Race: Late Eighteenth Century Writings* (Albany: State University of New York Press).
5 Whether this can be saved from an implicit endorsement of a form of biological preformationism, as I myself have argued that Kant embraced, depends in good measure on how one defines "preformationism" in this context, as the late 18th-century alternatives were not simply those of strong "pre-existence" preformation and pure epigenesis. There were also intermediary views based on "germ" preformationism that have

several resemblances to Kant's own positions and can be argued to underlie Kant's own use of the language of "generic preformationism" in the second (1787) edition of the First Critique. See my "Preforming the Categories: Eighteenth-Century Generation Theory and the Biological Roots of Kant's A Priori," *Journal of the History of Philosophy* 40 (2) (2002): 229–253.

6 Michel Foucault (1970) *The Order of Things: An Archaeology of the Human Sciences* (New York: Random House), p.166.

Introduction

I.1 Why now a book about metaphysics, biology, organisms, and Kant?

Camels and palm trees are alive; mountains and lakes are not. At least, this seems obvious to us. Yet, in some cultures, lakes would be alive, which indicates that our certainty of knowing what life is might not be completely or unanimously justified. Generally, life is ascribed on the basis of some appearance of spontaneous motion. Lakes move, but because of the wind; camels and palm trees seem to move, first, when they grow, and then through space, concerning the camel. A kind of motion is supposed to characterize life, and, for us, the lake is not alive because motion comes from the outside. Hence, inner motion, it seems, provides us with a first clue to justify our immediate feeling that some things are alive. But then, what is this "inner"-ity, how to distinguish it from other motions? We just face the same problem, one step later: capturing what exactly makes something such that we undoubtedly say it is alive, what properly constitutes its "vital motion . . ."

This means that "life" shares with several other general concepts the status of many metaphysical questions, namely: I can recognize whether X is living or not, but cannot immediately explicate the reasons why I say so, and much less, provide a concept supporting these reasons, for instance, the necessary and sufficient conditions for X to be alive.

Or, if one accepts my preliminary reflection, spontaneous motion leads us to Aristotle, whose reflection on life, especially in his *De Anima*, was crucial in his philosophy and centered on the notion of motion, as his physics in general, since *phusis* is a principle of motion. Aristotle's answer to our question is well known and it grounded centuries of natural philosophy: living systems have a *soul (psyche)*, which is their principle of spontaneous motion, and then this soul has to be split into three particular souls (vegetative, motor, perceptive), each ascribed to plants and animals.

But we live in a time where biology has been a flourishing science for almost two centuries. And here, the inner motion of camels and the correlated underlying

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soul became out of place. No science can accept that what turns a stone into a living thing is the addition of a soul, whatever this means. Nobody within science sees souls behind living creatures, and death, the cessation of life, as losing one's soul. Instead of body and soul, opening biology book, reveals the word 'organism' throughout. Life comes in the form of organisms.

In a word, biology as a science left behind bodies and souls in favor of organisms, a notion which implies at the same time *organs*, namely parts that do something special—"organ" meaning instruments in Greek—, and a specific kind of *connection* between parts. Such a connection contrasts with a set of stones, where parts do nothing special and are mostly permutable—, or a football team, where parts do specific things but can be replaced; granted, they are not permutable (think: goal keeper), but they can also live independently, as do most football players you know.

Historians and philosophers have extensively written about this shift and the arising of a specific science of life that no longer posits souls informing bodies. This book focuses on the constitution of the concept of *organism*; hence, many of these scholars will be discussed in the following pages. And starting from the late 18th century in Europe, many researchers—namely naturalists, physicians, physiologists, botanists, zoologists—concurred on asking questions about the development, the function, and distribution of organisms in nature, thus establishing the scientific field known as *biology*.

While biology faced a major upheaval with Darwin's evolutionary theory, soon to become the major framework of this science, organisms central in his view. We may know that evolution is about the change of gene frequencies as do current textbooks say, but Darwin was primarily interested in how the overall profile of organisms emerged and change over time, in relation to the interactions that organisms have with one another, a set of interactions he called "struggle for existence."

Some philosophers, including many friends of mine, think that the novelty of Darwinism made most of philosophy devoted to life before 1859 completely irrelevant. Actually, the table of contents of a typical philosophy of biology book includes entries that generally had no meaning before Darwin (think: units of selection; adaptationism; parsimony; information; genetic reductionism. . .). Yet, I would argue that philosophical texts focusing on this very concept of organism, central in Darwin's thought as well as in the science of his predecessors, may still be philosophically significant. This is the case of the section Kant wrote on organisms—"organized beings," as he says—in the *Critique of the Power of Judgment* (its second part, more precisely).

A few philosophers of biology took this text seriously, and I support them for the aforementioned reason. But notice that this is the third *Critique,* in a series of three *Critiques*, which are the key elements of a philosophy that labeled itself "critical." I will not, of course, explain the meaning of "Critique" *sensu* Kant in this introduction, but the presence of an interrogation about our knowledge of

organisms in one of the three *Critiques* indicates that the examination of biological judgment by Kant, far from being a sort of applied Kantian philosophy, was part of the general architecture of Critical thought, which itself knowingly appears as a systematic attempt to revise metaphysics, especially in its then current form of Leibnizian metaphysics. Thus, one can reasonably assume that Kant met "the organism" as a question from within the critical examination of metaphysics. Hence, the question of what organisms are and how we should know them emerges in the context of a questioning of the possibility of metaphysical knowledge: this is the starting point of the present book. In it, I investigate the reasons and the consequences of this unprecedented meeting between metaphysics and modern biological science in formation.

For this reason, this book does not intend to overcome the accumulated philosophical and historical studies of 18th-century biology—instead, I will obviously rely on this body of knowledge. For the same reason, neither does it constitute a commentary or an elucidation of Kant's *Critique of the Power of Judgment*, which already exists in several versions (starting from Heinrich Cassirer's 1938 commentary). Nevertheless, it bears on the discussions on the meaning of this work and its major claims. In a nutshell, my study proposes an archaeology of the concept of organism as a founding scheme of modern biology, undertaken from the viewpoint of the Kantian critique of metaphysics.

Granted, we are accustomed to seeing in Kant's philosophy a definitive contribution to the philosophical examination of science. But the case of biology is worth specifying here. Kant did indeed take the philosophical measure of Newtonian physics, not so much by translating it into philosophy (which would make no sense) as by formulating a framework for reconciling, as Puech (1990) has shown, the legacy of the German post-Leibnizian school of metaphysics and the new Newtonian physics.[1] But the fact remains that this modern physics had been constituted for almost a century before the *Critique of Pure Reason*. The situation with regard to the life sciences is more singular: Kant was contemporary with the multiple reflections that, according to modern historians (after Auguste Comte) mark the birth of what we call "biology," as a systematic study of the development, functioning and distribution of organisms. This birth sanctioned by the appearance of this very word (by Burdach, Lamarck, Treviranus, then Bichat around 1800).[2] The third *Critique* thus bears direct witness to a mutation of concepts that makes a science of life as we understand it possible. The second part of this *Critique* indeed is an analysis of the concept of "natural purpose," which—Kant argues—is objectively realized in "organized beings" (*Organisierte Wesen*), i.e., animals and plants. Most commentators (Löw, Zumbach, McLaughlin, Zammito, Quarfood, etc.) have read this text as a study of the foundations of biology, or of the specificity of biological explanation. This suggests that Kant is indeed dealing with the conditions for thinking scientifically about life. Some of them, such as Ginsborg (2015), recently insisted that the work itself achieves a strong unity, in such a way that the analytics of esthetic judgment, the

critique of teleological judgment, and the considerations about purposiveness of nature as a putative system of law expressed in the two introductions, hold together as a general epistemological conception of judgment, which completes the view developed in the first *Critique*. Along those lines, Zuckert (2007) provided an important account of the third *Critique*, which will not be discussed here in detail because of the difference of perspectives and the length of such a potential discussion.

While reading recent literature on Kant's accounts of judgment and teleology, after having completed a book in French stemming from my doctoral dissertation defended twenty-five years ago (!), I have been surprised by the lack of communication between traditions in Kant's scholarship. In a nutshell, the large body of French-language works on Kant since the 1950s and earlier, which have contributed to shaping my understanding of the questions addressed here, appears to be ignored in the mainstream anglophone Kantian scholarship. Some of the major books on the topic, starting with Gérard Lebrun's magnum opus *Kant et la fin de la métaphysique* (1970), are never cited in major recent English-language studies on Kant. I see the present book as a first attempt to rely on these two separate scholarships and bring them into dialogue. Authors such as Lebrun, Jules Vuillemin, Louis Guillermit, Michel Puech, Alexis Philonenko and several others, who wrote Kantian pieces of commentary worth meticulous study, are therefore also present in this book, which, I hope, constitutes a first step toward a more balanced dialogue between Kantian academic communities.[3]

However, investigating the meeting of metaphysics and biology in Kant's third *Critique* is not only of historical interest. Kant's theory of "natural purpose" in the *Critique of the Power of Judgment* provides a very powerful interpretation of both the epistemic autonomy of biology and the meaning of some of the main biological concepts, starting with '"organism." Kant's views were taken up by some ancient theoreticians of development, most famously naturalist Johann Friedrich Blumenbach, since he and Kant cited each other, as many historians have noted (e.g., Richards 2000, see chapter 6). This legacy is acknowledged within biology, for instance, Gilbert and Sarkar (2000) wrote that "the founders of modern embryology—Döllinger, Pander, von Baer, and Rathke—subscribed to the organicism set forth in Kant's *Critique of the Power of Judgement.*" Thus, from the viewpoint of biology, the relevance of Kant's views on organisms is acknowledged. Many recent works reflect a Kantian inspiration in their consideration of key biological features: development, organisms, and also physiological functions or even ecology.[4] My study may therefore appear as a contribution to this line of thought, insofar as it emphasizes the relevance of Kantian themes to current biology will be emphasized. Yet, this is not exactly the project undertaken here, which rather features a kind of *parallel reading*: Kant is read from the perspective of rising biology, and the biology in progress is in turn seen from the perspective of critical philosophy.

Many of the projects that have been carried on since I started this research are mostly undertaken in one or other perspective: (1) they improve our understanding of Kantism especially by focusing on his views of life (among others, see Quarfood 2004; Ginsborg 2015; Van den Berg 2014; McLaughlin 1990; Zuckert 2007; Toepfer 2011; Corti and Schülein 2023; Goy 2012, 2017; Watkins and Goy 2014); (2) they use Kant's views in order either to (2a) explain a moment in history of science, or (2b) extract an interpretative scheme allowing for a better understanding of current research projects on philosophy of biology centered around the concept of organism (respectively Zammito 1992, 2002; Sloan 1985, 2002, 2006; Richards 2000, 2002; Steigerwald 2019; Wells, 2020; Nassar 2013 (2a) *and* Mossio and Bich 2014; Cooper 2023a; Van de Vijver et al. 2005, 2003; Huneman 2017a; Desmond and Huneman 2020; Toepfer 2019b; van den Berg 2025; Wilks 2023; Rupik 2024; Jones and Cooper 2023; Goldstein 2017 (2b)). The present book coincides exactly with none of these strategies, because of the double relation it entertains with the history of metaphysics and the philosophy of biology.

Here, I have first to say a word about the situation of my own research in this context of the recent philosophy of biology.[5] Organisms do *develop*, and Kant focused on this dimension, both in his contributions to natural history, which proposed a theory of germs and dispositions supposedly helping to make sense of development and species maintenance (see Chapter 6), and in the third *Critique*, which famously paid a debt to Blumenbach, who proposed the notion of *Bildungstrieb*, a formative trend underlying all developments.[6] For sure, I will investigate all these aspects in detail in the book, but I just wanted to set the stage here.

But development is not only one feature of organisms that contrasts with the unordered trajectory of physical systems, which are generally governed by the increase of entropy. (The apparent orderliness of development was such that, by the 1980s, advances in molecular biology and knowledge of the genetic code led researchers to conceive of development in terms of a *program* operating within organisms.) Yet development signals also a major divide within current biology, namely, the *articulation between the theory of development*[7] *and evolutionary theory*. For the biologist, unlike for the lay person, development and evolution are completely distinct: "organisms (individuals) develop, species (populations) evolve" is the guiding motto. Moreover, the separation between *individual* development and intergenerational transmission of traits in a *population* (= inheritance) is definitive of modern evolutionary biology (called "Modern Synthesis," see Gayon 1998; Gayon and Huneman 2019). Several researchers emphasized this divide, studied its origins, such as Amundson (2005) who, like some others, claimed that there is an unsurpassable divide here. Others (e.g., Gilbert et al. 1996; Burian 2005; Pigliucci 2007; Müller 2017) argued that a novel synthesis between evolution and development constitutes a major aim for biological theorizing. Many of the recent controversies about evolutionary theory, perhaps from the groundbreaking work by Stephen Jay Gould (*Ontogeny and Phylogeny,*

1977), deal with this problem of articulating development and evolution.[8] To this extent, assuming Kant's involvement in the history of developmental theories, his philosophy becomes relevant to this controversy.

This is all the more significant because "organisms" have become a central issue this controversy, increasingly occupying the theoretical space in evolutionary biology itself since the 2000s. Molecular biology and Modern Synthesis in evolutionary biology have been framed in terms of concepts referring to "suborganismal" entities, molecules and genes, unlike developmental biology. Behavioral ecologist Patrick Bateson entitled a 2005 paper "The return of the organism". He argued that evolutionary biology eclipsed the organism by focusing on changes in allele frequencies in gene pools, while since the 1990s, developmental biology and ecology increasingly acknowledged a causal role of development and the functioning of organisms in evolutionary processes. Denis Walsh, one of the most vocal advocates of a revision of the Modern Synthesis on philosophical grounds, similarly distinguished between "organismal" and (what he calls) "suborganismal" biology (Walsh 2013). Given that Kant analysed the conditions of biology with "organism" as a foundational scheme for understanding life, his thought is naturally relevant for those who are interested in such a "return of the organism" appears quite natural.

I have been involved in these discussions for years, defending a reasonably skeptical position about the claimed novelty of a putative evolutionary synthesis (Huneman 2017a) and about the supposed impossibility of accounting for organisms within the classical Modern Synthesis framework (Huneman 2010, 2017b). In this book, I do not aim take a stance in any of the current controversies. My goal is to understand Kant's theory of organisms, in its biological context, and in connection with the major epistemological and metaphysical reasons that led him to make room for "organisierte Wesen" in a critical theory of judgment. Then I draw consequences about the relevance of Kant's views of purposiveness to philosophical reflections on organisms, development, and evolution, or adaptation and biological functions. However, I do not propose any Kantian synthesis suited for solving current theoretical problems. As I indicated elsewhere (Huneman 2023c), I do not think such a solution exists, and I still acknowledge incompatibilities between views of organisms—something that will be argued for in the last chapters. Future works will be devoted to exploring the limits of this incompatibility. For the moment, I aim to explain how Kant's theory of organisms, and, before that, of purposiveness, stems from profound metaphysical questions concerning the order of nature and, beyond that, *contingency and necessity*. To the extent that these metaphysical issues are at stake in debates proper to theoretical biology, Kantian options are relevant; however, if they remain Kantian, they have to be explored on the basis of awareness of such metaphysical issues.

For this reason, the specificity of this book consists in keeping together the *biological context* in which Kant thinks, which has been crucial for the fate of life sciences, as many historians have taught us, and the *metaphysical context* in which the concepts at stake can only make sense. This connection will ultimately explain why my view contrasts with two extreme interpretations of Kant's relevance in recent scholarship: those who, like Zammito's major book (Zammito 2018), finally deny that Kant's epistemic interpretations of the specificity of organisms was instrumental in shaping modern German biology (Zammito 2006), and those, such as Gilbert and Sarkar (2000), Weber and Varela (2002), or Corti (2023), who think that Kant's notion of purposiveness is exactly what is needed to philosophically make sense of models of organization (e.g., self-organization, biological autonomy).

Actually, both views concur in thinking that the so-called *regulative* dimension of the Kantian concept of purposiveness should be dismissed.[9] Zammito thinks that the need for such dismissal shows Kant's irrelevance for contemporary biology, while his opponents think that we just have to get rid of this feature to see how Kant remains relevant to us. Yet, they don't really ask the same question: Zammito questions about the historical impact of Kant's views, while Mossio and Bich (2014), Corti (2023), and others question Kant's current relevance to biology. In my view, both are wrong, though they provide precious insights.

In stark contrast with these approaches, I will show that the regulative character of purposiveness is central to the systematic organization of Kant's thinking on biology, organisms, and purposiveness. Consequently, only the whole conceptual architecture elaborated by him, including the role played by the difference between constitutive and regulative principles, allows his account to be relevant for theoretical biology, and distinguishes it from some naive instrumentalism or projectivism.

In the rest of this introduction, I will explain the peculiar historical situation of life sciences at the time of Kant and its importance for his project. Then I will justify what will be my interpretative thread to undertake a cross-reading of Kant and of the biologists of his time. Finally, I will explain the structure of the book.

NOTE: This is based on a 2008 book, itself derived from my PhD philosophy dissertation defended in 2000 and supervised by Gerard Lebrun, who authored perhaps the most insightful book ever on Kant's *Critique of the Power of Judgment* (namely, *Kant et la fin de la métaphysique*, 1970). I am still greatly indebted to his thinking.

While a complete updating of the book would have been beyond my reach, especially because since its publication, the number of studies devoted to Kant and biology considerably increased (which by the way includes some of my own work in English), I aimed for this edition to be accurate, and to discuss some of the views that made important contributions to the matter I am studying. I will not try to be exhaustive, and I will not discuss many studies or articles, especially when they concur with my own papers in English, and with my 2008 book in French (often in complete unawareness

of the authors). Therefore, while I acknowledge the importance of several books published after my completing the book published in 2008, and may sometimes refer to them—here, I think of Zuckert (2007), Nyhart (2009), Mensch (2013), Ginsborg (2015), Van den Berg (2014), Duchesneau (2018), Massimi and Breitenbach (2018), Cooper (2023), Steigerwald (2019), Zammito (2018) and Bognon-Küss (forthcoming)—I won't systematically enter into a detailed discussion of their arguments, nor will I always take the time to emphasize the many convergences between some of their views and mine.

Most importantly, I was also deeply willing to emphasize the relevance of this study to the new discussions I just mentioned on development, organisms, and evolution, not least because some of my own work has been precisely focused on the objects of these discussions.

Yet, despite this lack of scholarly exhaustivity, I do hope that this book has another interest than just bringing to the attention of a handful of readers a text that existed in French fifteen years ago. The present text is deeply different from the 2008 book, especially because I integrated many reflections about the relevance of these ideas for current philosophy of biology. I modified many aspects of my account, due to the state of the art on these topics, and my own results gathered since 2008, especially concerning the current concepts of organism and their epistemic challenges.

Thus, it is actually *another book* than the French 2008 opus. I still hope that in the end, all of this will make sense.

I.2 Kantianism, science, and biology

One obvious fact underlies the third *Critique*: living things (animals and plants) are organisms; Kant was the first to formulate the idea that they are self-organizing (see Chapter 9). In the space of almost a century, we have indeed moved on from an approach to the living world in terms of body and soul, in which the notions of living being and organization[10] would mean, in a distantly Galenic sense, a set of parts, each with a utility, and directed by a soul, to the idea of the living as a totality of parts circularly linked by reciprocal causation. It's intelligibility lies precisely in this specific relationship between the parts themselves, and the parts and the whole (the word "organism" emerging precisely at this moment in Latin, French, and German, as addressed in the following). At the same time, natural history, as a discipline concerned with the totality of nature's products, has turned into a zoology and a botany focused essentially on the living, and presupposing—rather than natural history's tripartition of kingdoms- an almost ontological division between the organized and the unorganized. This second shift, through which "organization" becomes the key criteria founding an ontological difference, reinforces the effect of the disappearance of the soul–body scheme in physiology, so that at the times of Kant there is a massive commitment to the notion of the organism as a specific, ontologically irreducible scheme of thought and form of existence (as Chapters 1 and 2 will exemplify). In this sense, the *Critique of the Power of Judgement* seems to mirror such a mutation. If we want to take a close look at the new relationship between science and philosophy in Criticism, we can therefore ask how such a mutation in the conception of

life (centered here on the constitution of the concept of organism) came to meet Kant's critical thought, and what role it played in it.

Let me clarify these matters a bit more here. Traditionally, since the living thing had a body, it was an object of "natural philosophy,"[11] namely, the ancestor of our "physics"; and the description and classification of its various forms was then a matter for "natural history," the general discipline of the forms of the products of nature, which included the study of minerals. This discrepancy between the absence of a science of life *proprio sensu* and the scattered presence of life in these two academic disciplines has indeed been the object of a question addressed by Charles Wolfe (2011): "Why was there no controversy of life in the so-called scientific revolution?"

Kantianism set itself the task of a major upheaval in the order of the conceivable and the distribution of knowledge, since metaphysics, philosophy, theology, and science no longer deal with exactly the same objects after his critical philosophy. In particular, science and philosophy became two distinct types of knowledge, at least retrospectively, since we easily distinguish what is physics (under the name of natural philosophy) and what is philosophy (namely, metaphysics, logic, epistemology, etc.). By turning philosophy's gaze toward the conditions of knowledge before any scientific enterprise, as one knows Kant did, one clearly demarcates a territory proper to philosophy (metaphysics and epistemology) from a territory proper to science.[12] Insofar as it is correlative to a transformation in the configuration of knowledge, the shift in the perception of the living marked by the rise of "organism" and "organization" should have thereby left its mark on Kantianism, making it readable in his work, or explicitly reflected by it. Hence, the object of my inquiry takes the form of a *parallel* or *cross-reading*.[13]

As soon as philosophy and science separate in the century after Kant, the question of the reference of the terms used by these disciplines becomes a delicate one, since their homogeneity is no longer assured. In the case of biology, this difficulty is borne out by several phenomena. For example, it is surprising that the very moment when life became the object of positive or scientific discourse—namely, the 19th century—was also the moment when, throughout philosophy, the concept of "life" became able to expand to the point of naming realities which, from the point of view of ordinary language, do not fall under the extension of "life": societies, the mind, religion and so on.[14] A question arising at the horizon of the present study is, therefore, whether this double shift around positivity refers to the construction of biology as a science of life under the scheme of the organism—and to its philosophical reflection in Kantianism. In this way, the most distant issue at stake in my investigation is the problem of the use and reference of the term "life," after the transformations in the relationship between philosophy and science that followed critical philosophy and the constitution of biology.

By considering a cross-reading of Kant and contemporary biology I do not, therefore, intend to make a study of the influences on Kant's thought, especially as those of Adickes (*Kant als Naturforscher,* Bd II), Timothy Lenoir (*Strategy of Life*, chapters 1–2; "Kant Blumenbach and the Göttingen school"), and McLaughlin (*Kant's Critique of Teleology*, chapter 1), among others, have largely paved the way for understanding the subject. Most recently, van den Berg (2024) and Cooper (2023) provided further elements to this study, as well as Zammito's 2018 opus on German biology. Instead, I aim to place Kant alongside with several texts on biology, or "pre-biology,"[15] if we may call it, Creating a kind of reflective interplay between them. These texts encompass the Theories and conceptions of the late 18th century which, in retrospect, yielded the relatively unitary and autonomous science we call biology, aiming at understanding living beings in terms of their functioning, interspecific relationships, and genesis.[16]

But let me specify here that I will read biology from Kant onward, and precisely from what is indicated in the *Critique of the Power of Judgment,* namely the obviousness of the organism's scheme for apprehending living beings: one must therefore identify the *decisive moments* in the emergence of this obviousness. In retrospect, I will then read Kant from these decisive moments, attempting to mark their incidence in the genesis of Kantian thought on the organism, from the *Only Possible Argument for the Existence of God* (1763), to the *Critique of the Power of Judgment*. My reading of the various biological moments is thus subordinated to the Kantian itinerary, which is itself read through an interrogation about the question of the living within it. Such is the method: my program consists in reading moments in pre-biology from the Kantian viewpoint, and in return reading Kant in the light of this pre-biology.[17]

This reading mode invites us to practice a history of science that, by dint of putting texts and concepts first, does not enter into some recent, so-called externalist avenues of research in the field. Here, my understanding of epistemologically decisive moments is guided by my reading of Kant. Hence, this is by no means an exhaustive study of the premises of biology, which, as such, would have to take account of the institutional and political movements of the time. Over the last fifteen years, many have contributed to it; to name a few, Nyhart (2009), Steigerwald (2019), Gaukroger (2010), Duchesneau (2010, 2018), and Zammito (2018) provide invaluable insights. My aim is to design a genealogical questioning of criticism, asking what led the critique of metaphysics to the concept of organism in the *Critique of the Power of Judgment,* and confronting it with an epistemological questioning that unravels the archaeology of the "organism" as a biological scheme that is still present in biology today, as indicated by my briefs allusions above to the issue of organism in current biological thought.

My primary aim, therefore, is not to identify "sources" or "influences" but rather to understand the ways in which the theoretical unavoidability of the organism as a biological concept became apparent to Kant as he embarked on his

critique of metaphysics. The second section of the third *Critique,* the "Critique of the Teleological Faculty of Judgment," is not an excursus to transcendental philosophy, a sort of criticism simply applied to biology: it proceeds from an internal necessity in Kant's thought, as is clearly demonstrated at the end of the text when Kant handles the problem of a mediation between nature and freedom, which answers the metaphysical issues raised by the Introduction about the gap between nature and freedom.[18] Tracing this internal necessity allows one to understand how Kantian thought had to come to terms with simultaneous scientific developments in the field of biology. By identifying some decisive moments in the constitution of the concept of "organism" for thinking about life, I will therefore analyze how, starting from philosophical problems related to the critique of Leibnizian metaphysics, Kant was led to reflect on life itself. I intend to show here how Kant's critique of certain ontological notions of Leibnizian metaphysics (order, necessity, contingency, final causes) was to be articulated with autonomous scientific developments that took place at the same time by authors such as Haller, Barthez, Buffon, Caspar Wolff, and Blumenbach and, in turn, shaped the scope of the meaning of "life" for future philosophy and biology (especially, Cuvier, Goethe, Geoffroy Saint-Hilaire, and all the way down to Darwin).

I.3 The common thread: organism, purpose, and order

Kant had always been preoccupied with the questioning of the living world as it existed in the sciences of his time. His early letters to the physician Marcus Herz spoke of a "Medical introduction" by Mac Bride, or Donald Monro's *Essay on Dropsy and Different Species*; and his own essays on human races[19] inspired Girtanner, a famous Göttingen physician and naturalist, to write an essay *Uber das kantische Prinzip für die Naturgeschichte*, which Kant approved of at the time.[20] Nevertheless, as he admitted in a letter to Breitkopf in 1778, natural history was not an object of study for him but a distraction. After all, Kant's writings include major considerations on the history of the universe (I will read them below) and on geology, while his lectures in class were often about geography, a topic he taught for decades (Ak. Ausg. Vol. XIV, and Vol. XXVI).[21]

How, then, can we pinpoint the problem that was decisive for the critical consideration of biology? If life is to be understood as an organism, and if the organism realizes this concept analyzed in the *Critique of the Power of Judgment*, which is "natural purpose" (*natural Zweck)*, then our key issue is indeed *purposiveness*. Adickes (1923) said that biology in Kant's time was unified around his concept of organized being, but had not grasped that the central issue was the idea of finality, which took Kant to be brought to light; we must therefore ask ourselves why Kant felt the need to consider biology, and how this engagement enabled him to locate in the notion of purposiveness the resources required for the concept of organism. This need is addressed in Part 1 of the book. But the

connection between biology and purposiveness deserves a preliminary sketch in this introduction, in order to explicate Kant's general take on life sciences and biological judgment, as well as its being grounded in an immediate phenomenology of the experience of living things and the discourse on life.

Phenomenologically, the purposiveness of the living shows itself in three aspects: the parts of organisms have *functions*, i.e., they *should do* certain things; the *development* of organisms is a process that seems directed toward a *goal*, i.e., the adult organism; and the properties of an organism yield its *fit* with its environment, which constitutes the fact that it is *adapted:* physiology, embryology and comparative anatomy, at least, must therefore make extensive use of a teleological discourse. This multifaceted recourse to *purposiveness* characterizes not only the way we describe living phenomena but also the way we *explain* them: functional statements answer questions about why animals and plants have the parts they have; developmental goals explain features of the succession of developmental steps; adaptation explains why a living thing is designed as it is. Purposiveness, therefore, constitutes an apparently decisive epistemological feature of our knowledge of life. As I will explain throughout the book. This feature emerged clearly in the theoretical advances constituting prebiology, but is general enough to be discernible from the Aristotelian and Galenic treatises onward. That a "teleological judgment" is at stake when it comes to understanding life consists precisely in acknowledging this epistemological nature of the notion of purposiveness and its crucial role in the knowledge of life.

As an heir and a discussant of Leibnizian metaphysics, which explicitly tried to reconcile "les *efficientes et les finales,"* efficient and final causes (*Discours de Métaphysique*, 1686), namely to explicitly make room for purposiveness within science (unlike its implicit role in Cartesian mechanicism *à propos* of the living, which is a machine, and therefore, divinely designed), Kant had to think very early about the concept of purposiveness, and even earlier than what historians call his critical turn.[22] Conceptually, he ascribed to the notion of purposiveness two sides: *system* (arrangement of parts subordinated to a whole, through which each part has its design) and *technique* (the system has to be specifically produced to do the things that make it robust). This difference between *system* and *technique* is present in the 1763 text, *The Only Possible Argument for the Existence of God.* Life is then a matter of *divine technique*; the order achieved by this technique is *contingent* with regard to the laws of nature (unlike the *necessary order* of the planets' revolution, for instance). However, Kant was not satisfied with this conception: the notions of "system" and "technique" were to change after his critical shift, and the status of life was to evolve accordingly. The consideration of biology in the *Critique of the Power of Judgment*, and the critical elucidation of the foundations of a science of life based on an analysis of the notion of purposiveness, are therefore fully in line with the question of the order of nature and divine technique addressed by Kant in 1763. I will extensively develop these ideas, but I wanted to make provisionally the case for a reading of

Kant that goes beyond the third *Critique*, and intends to diachronically approach Kant's shifting views about purposiveness.

From Kant's beginnings, life seems to be part of a contingent order. One of the decisive claims of the *Critique of the Power of Judgment* is indeed that purposiveness is "the lawfulness of the contingent as such": a strange formula, since the contingent, on the face of it, can have no law. Such a phrase clearly indicates that the consideration of the foundations of biology stems from a general problem in which what is at stake is the possibility of thinking an order of, or in, nature, even when things seem physically unnecessary. More precisely, it is the issue of the place and possibility of a contingent order in nature, and beyond this, the very meaning of the category of contingency. In 1763, this question lay at the heart of Kant's critique of Leibnizian metaphysics, since Leibniz's understanding of contingency rests on his conception of God, of the relationship between divine understanding and divine will in God, and thus, between logical laws and maxims of suitability (*maximes de convenance*).[23] In the problem of contingent order, then, I see a motif that enables us to follow Kant's interest in the thought of life, the shifts in the status of life as his critical thinking develops, and finally his encounter with certain decisive advances in biological thought—all this, starting from the very enterprise of breaking with classical Leibnizian metaphysics.

My ultimate question, then, is how the question of contingent order, or the possibility of order and the status of contingency, led Kant to a critical elucidation of the meaning of "life." By so doing, we will better understand the relevance of the theme of life for critical philosophy, and how (biological) scientific discourse can be taken into account by (Kantian) philosophical discourse. While I will exhaustively explore this question of the "lawfulness of the contingent as such" in due time (Part 2), let me indicate provisionally the meaning of such a notion—life—in the context of late 18th-century life sciences.

Science in the wake of modern physics appears as driven by the scheme of what Descartes called a *mathesis universalis*, namely, an overall transparency and reachability of whatever exists, understood through a mathematical order.[24] While the understanding of this mathematics and the forces described by them was controversial, there existed a general agreement on the governing role of the *mathesis* scheme for science, visible in the pervasive use of this phrase by several philosophers (Descartes, Leibniz, among others). Given that I use this phrase to label a space of knowledge that was disrupted both by criticism of the relation between metaphysics and science, and by the emergence of a science of organisms, I will say, provisionally, a word about my use of this label here.

Descartes coined this phrase in the *Regulae ad Directionem Ingenii*:

> with regard to measure, it makes no difference whether it be in numbers, shapes, stars, sounds or any other object that such measure is sought, and (. . .) there must therefore be some general science which explains all that can be inquired into concerning order and measure without application to any one

> special matter. We can denote such a science not by a foreign term but by an old word which has passed into general usage, i.e., by the expression *mathesis universalis.* This science also contains the reason why the remaining sciences are called mathematical theories.
>
> (AT X 378, CSM I 19)

At the time, the phrase *Mathesis Universalis* concerns sciences that are related to mathematics, while S*cientia Universalis* is supposed to be the science of everything, programmatically tied to a universal language of science (Mittelstrass 1979). Such a phrase has mostly been used in mathematics. In his translation of Descartes's geometry, Franz van Schoten, a friend of his, renders the title as: *Principia Matheseos Universalis* (De Buzon 2015). As Descartes indicates, the phrase already existed; De Buzon explained that "Descartes adopts an expression that appears in the *Apologia pro Archimede* (1597) by Adriaan van Roomen" (p.477). While Descartes's text, written around 1621, remained unpublished until 1721, mathematician John Wallis used the phrase "Mathesis universalis" in the title of his *Opera Mathematica* in 1657. But here mathematics is summarized by "order" and "measure" rather than numbers and figures. The term "universalis" indicates some unity, which is primarily internal to mathematics, namely, the unity between geometry and arithmetic, which was precisely realized by Descartes's analytic geometry. "Order" is provided by arithmetic, namely the arithmetic series, while "measure" means the proportions and their relations, objects of geometry.

From a Cartesian viewpoint, however, this within-mathematics universality translates into the unity of natural philosophy, to the extent that Descartes's metaphysical thesis states that only two "substances" exist, namely "thought" and "extension," the latter being the object of geometry and arithmetic, hence, of *mathesis universalis*. As De Buzon indicates, Descartes modified his understanding of mathematics, in accordance with his metaphysical views of nature, by ascribing *motion* as a primary object. Thus, even though he did not use the word in published writings, one can see how *mathesis universalis* means a universal ordering of a science of nature addressed through relevant properties of measure and order.[25]

Most famously, Leibniz took over this notion of *mathesis universalis*.[26] Notwithstanding the crucial divergences between his views of mathematics and Descartes's idea,[27] this ideal of a science grounded on the transparency between an ordered material nature and mathematics remained a governing epistemic scheme. I therefore use *mathesis* to characterize a space of knowledge in which novel contributions as well as theoretical controversies would take place after Descartes, including the major divergences between Cartesians and Leibnizians, or Leibnizians and Newtonians, documented by texts (Leibniz's *Animadversiones* on Descartes, Spinoza's *Principia Philosophiae Cartesianae*, Leibniz's correspondence with Newton's advocate Clarke)[28] and exhaustively studied by

historians of science and philosophy (Gaukroger 2006; Duchesneau 1994, 2010; Fichant 1997, 1998; Smith 2011). In this space, authors can agree and are allowed to strongly disagree, yet against the background of a general understanding of the meaning of knowledge, its resources, and the requisites for a proper explanation of natural phenomena. For instance, Leibniz's mathematics allowed for purely symbolic operations and dealing with infinite quantities, which led him to the calculus, as well as to major steps toward probability theories, whereas all this wasn't meaningful for Descartes (Belaval 1960). For the Cartesians all forces were contact forces, making the universe analogical to a large billiard table or, more precisely, an indefinite series of articulated whirlpools, as Descartes's *Principes de la philosophie* (vols. 3 and 4) explained, while Newton, of course, allowed for an action at a distance (i.e., gravitation).

Selecting order and measure properties to elaborate theories; using mathematics because one is justified in thinking that nature can be expressed in geometrical terms and motion itself is mathematically structured; conceiving an intertwining between mechanics and causation, and then conceiving of the explanation of natural motions on the background of an intrinsic relation between mechanism and mathematics (a conjunction paradigmatically realized by the calculus, which can mathematically express motion by capturing acceleration as a second derivative, and therefore track causes as forces); seeing unity of the whole nature reflected in the unity of mathematics, which makes an overall mathematical intelligibility encompassing nature in general likely to derive from the proper mathematical principles—these are the tenets that constitute what I call "the *mathesis*" and which governed the reflections about the construction of science by natural philosophers from the post-cartesians to Kant.[29] Kant himself nicely expressed it in the Introduction to his *Metaphysical Foundations of Natural Science* (1785)[30] when he saw science *(Naturwissenschaft)* only where one finds mathematical formulations and a priori principles, even though this space of the mathesis would be deranged by the development of Kant's critical philosophy, as I will argue below (Part 3).

In this space of *mathesis*, the living may appear as hardly accountable for. Cartesian mechanicism seemed to reduce all vital motion to a sophisticated push-and-pull series.[31] All that is meaningful or significant for the living itself—*vital*, so to speak—in this context appears completely contingent. For instance, when a wolf or a cheetah runs after an antelope, we would say that "it hunts prey"—and that this is for eating, which pertains to its necessity to survive. The very concept of hunting includes such ideas of eating and surviving (as does the notion of prey). The reason why it runs after the prey is, however, not part of the laws of physics, as a set of mathematical laws governing motions; these motions indeed may include the success or the failure of the hunt, but those two outcomes are not different in themselves with respect to such laws. As to the physics itself, there is no necessity that a given cheetah lives one more minute, but living this additional minute is the reason why the cheetah hunts. Therefore, the life of the

cheetah, its hunting, and its seizing the prey, are contingent with respect to the laws of nature. In his above-quoted formulation of purposiveness, Kant thought of this kind of contingency. There is no place in the necessities of nature for the reasons to hunt, hence no place in the *mathesis*; yet a cheetah's hunt has a reason, or at least, the naturalist (now, we would say the behavioral ecologist!) studying cheetahs assumes such a reason.

Cheetah hunting is not derivable from the laws of nature. More precisely, and to put it in terms close to Spinoza's, the fact that this particular cheetah is now hunting can surely be caused by a set of physical processes in the world and, ultimately, determined by the state of the world immediately preceding it, but this does not mean that there is a *reason* for cheetahs in general to hunt. Some cheetahs don't hunt, stop hunting, and so on, and this is included in what is determined by the immediately prior state of the world. The hunting, in itself, the fact that this cheetah hunts or does not hunt, is contingent in the sense of "contingent upon the prior state of the world."[32]

Many philosophers of the classical rationalist period, starting with Leibniz, and acquainted with the space of *mathesis*, were indeed concerned by this contingency. It is not absurd to think that cheetahs hunt for a reason. Actually, the very word "hunting" means exactly this: running after other animals that are edible, with the aim of eating them, an aim being a reason for performing an action. And hunting takes place, whether or not it is successful (notice that we can see a cheetah hunting, irrespective of whether it catches an antelope or not). So, is there a place in the science of nature for the *reason why cheetahs hunt*? I will return to this quickly, but in order to picture the general idea that drives Kant's view of organism, let us briefly focus on this.

Leibniz, like Pascal, was unsatisfied by this Cartesian world where everything works *par figures et mouvements*. In his *Discours de Métaphysique*, he argued that mechanical movements are always underlain by purposes, to the extent that the laws of mechanics have themselves a reason, and that this reason is precisely the reason for which this actual world has been selected by God among all possible worlds. Therefore, these motions rely on purposive reasons, since God, as perfect, hence rational, always acts for reasons; namely, He aims at the greatest good.

As I will explain in detail (Chapter 1), such dissatisfaction with mechanism embodies the Leibnizian project of reconciling the new science—the *mathesis*—with the classical, Aristotelian, metaphysics of substances and forms (in a nutshell, "substantial forms" rather than geometrical motions explain the patterns of the natural world). However, life held a major status in the Aristotelian science (*episteme*) of movement (namely, the *Phusikè*), where plants and animals constitute a paradigm of movement, and the grounds of their study are set out in an influential treatise, the *Peri psukhè* (*On the soul*). Hence, such a reconciliation project implied meaningful consequences regarding living beings and their knowledge.

But besides metaphysics, naturalists of the time of Leibniz conceived of reasons for the phenomena of animals and plants that seemed alien to the necessities

of mechanics, and, while mechanically contingent (as exposed above), featured a novel and proper kind of regularity.[33] With respect to the laws of mechanics, life itself is indeed not a necessity, but 18th-century embryologists such as Caspar Wolff, later Pander and Meckel,[34] whose major treatises appeared between 1758 and 1802, sought to explicate the reasons that are intrinsic to the development of the chicken's egg, which seems in principle to aim at producing adult chicks. Similarly, physiologists like Harvey exposed the reasons why the heart moves as it moves, namely, pumping blood to send it throughout all parts of the body. Circulating blood appears as the reason for the pumping, while no mechanism in the strict scientific sense allows for a unique reason to drive a motion. Blood circulation is constrained naturally by the laws of physics—even though they were not wholly known to Harvey's contemporaries—but it prescribes for the heart a specific kind of motion, namely pumping, which in turn is the reason for some of the strictures of the heart (the presence of the muscles, the compartmentalization, the size of the cavities, etc.). Kant's philosophical endeavor consisted in systematically making sense of this kind of reasons, namely, in characterizing the status of such a lawfulness that does not dissolve what is contingent into the necessity of the laws of mechanics or physics; hence the importance of this phrase: "lawfulness of the contingent as such." This book will explain it in detail and show how this notion mirrors the various and independent processes of analyzing and conceptually modeling such lawfulness that pervaded the natural sciences in the second half of the 18th century, and led to the emergence of a relatively unified science of the functioning and the development of living things. This is how my reading of Kant would concur with the historians who detect an emergence of the discipline called "biology" in this period, while at the same time casting a new light on the core concepts and objects dealt with by naturalists, philosophers, and physiologists involved in this process. I frame it in terms of a quest for the *reasons of living phenomena*, and of the metaphysical and epistemological characterization of the *status of these reasons,* in order to make the reader understand that the philosophical issues dealt with here are akin to those that we, as philosophers of biology, face now.

As Gayon (1998) said of his own groundbreaking book on the rise of the Modern evolutionary synthesis, this is a rather conceptual history of early biology that could count as a "rational reconstruction," not in the sense of the logical empiricists, but in the sense that the sequences and confrontation of theoretical stances and concepts deploy an immanent rationality, which is reflected within the sequences and contradictions intrinsic to Kant's thinking about contingent order. In his study of the *mathesis universalis* from Descartes to Leibniz cited above, Mittelstrass (1979) stated that

> an attempt is made to combine a *historical study* with a *conceptual analysis,* or *rational (logical) reconstruction,* something which may appear to some commentators as a forbidden encroachment on historical truth. However,

> speaking about historical (or textual) truth in philosophy must not obscure the fact that a 'philosophical history' can never be just related, but has always to be reasoned about.

The present work, addressing at the same time the history of philosophy and the history of science, subscribes to such a view.

I.4 Expected contributions

As the reader has understood, this book is as much historical as conceptual, and if I were Hegelian, I would say that I address history to the sole extent that it is conceptual and concerns the Concept as what unfolds itself throughout a historical process. In any case, the ambition is both historical and conceptual, and therefore I wagered that theoretical biology is concerned with the propositions I will develop throughout the book, to the extent that it often vindicates the legacy constituted by the views and theories involved here. At the same time, I would like to provisionally indicate some issues that preoccupy current philosophers, and that are touched upon in this work. This will hopefully become clearer as the book unfolds, but since the introduction gives a taste of what is to come, I would like to mention a few such questions.

First, Kant's third *Critique* includes, like all the *Critiques*, a Dialectic, namely an examination of the traps in which reason spontaneously falls when it seeks to exceed the limits of possible experience. One such trap is called an "Antinomy," namely the appearance that two contradictory statements are equally valid. In the "Critique of Teleological Judgement," the Antinomy famously holds between *mechanism*—a way of judging that pertains to the *mathesis*, in the present context, and *teleology*—the recognition that purpose plays a role in biological nature. I will explain further how this works and how it makes sense of the scholarly context regarding living beings in which Kant evolves.

However, I should first remind the reader that "mechanism" is a very contentious term in contemporary philosophy of science. In the 2000s, the view, supported mostly by Lindley Darden, Carl Craver, and Stuart Glennan, according to which explaining means uncovering a mechanism yielding the *explanandum*, has pervaded the discipline. Termed "new mechanical philosophy" by Glennan (2017), this view of science and explanation allows one to avoid well-known issues raised by the classical (Hempelian) view of explanation as deductive-nomological argument. Its supporters debated the notions of dynamical, topological, structural, or mathematical explanations,[35] and often argued for their reducibility to mechanisms (e.g., Craver and Povich 2017). However, their very notion of mechanism may not be the one discussed by Kant—who opposes it to teleology—or by Descartes, the Cartesians, or the philosophers and scientists thinking in the space of the *mathesis*. By explicating the connections

between this Kantian analysis and the rise of novel explanatory practices that constituted living phenomena into a scientific object in the second half of the 18th century, I intend my philosophical study of Kant's notions of life and purposiveness in their scientific context to cast a light upon the conceptual possibilities involved in the general idea of mechanicism.

Yet, making sense of the reasons why Kant builds an antinomy of teleology and mechanism in the context of rising biology connects directly with other concerns proper to current-day philosophers. Kant's formula about purposiveness, recalled above, suggests that one issue nowadays addressed by philosophers, namely teleology, recently fueled by discussions about autonomy, self-organization and self-maintenance in the living (Moreno and Mossio 2015; Corti 2023), might be positively enriched by an exploration of his complex views, elaborated simultaneously with the development of several essential threads in the arising biology.

More specifically, the general issue of the reasons why animals develop as they do and have the parts they have, which I framed above in terms of a challenge addressed to the *mathesis*, directly touches upon a hotly debated issue in theoretical biology and philosophy of biology. From various perspectives, authors have reconceived the need for a concept of agency as theoretically sound in the context of biological individuals. Philosophers like Denis Walsh and biologists like Sonia Sultan, Amin Moczek, or Johannes Jaeger (Walsh 2015; Sultan 2015; Sultan et al. 2022) argued that recent advances regarding phenotypic plasticity or ecological behaviour of organisms justify seeing them as agents. Notwithstanding the complexities proper to the concept, one should at least admit that agency goes hand in hand with reasons: agents act for reasons, which distinguish them from events, mostly caused by processes. The Kantian conception of organisms engages a notion of purposiveness that I just sketched, which directly tackles the need for explicating the "reasons" life and living beings seem to yield. Hence, it holds the promise of contributing to these discussions about agency and allowing a better assessment of the vindication of the use of this notion. (The agency accounts are put in perspective in Chapter 7.)[36]

Finally, this work examines systematically a theory of biological judgment. Of course, biology nowadays bears little resemblance to embryology or comparative anatomy of Kant's day. The three major theoretical frameworks allowing modern biologists to make sense of life, namely evolutionary biology, cell biology, and molecular biology (with genetics overlapping between them), did not exist in his time. Yet the judgment we make living things—entities that seem to have a reason to live, and which, when one wants to explain them as living things, require such a reason—shares epistemic features with the teleological judgment described by Kant. I will detail these features in Chapter 9, §2, but I am content here to indicate that the proposed explication of Kant's views concerns these features *generaliter*. Philosophers of mind have been dealing for decades, and at least since works by Wittgenstein, Millikan, or Dennett, with the

gap (Levine 1983; Dretske 1988) between finding *causes* and offering *reasons*, as an explanation of a behavior or an action. Philosophers of science recently rediscovered the family of noncausal explanations (Lange 2016; Reutlinger and Saatsi 2018), which challenged both the "new mechanicism" and the claim that all explanations are about pinpointing causes or inserting something in the "causal structure of the world" (Salmon 1984). Granted, all explanations pick out reasons, since explaining as such consists in giving reasons (Skow 2016; Huneman 2023b), broadly speaking, but the very general issue of "reasons" (in the more specific sense of "reasons for action") that exceed causal explanations or mechanism echoes the concern of those who after Leibniz searched for "reasons" in the space of *mathesis*, and thereby helped shape a new space of knowledge whose exploration I undertake now.[37] Understanding how a particular state of an animal or a plant, such as its adult structure produced by its embryogenesis, or its nutrition in the context of the hunting process, can be a reason for some material processes, while these processes are always governed by the laws of physics but could in principle have gone otherwise (e.g., miscarriage) and still be physically explainable: this lies at the heart of Kant's conceptions. It consists in finding lawfulness where contingency rules. To this extent, reconstructing the way these conceptions were anchored in the actual biology of Kant's time, while also arising from deep metaphysical concerns, as I will argue now, very probably will help account for these possibly non-mechanical explanatory reasons now debated by philosophers of several disciplines.

I.5 How to proceed?

This parallel reading of the constitution of the concept of organism and Kant's problem of contingent order, through which the question of the living must be included in the program of a critique of metaphysics, determines the modus operandi of my investigation. We will have to move constantly from one to the other, in other words, highlight moments in the constitution of the concept of organism, and in return, show in what sense they may have been reflected in Kantian questioning.

The first part of the book (Chapters 1–4) confronts Kantian difficulties and hesitations in the determination of life, before the *Critique of the Power of Judgment*, with the positive elements that contributed to making the organism into an object with its own intelligibility, through the notions of vital properties and developmental trends. This is why I start with ruptures that were decisive in the birth of biology as an autonomous science, namely the critique of mechanicism and the conceptions of organicity according to Leibniz and Stahl (Chapter 1). I felt I had to start with Leibniz, since for Kant, his views exemplify metaphysics as an ordered edifice of the illusions of reason, which the *Critiques* set out to expose. Concerning theories of life, it is also relevant to my investigation that this same Leibniz, within the framework of his philosophy, proposed a notion of organism—indeed inventing the word for it (see Duchesneau 2018, chapter 1)—and was one of the first to criticize mechanism at the level of principles and

to propose an epistemologically robust alternative. Examining his conception, therefore, provides a proper starting point for a study of Kantian criticism of metaphysics that would focus on the concept of the organism. I will then examine what was undoubtedly the first positive milestone in the apprehension of life as an organism, namely the notion of *vital properties* developed by the 18th-century vitalists and the correlative conception of the living as an "animal economy" (Chapter 2). I turn next to the Kantian itinerary, examining the place of the living within the problematic of order as it is initially set up in *The Only Possible Argument. . .* (Chapter 3). Chapter 4 returns to pre-biology to examine the notion of *vital force* and thoughts on epigenesis, in order to understand Kant's first position on the specificity of the living and the generation of animals, in relation to Maupertui's and Buffon's theories on the topic.

The second part (Chapters 5–8) addresses the proper encounter of the critical thought with notion of organism, beginning with the revision of the notion of order of nature in the first *Critique*, and culminating with the presentation of purposiveness as the key metaphysical concept in the third *Critique*. I first examine the intermediate stage of Kant's thinking on *order,* and consequently his position on the specificity of biology, in the "Appendix to the Transcendental Dialectic" of the *Critique of Pure Reason* (Chapter 5). By showing what remains insufficient in this text with regard to the necessities of understanding the living, I will be able to grasp the need for a further elaboration of these questions, which was undertaken by Kant in the *Critique of the Power of Judgment* in the wake of his above-mentioned essays on human races. I will thereby approach Kant's thinking on races, species, and adaptation as represented in these opuscules, having previously situated this work against Buffon's conceptions of the species (Chapter 6). Before turning to the concept of purposiveness which rethinks this whole elaboration from a transcendental viewpoint, in the third *Critique* (Chapter 8) I will examine another discourse on life that runs through Kant's oeuvre work, and which treats life as a form the faculty of desire, and I will question the coexistence of this view of life with the account proposed in the third *Critique* (Chapter 7).

In the third part (Chapters 9–12), I reconstitute the Kantian account of the concept of organized beings (Chapter 9) and compare it to the comparative anatomy of Goethe (Chapter 10). Then I consider comparative anatomy, namely the works of Cuvier and Geoffroy Saint-Hilaire, focusing on their respective epistemic principles; I explain how these descendants of the Kantian account of organisms raised questions and debates that set the stage for some of the contemporary theoretical cleavages regarding biology of form and functional biology, and ask why these cleavages seems unsurpassable (Chapter 11). The last chapter traces back these analyses to metaphysical issues by asking why the notion of purposiveness is even a priori possible (Chapter 12). Relying on the §§ 76 and 77 of the *Critique of the Power of Judgement*, I there address the resolution of the metaphysical problem of contingent order that I have been diagnosing in Kant's 1763 treatise as the starting point of his overall reflection

on purposiveness. I finally explain how such a connection between metaphysics and biology casts light on the current landscape of theoretical thinking in biology, insofar as the notion of organism stands nowadays at the center of discussions and conflicts regarding the nature and development of evolutionary biology.

Who might read this book?

This book intends to disentangle several threads to understand the meeting of the metaphysics of contingency and the rise of biology, undertaken from the viewpoint of Kant's philosophy. For this reason, readers from several backgrounds may want to read this study. While I would like to say that this is "one long argument," as one famous man said of his book, I admit that there are various ways of considering it depending on one's main interests. The cross-reading of Kant and nascent biology told in the book may be only partially consulted, and here are some suggested itineraries it:

1 Philosophers of biology might be mostly willing to consider how the Kantian account of the organism in the third *Critique* emerged, and how it has been shaping some of the conceptual features of biological theory now. They can concentrate on parts 2 and 3, especially Chapters 7, 8, 9, 10, and 11. Some relevant context from the history of biology is given in Chapters 4 and 6. Conversely, a story to be considered by metaphysicians only includes Chapters 1, 3, 5, 7, 8, and 12.
2 Historians of philosophy mostly interested in the development of Kant's thinking should mostly read chapters centered on Kant's trajectory, namely Chapters 3, 5, 6, 7, 8, 9 and 12.
3 Historians of biology, on the contrary, can skip chapters mostly focused on Kant, namely Chapters 3, 5, 7, 8, and 12.

I tend to believe in the coherence of the analyses and the narrative I elaborated in this work, but I think that those partial snapshots of the overall journey may contribute to the inquiries of these readers. Or, at least, that one can safely consider a one-sided reading of my cross-reading.

N.B.: References to the Kantian text are given in brackets in the body of the text. Unless otherwise indicated, other references are given in footnotes. Translations of Kant's texts and texts in French or German are mine, except if mentioned otherwise.

Notes

1 Regarding the relation between Kant's first *Critique* and Newtonian metaphysics, see also Watkins (2004).
2 See McLaughlin (2002) for a detailed revision of this priority: he found a first occurrence of the word in Hanov's *Philosophia naturalis, sive physica dogmatica* (1762,

vol. 1. Halle); see Duchesneau (2018, chapter 7) on Hanov. Yet Burdach and the others were more widely read than Hanov. For references about the word "biology," see Huneman (2023a, chapter 1).

3 While historians of science have experienced more cross-relations between national communities, I also hope that this book will suggest the interest of work done by Judith Schlanger, Henri Daudin, Bernard Balan and by less well-known members of the group of Canguilhem's students, who, unlike Jacques Roger or Roselyne Rey, are not often read by Anglo-Saxon scholars.

4 For development, see Walsh (2015); Kauffmann (2003). For the notion of biological organization see Van de Vijver and Haeck (2023), Mossio and Bich (2014). For ecology, see Toepfer (2019b).

5 When I started working on these topics in the 1990s, of course the major theoretical options currently available were inchoative—the connection between development theory and Kantianism was not obvious, as well as the filiation between self-organization *à la* Kauffman or Varela and Kant's ideas; this has been strongly developed now, as we will see below as my argument goes.

6 On Blumenbach see Richards 2002; Zammito 2007, 2018; on germs see Sloan 2001—and in general hereafter Chapters 6 and 10.

7 About theory of development, and the sense in which one here should understand "theory," see Minelli and Pradeu (2014).

8 See, e.g., Raff (1996), Brandon and Sansom (eds.), Burian (2005), Baedke (2018a, 2018b), Burian (1986), Bateson (2017), Depew (2017), Nicoglou (2024), and Loison (2024).

9 "Regulative" roughly means that the concept has its validity only as instrumental for our knowledge. Today, that might be interpreted as a kind of projectivism (see in this sense Ratcliffe 2000) or as an instrumentalism, a bit like the one proposed by Rosenberg (1990). That's enough to provisionally talk about it; a philosophical account is given in Chapter 8.

Part 3 of this book will propose a detailed interpretation of this notion, and argue in favor of its indispensability.

10 About accounts of biological organization now, see Mossio (2023).

11 "Natural philosophy" is the object of the inquiry led by Stephen Gaukroger (2006, 2010) on the rise of modern scientific culture. He shows how the relations between mathematics, mechanics, matter theory and metaphysics take a new turn in the end of the 16th century, with the formulation of mechanicism as an account tying mechanical laws, geometry and matter theory through the assumption of a corpuscularian grounding of motion and matter. Descartes, Gassendi, Huyghens, then Newton, after Galileo and Copernicus, contributed to elaborate such a framework, which contrasts with Aristotelian natural philosophy, dominant in the previous periods, especially because explanation starts from basic elements (corpuscules) rather than "first principles." All these authors had important disagreements but together they elaborated a new form of natural philosophy inherited by 18th-century philosophers. Gaukroger (2010) analyzed the transformation of such natural philosophy, and the inflexions brought to original mechanism, which led to a natural philosophy making decisive room for vital phenomena, and advancing a new key concept, namely sensibility.

In many respects, my study crosses Gaukroger's inquiry. But my double focus, on transcendental philosophy and biology, is something else; to this extent, I use a much simpler characterization of natural philosophy, and a notion of *mathesis*, in the following, that could be connected to the general framework of post-Cartesian science Gaukroger minutely analyses.

12 This characterization is very simplistic but provisory; I'll enter into the details of the Kantian enterprise throughout this book's argument. This reasoning only presents us with a justification of the question and the method.

13 Recently, Steigerwald (2019) similarly intended what she calls a "parallel reading" of philosophy and biology. Her focus on the dual elaborations of novel conceptions of life and novel ways of experimenting on it, hence considering various philosophers in the period, and therefore proved quite complementary to the present book, which, in turn, centers its parallel on Kant and the development of his thought.
14 Think of the "life of the mind" according to Hegel, the "life of societies" according to Durkheim or Weber, of"'communities'"according to Herder, Schleiermacher, or Dilthey.
15 Gérard Lebrun used to call these discourses *prebiology* (personal communications). Duchesneau (2018), Zammito (2018), Bognon-Küss (forthcoming) are all recent attempts to map this space of prebiology from various viewpoints.
16 Bognon-Küss and Wolfe (2019) talk of the "philosophy of biology before biology," which, from their perspective, targets exactly the moment when ideas and methods about living things started to precipitate into biology but hadn't reach their theoretical outcome.
17 In recent scholarship after 2008, several authors addressed Kant's critique of teleology in the perspective of his general philosophical development. For instance, Wilson (2018) also recognizes that the topics of systematicity and purposiveness trace back to the precritical writings of 1755 and 1763; Duchesneau (2018, chapter III) also acknowledges that Kant's question about the living and its production emerges in this 1763 essay.
18 Zammito (1992); McLaughlin (1990); McFarland (1970); and Zuckert (2007) addressed this question of the role of teleology as a mediation. Concerning the analogy between nature and freedom realized in esthetics, see above all Lebrun (1970, chapter 10).
19 I will extensively examine these essays in Chapter 6.
20 On Girtannner see Zammito (2007) and Steigerwald (2019, pp.42–57). His 1790 *Abhandlungen über die Irritabilität als Lebensprincip in der organisierten Natur* ("Treatise on irritability as principle of life in organized nature") sparked numerous discussions at the time, and it is no wonder Girtanner seized the opportunity to connect with Kant's account of organization, which explicitly started with his essays on races.
21 On Kant and geography, see also Cooper (2023a).
22 Recently, Duchesneau (2018) offered a thorough analysis of the deployment of biology in the 18th century in the wake of Leibniz's idea about organic bodies. The *terminus ad quem* of his analysis is Kant's third *Critique*. The reader would easily see the convergences with the present work, since both analyses study biological ideas connected to metaphysics, deployed from Leibniz to Kant. However, the context of questioning that characterizes Duchesneau's book and the present one are very different; not only because the viewpoint of his book is Leibniz's while mine is centered on Kant, but also, because Duchesneau's question engages a more exhaustive analysis of the theories in life sciences (e.g., Hanov, Needham, Bourguet) and considers in detail Leibniz's heir, Christian Wolff, whose systematic treatises were so influential until Kant (included). In turn, I address biological theories in relation to Kant's elaborations, and on the background of the current biological question about the theoretical roles of the concept of organism. I don't systematically address differences between Duchesneau's account and mine, but may answer some of his criticisms regarding my earlier book.
23 A major locus for Leibniz's understanding of contingency, and more generally modalities, at the moment where he has not elaborated the system of *Monadologie,* is his *Lettres à Arnauld* (1775) mostly devoted to make room for human *contingency,* the condition for freedom. In Chapter 1, I address these views more precisely.

24 This claim is justified later in the book; I tried to depict a change in science as a break-up with the *mathesis universalis* idea in Huneman (2006b, 2010b). Gaukroger (2006) used another perspective to explicate in much more detail the same shift, namely, he conceived of a notion of mechanisms that is much encompassing than Descartes's mechanism, and that spans across a general theory of matter and a recourse to mathematical laws likely to enter a Cartesian coordinate plan. The endeavor proper to natural philosophy in the post-Cartesian era consists, therefore in trying to connect these two poles. This choice allows Gaukroger to situate the space of knowledge shared by Galileo, Descartes, or Gassendi in a thin but real continuity with scientific enterprises elaborated since the 14th century in natural philosophy. In the present paragraph, I sketch the notion of *mathesis* I want to use, and it is more general and less historically detailed than Gaukroger's analysis of Cartesianism and its discontents.

25 Desanti (2005) sees this "Mathesis" as a matrix for statements of mathematical nature, and applicable to the world—this very general meaning could encompass what is at stake in my analysis here, but I will not argue for that now.

26 David Rabouin (2009) conducted an exhaustive study of this notion and the shift it has undergone after Aristotle, until it was reinterpreted by Descartes in the context of his own novel mathematical theories. Rabouin (2018) tracks the various meanings of "*mathesis universalis"* throughout Leibniz's writings and indicates its moving relations with arithmetics, "universal characteristics" and *ars combinatoria*.

27 See Belaval (1960) on the divergences between Leibniz and Descartes regarding mathematics.

28 Gottfried Wilhelm Leibniz, Samuel Clarke and Roger Ariew (2000) *Leibniz and Clarke: Correspondence* (Indianapolis: Hackett Publishing Company).

29 Of course, I do not want to homogenize the complete philosophical scene between Descartes and Kant. There are many discontents with the *mathesis* so described, and one easily thinks of Locke or Hume in this way; yet their apparent unsubscribing to the central role of mathematics does not exclude them from the *mathesis* but rather situates them at the margin, because they would endorse most of the other views. Once again, I do not take *mathesis* as a theory, but as a space of knowledge, hence a conceptual place where deep theoretical disagreements, be they semantic, ontological, or epistemological, can be formulated.

30 For a detailed commentary of the *Principles,* see Vuillemin (1987) and Friedman (2013).

31 On the arising of mechanism as a scientific reform of the old ways of thinking, with no major threat to the theological order, see Gaukroger (2006). On Descartes's mechanism, see below; and for now, Andrault (2014); Gilby (2025).

32 I return to the difference between "absolutely contingent" and "contingent upon" in Chapter 12; it is essential in Kant's thinking about modalities in the *Critique of Pure Reason.*

33 Riskin (2016) undertook a study of the developments of conceptions of this regularity, which, borrowing a metaphor from Leibniz (again), she calls accounts of "what makes a clock tick." But the scale and level of her analysis, which spans from Leibniz to molecular biology, makes her examination very different from the question addressed here.

34 On Pander see Schmitt (2003); on Meckel, see Canguilhem et al. (1962).

35 See Lange (2016) on mathematical explanations, Huneman (2010b, 2018) on topological and structural explanations, and Reutlinger and Saatsi (2018) on various views of noncausal explanations.

36 Rupik (2024) intends to show that the "romanticized" evolution that Goethe, Herder, and Schelling concurred in picturing provides us with an alternative map of biological

phenomena, likely to philosophically support the current critiques of the Modern Synthesis. While I do not use the same—illuminating—category of scientific map, taken from Winther (2020), the present book has undertaken a parallel task of enriching methodology by archaeology.

37 The whole problem of reasons is obscured by the fact that the word "reason" has a large and a narrow meanings: it can mean all kinds of explanations as answers to why-questions, and therefore include causes as well as goals or roles; or it can mean the reasons we use to justify our actions, and here it is opposed to natural causes. See Huneman (2023b), which defends a minimal unity of "reasons," and Skow (2016), which focuses on natural causes and justificatory reasons.

Part 1

The emergence of a science of life and the Kantian interest in the philosophical problem of life before the third *Critique*

It is just that I have found nowhere—I mean, in no book that has ever come my way—any trace of a. . . tendency, an intention to form an overall representation of the living being. . . In short, an idea of its functioning as a whole. . .

I find the main functions wonderfully described, but no attempts at synthesis. . . It's a bit as if physicists had confined themselves to studying optics, mechanics, heat, chemistry, each in isolation. . . They sought relations.

Do you believe an organism is any less. . . unified than a universe?

Paul Valéry. *L'idée fixe.*

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1 First conditions for the concept of organism: disruptions

Leibniz, Stahl, and the critiques of mechanism

1.1 Introduction

In the 16th and 17th centuries, nature was thought to be divided into three kingdoms: mineral, animal, and vegetable. As late as 1710, John Harris's *Lexicon Technicum* described natural history with a varied catalogue of the products of nature: "Natural history is a description of each of the natural products of the earth, water, or air, such as beasts, birds, fish, metals, minerals, and fossils, together with the phenomena that sometimes appear in the material world, such as meteors."[1] We can easily find, by Charles Bonnet,[2] Bourguet, Robinet, and others, texts in which the intermediate beings between the kingdoms—coral, mushroom, polyp—are described with relish. Leibniz's principle of continuity was the rigorous metaphysical formulation of the cultural motif of the *Great Chain of Being,* famously studied by Lovejoy's 1936 book bearing this title. If we now consult Jean-Baptiste Lamarck's *Philosophie zoologique* (1809), we encounter a radical opposition between the *organic* and the *inorganic*. As Félix Vicq d'Azyr put it at the same time: "There are therefore only two kingdoms in nature, one of which enjoys and the other is deprived of life."[3] In other words, in the 18th century, the living world came together under the heading of the organic, which featured a massive opposition to stones, mountains, "brute bodies," or "brute matter" as they would later be called. Kant wrote the third *Critique* against the backdrop of this opposition.

What about this "organic" and the "organism" from which it takes its name? In Greek, *organon* means both a limb and a tool. That an animal is an organism is nothing new. On the contrary, the instrumental dimension is part of the common understanding of living things. For Aristotle, the body was already the instrument of the soul, and for Galen above all, whose theory was to serve as a framework for physiological thought for almost as long as Aristotle's—and in the same way as Aristotle's was the breeding ground for philosophical thought—the animal is a collection of parts, each of which has its own utility, in that it performs a function essential to the existence and maintenance of the body.[4] His important treatises are thereby entitled *On the usefulness of the parts of the body*. But I would like

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to show that, gradually over the course of the 18th century, the organism takes on a new meaning, the very one intended by the *Critique of the Power of Judgment*, according to which all living things can be conceived. In this first section, I will identify the initial conditions that led to the emergence of a new understanding of the living being, one at odds with the organism.

In the Galenic tradition, the human body is thought of as an association of instruments, each of which performs its own role through its own natural faculty. The question, which is inseparably anatomical and physiological, then consists in showing how the configuration of a given organ best enables that to perform its function, and is thus useful to the body as a whole. The notions of utility and instrument are crucial here: every organ is an instrument because, since Aristotle, the body itself is an instrument for the soul.

I would like to emphasize two fundamental points in this notion of the living being: the idea of instrument, and the soul–body schema. The Cartesian mechanism sought to put an end to the Aristotelian soul, which was the principle of life, and not of thought. Yet it may have not displaced the instrumental aspect of the organism, since Descartes elaborated a model of the "animal–machine," as his doctrine came to be known (Andrault 2014; Gaukroger 2006). In any case, it was from his critique onward that the Galenic organism started to fade away, to be replaced by the organism in the modern sense.

I will now examine some of the transformations leading to the fact that, for 19th-century thought, while the living being (animal or plant) is essentially an organism, it can no longer be an organized body in Galen's sense. I start with the negative aspect, i.e., the critique of Cartesian mechanism, which forms the basis on which the organism can be thought of (Chapter 1). The next chapter (Chapter 2) will tackle the first positive aspect, namely the attribution of irreducible vital properties to the living, which will allow me to study the concept of "animal economy" proposed by the vitalists to think about the living. I will then be able to enter into the Kantian problem of order and life (Chapter 3).

1.2 The mechanistic program in a nutshell and its pitfalls

Harvey's 1628 discovery[5] of the circulation of blood certainly allowed one to conceive of animals as mechanical, because it emptied the arteries of the vital pneuma supposed to be in them, and eliminated the hypothesis of a continuous production of blood. That inaugurated the great metaphor of the circulatory system as a machinery of pumps and pipes. Cartesian dualism philosophically legitimized such a metaphor, likening the functioning of the animal body to a machine.[6]

Cartesianism thus gave rise to a mechanistic physiology that was sometimes fruitful, particularly in explaining the mechanisms of circulation, which somehow constituted its paradigm. Descartes's *Traité de l'homme* (published in 1662) is the foremost example.[7] For other scientists, however, who were skeptical of the ideal

of a mechanistic explanation of all living things, as dreamt of in the treatise *De la formation du fœtus*, the Cartesian mechanism had the status of a regulative ideal. For the most famous mechanist, Boerhaave, in his *Institutiones rei medicae in usus annuae exercitationis domesticos digestae* (Leyden 1708), what is epistemically fruitful is the possibility of identifying partial operations of a living being with mechanical tasks and devices (pulleys, levers, etc.) rather than reducing its functioning to the laws of mechanics.[8] But ontologically, the absence of any vital principle other than these "mechanical laws," which support any explanation referring to mechanical devices, breaks with the Aristotelian understanding of life, as well as with the occult virtues presupposed in the organism of Galenic physiology. Nevertheless, within this model of the machine, the instrumental dimension that was fundamental to the organism in the Galenic sense persists, and with it, the notion of utility, since every instrument is useful for something specific.

It is worth noting, however, that the machine model and, more broadly, the mechanistic understanding of the living world mean a profound break with medieval medical understanding, for which the human body is fundamentally comprehensible in terms of foreign influences, particularly astral, and the correspondences between microcosm and macrocosm that govern the order of the world. In this way, the mechanicism is a first step in the affirmation of the autonomy of living beings, at least of this living being, namely the human.[9]

Yet we can distinguish two aspects of Cartesian "biology": the idea that physiological functioning is analogous to that of a machine and should be intelligible without further laws, and the idea that the animal is constructed from embryo onward by the laws of mechanics. On one side, the *Traité de l'homme*, on the other, the *Traité de la formation du foetus*. Here, an epigenetic conception of animal genesis; there, the use of a machine-like model to understand animal behavior and physiology. This constituted the mechanistic program itself.

Roughly speaking, such a program encountered two main pitfalls:

1. While it is possible to explain the mechanics of some of the most important organic apparatuses, such as circulation and muscular activity, by means of machine-models (pumps, levers) taken from the world of technology (Boerhaave, Baglivi,[10] Hoffmann as examples), it is difficult to build an overall mechanistic theory of the living body.
2. Reproduction is a problem. After Descartes, it was repeated at length that, unlike machines, animals reproduce. "An animal may be like a watch, but nowhere have we seen a watch beget another watch," said Fontenelle. Roger (1963) shows how thinking about generation radically challenged the mechanistic framework. Indeed, if the living is a machine, then it will always have functions to perform, which have been prescribed to it by an "engineer" who built it. So, where is the engineer of a wolf or a crab? In Cartesianism, divine activity resolves this difficulty, but then, the living beings to be born are also constructed by God.

Father Malebranche, one of the major Cartesian thinkers, drew the natural consequences from Descartes's thought, believing that generation merely develops pre-formed, pre-existing germs, which are in miniature the machines built by the supreme engineer, God. But then the Cartesian epigenetic hypothesis, according to which living beings form themselves by simply following the laws of mechanics, comes itself in contradiction with the principle of order in nature that grounds the thesis of the pre-existence of germs: Malebranche seems to bring the two Cartesian mechanistic theses into contradiction.[11] The "pre-existence" idea, which focused entirely on the immutability of the laws of nature so crucial to the Oratorian, would develop until the following century.[12] In other words, 17th-century thinking on the living presents a systematic coherence between the concepts of God the Creator, the animal–machine model, and the preexistence of germs. Hence, the theoretical problem of the living world frequently came to solidify around the opposition of the animal and the machine: this means that the notion of organism developed around the difficulties of the animal–machine model, by detaching itself from it. I will here focus on Leibniz's and Georg Ernst Stahl's accounts as major instances of this conceptual development.

In a sense, Leibniz's and Stahl's theories of the living are two ways of asserting the status of the living within a post-Cartesian physics, i.e., one in which nature is inert. In both cases, "organism" is the name of that which cannot be fully interpreted as a machine. Since graduating in 1684 and becoming the main physician to the court of Johan Ernest von Sachsen-Weimar in 1687, Stahl has continued to refine his anti-Cartesian intuition. But whereas Leibniz thought of it within mechanicism, as a kind of passage to the limit of the notion of machine, Stahl thought of it in opposition to machines' mechanisms. In fact, this was the subject of their exchange after the publication of Stahl's *Theoria medica vera* (1708),[13] a long back and forth correspondence between them, in which short remarks by Leibniz are followed by extended and often abstruse elaborations by Stahl, to which in the end Leibniz did not respond.[14] This correspondence sufficiently justifies focusing on these authors when questioning the first conditions of the concept of organism. But above all, Stahl and Leibniz are the first authors to use this word.

1.3 The organism according to Leibniz

1.3.1 Natural machines

As to Leibniz, he coined arguably the first occurrence of the term "Organism" in a letter to Lady Masham in 1704. Lady Masham, née Cudworth, was a literate aristocrat of the times, famously close to John Locke;[15] she was also the daughter of Ralph Cudworth, a major "Cambridge Platonist," whose views about the plastic natures already undertook a defense of the specificity of life against mechanicism.[16] Leibniz writes here: "Je définis l'*Organisme*, ou la Machine naturelle,

que c'est une machine dont chaque partie est machine, et par conséquent que la subtilité de son artifice va à l'infini, rien n'étant assez petit pour être négligé, au lieu que les parties de nos machines artificielles ne sont point des machines."

Thus, *organismes* are defined initially as "natural machines," and specified by the mention of an infinite organization. At the same time approximately, Leibniz contrasts our technical machines with "the machines of nature, that is, living bodies," which "have a truly infinite number of organs, and are so well equipped and proof against all accidents that it is not possible to destroy them. A natural machine still remains a machine in its smallest parts, and what is more, it always remains the same machine it once was, being only transformed by the different folds it receives, and sometimes extended, sometimes tightened, and as if concentrated when it is believed to be lost,"[17] whereas "a machine made by the art of man is not a machine in each of its parts. For example: the tooth of a brass wheel has parts or fragments that are no longer something artificial for us, and no longer have anything that marks it as a machine in relation to the use for which the wheel was intended."[18] Note here the persistence of the technical paradigm in understanding the living: a living being is a machine because everything in it is intended for some use. But because of this design, such a being is affected by a necessary exteriority: the essence of its vitality refers back to its engineer; to this extent, Leibniz, like many of his contemporaries, would have to commit to the pre-existence of germs when it comes to the question of generation.

Yet having an organized body is not enough to make a living being—or, to be more precise, it is only organized because its infinite diversity gathers under a unity:

> moreover, by means of the soul or form, there is a true unity which answers to what is called me in us; which cannot take place either in the machines of art, or in the simple mass of matter, however organized it may be; which can only be considered as an army, or a herd, or a pond full of fish, or as a watch composed of springs and wheels.[19]

Let us take a look at this text: it orders three kinds of multiplicity: (1) the aggregate (an army, a herd, etc.), (2) the artificial machine (a watch),—which are the two ways of "considering" a mass of matter—together opposed by (3) the living body, which alone possesses unity because it alone admits a soul.[20] To understand this claim, we need to return to Leibniz's critique of Cartesian mechanism.[21] This was based on a refusal to see extension as the essence of bodily substance, as Descartes did. The Leibnizian concept of substance led to this metaphysical rejection.

Such a concept relies on his particular view of judgment, often called the "doctrine of *inesse*," stating that in a true judgment, the predicate is inherent (*in-esse,* in Latin) to the concept of the subject; this inherence grounds the truth of this judgment. Now, the inherence of the predicate to the subject in a true

judgment implies that the "*substance*," which metaphysically means what plays the role of a subject in any judgment, *provides a reason* for its predicates.[22] But extension, as pure multiplicity, cannot *account* for what happens to bodies, in particular—as is argued by Leibniz's dynamics (Fichant 1998; Duchesneau 1994; Guéroult 1967; Gaukroger 2010)—the principle of inertia or the resistance to penetration.[23] Extension is perceptible, it defines the level of "phenomena," namely being as it is perceived; it can be dealt with by geometry, it is in a way an *être d'entendement* (it exists only in the understanding). In turn, force, as substance, is more real; it comes under principles that are "metaphysical" (namely, they concern what is actually real) and refer to the "maxims of suitability" (*maximes de convenance*) used by God in selecting the possible world He has produced.

In this sense, the "simple mass of matter" cannot have unity. Take the example of the heap of stones, discussed in some of the letters to Arnauld (April 30, 1687), a prime example of "being by aggregation." "If there were no real substantial units, there would be nothing real or substantial in the collection,"[24] writes Leibniz. Here, the aforementioned letter to Arnauld elevates the justification of this statement to an "axiom": the convertibility between unity and being—it is an axiom[25] because it is transparent in any statement of facts, and it has to be taken for granted. I cannot think of two things as a thing that exists (since there are indeed *two* things, not one). Considered as pure extended mass, and thus as a multiplicity, matter cannot thereby be real. The pile of stones has no proper essence; what makes "the essence of a being by aggregation is only a manner of being of those of which it is composed."[26]

Extension is, therefore, phenomenal: only units can claim to be metaphysical, and extension does not confer unity to anything. The analysis of matter inevitably leads to "atoms of substance":

> there are only atoms of substance, i.e., real units absolutely stripped of parts, which are the sources of actions, and the absolute first principles of the composition of things, and as the last elements of substantial analysis. We might call them metaphysical points: they have something vital and a kind of perception, and mathematical points are their points of view for expressing the universe.[27]

Later, after 1698, Leibniz would call *monads* these atoms of substance.

If we now return to our initial text from the *Système nouveau*, we see why there can be no soul in the simple mass of matter, however organized it may be. Here, we are speaking about an organization that never extends to infinity, since one can count stones, or soldiers in an army, or wheels in a machine. A few lines earlier, Leibniz had indeed criticized the Moderns, namely, the Cartesians (the explicit target being Fontenelle), for believing that "the difference between his (God's) machines and ours is only from large to small." Living organization

will indeed appear to Leibniz as more different from simply something more complex. Granted, we can conceive of several levels of finite organization: the shapeless aggregate like the heap of stones, then the somewhat ordered aggregate like the army, and finally the machine, whose organization as a whole serves a purpose. But in all cases, the organization *comes from outside*, and, the act of organizing, i.e., bringing together a multiplicity, does not create a new unity: unity, the foundation of substantiality, comes from the substantial units we organize. Leibniz makes this clear for the machine: "Every machine also presupposes some substance in the parts of which it is made" (*Système nouveau de la nature et de la communication des substances,* Oeuvres philosophiques, Janet P. ed., I, Alcan, p. 639).

However, for the living body, we cannot speak of a more or less organized collection of heterogeneous units, because its organization is infinite. A natural machine—i.e., not made by men—is, as we can infer from the text, "machine in all its parts." A part is therefore a machine, and a part of this part is a machine, and so on.[28] One can emphasize the dependence of this view upon the observations of animalcules and extremely small living entities such as spermatozoa—"animalcules"—and the complex structure of "*infusoires*" (i.e., lice) (Ratcliff 1999), developed simultaneously by naturalists such as Leeuwenhoek and Swammerdam. It is well known that these empirical advances made possible the ideas of preformationism and preexistence of germs (Roger 1963). However, the *infinite machine* according to Leibniz relies on a profound idea: the actually infinite divisibility of space, meaning that space is not virtually but actually divided—a metaphysical view often connected to Leibniz's idea of *calculus*, but here, relevant to the possibility of "natural machines." The relation between infinity and finiteness assumes that infinity is as actual as finiteness and allows a certain epistemic penetration through specific mathematical theories (the *calculus*, the analysis of numerical series, the *analysis situ* (a project from which later topology will inherit), etc.), while it often underlies finiteness: the actual world is chosen over an infinite series of possible worlds, the human understanding mimics the divine understanding which is infinite, etc.

Nachtomy (2011) aptly interpreted this infinity of natural machines in modern terms of *fractals* (Mandelbrot 1982). This does not seem excessive given that Leibniz's mathematics and logic continued until modern times under various guises (combinatorics, topology, modal logic, etc.). I should add that the concept of infinity is crucial here. The infinite is larger than any finite quantity; therefore, the infinite machine is more complex than any machine, but because infinity designates a limit to any finite progression, this machine is also inaccessible to our machines; by definition, our technique cannot produce such machines. Depending on how we look at the relation between finiteness and infinity, machines can be seen either as analogous to living things, since both are machines, or as infinitely remote from them, because the difference between a machine of any complexity and a natural machine is infinite, given that the infinite is larger than

any quantity (even incredibly large to our eyes). As a consequence, while all parts of a machine have a role, the infinity of parts of parts of parts in a natural machine (organism) implies that we cannot know the roles of all sub-functional parts. They may indeed have a role, but some roles will necessarily be opaque to us; this is due to the character of infinity proper to living being.

And this traces back to a key feature of Leibniz's epistemology, namely the fact that knowledge can be produced even by operations that are not transparent to our intuition. The *Animadversiones on Descartes' Regulae* made clear this point: some purely "symbolic" or "blind" thoughts—namely, such that I cannot have the intuition of the content—can still be knowledge-producing, as long as they respect the proper logical form. This goes against Descartes's idea that the only two ways toward knowledge were "intuition" (some idea is given to me in an obvious way) and "deduction" (a step from one intuition to the next, likely to be monitored by an intuition).[29] Allowing for knowledge even in contexts where infinity precludes any acquaintance with the content, such as in the case of the infinitesimal calculus, holds the promise that the infinity of parts and operations underlying life in animals and plants are still intelligible and accessible to our theorizing.

As is often the case with Leibniz, Mathematics, Theology, Metaphysics, and Physics go manifestly hand in hand. Here, the notion of infinity can articulate the difference between natural living beings and machines to which they are analogous, and at the same time, analogously, the divine understanding, which is infinite, and our understanding, which is finite but analogous in its operation to the divine understanding. The same dual relation of analogy (hence, comprehensibility) and heterogeneity holds between the two kinds of understandings as it holds between living beings and artefacts. The fact that infinity can be grasped in some cases by our understanding, exactly in the way a numerical series defined by the relation of two successive terms can sometimes be reduced by our analysis to the reason of the series, would suggest insights about the possibility of understanding life.

In a famous passage from the *Monadology*, Leibniz compares an organism to a pond full of fish, each itself full of fish, and so on, a metaphor perfectly in line with the idea of fractals. This illustration, which could remind us of Escher's drawings, adequately represents the composition characteristic of what Leibniz was among the first to call "organism." Cheung (2010) explains that this first use of the term denoted precisely a peculiar composition of something, a mode of compositionality, rather than an entity. This is actually what Leibniz meant when he talked about organisms, even though, precisely because of the infinity of the composition, a specific unity underlies it. An organismal composition has a unity, which is a *soul*, as emphasized in the above-quoted text, because its organization is such that each part, being infinitely organized, is the seat of infinite relations of subordination between the parts, all these subordinations necessarily converging to create some unity. While the unity of the artificial machine is given by the

external finite designer, who ascribes it its functions, the unity of the organism cannot be external and finite, since no external worldly instance has the power of compounding an infinity of infinitely compounded parts. Its infinity as a natural machine thus requires something holding together the parts, as in any machine, hence, this unity has to be intrinsic, since it cannot be externally maintained.[30]

Conversely, as a finite set of substantial units, an artificial machine encompasses parts of unorganized material, so it is analogous to a mass of matter, and its unity remains external to it. Consequently, if I remove one of its parts, I destroy the machine, given that its existence relies upon its parts. We see here that the notion of an infinite machine allows one to make sense of the manifest independence between the identity of a living being and the presence of its parts. Granted, Leibniz did not know that an organism's cells are replaced throughout life, but he relied on a longstanding experience of the turnover of the parts of living creatures (think of plants' leaves, or animals' fur and hair): "all bodies are in a perpetual flow like rivers; and parts enter and leave them continually" (*Monadologie*, §71).

This is the reason why Leibniz connects the infinity of the "organism" and the power to resist degradation. As a machine of nature is infinitely organized, and "so well equipped against accidents that it cannot be destroyed," its unity is indeed not as external as that of a more or less compound piece of matter. Between its parts, there is therefore some solidarity, since alteration, by subtracting parts, seems to have no effect, the parts remaining infinite. In contrast, an artificial machine has been assembled by an external agent, who can, in turn, remove some parts, such that the machine ceases to exist. This is not possible in the case of the self-preserving infinite organization of natural machines, essentially endowed with an intrinsic unity. Infinite organization, self-preservation, and intrinsic unity are correlative concepts in Leibniz.

While matter is actually infinitely divided, the organization of the living body means more than this infinite subdivision of matter: only an intrinsic unity between the parts makes it possible. The difference between the natural machine and the artificial machine, presented as that between the finite and the infinite, extends to the difference between intrinsic and external unity. To this extent, the natural machine has a "soul." As we shall see, the nature of this soul separates the two contemporary creators of the term "organism," namely Leibniz and Stahl. The core of their argument remains the intrinsic solidarity of the parts of the living being. This is manifested in a performance that no machine can offer, namely, the disposition to self-preservation.

1.3.2 Final causes and ambiguities

One must note a profound ambiguity in this Leibnizian concept of infinite machine, labeled "organism" by him: being a machine, it requires, by principle, a designer, while its difference from our artificial machines consists in an intrinsic

infinite coherence that provides it with some autonomy. Leibniz means such autonomy by the term "soul" for animals, and "entelechies" for plants. The term "organism" thus already begins to acquire its proper meaning by differentiating itself from the machine, which at the same time provides the necessary context for understanding an organic relationship, because an *organ*—as its etymology makes it clear—is above all *instrumental,* and a machine shares the utilitarian and practical disposition of an instrument. The Leibnizian organism sets, therefore, a first milestone between the Cartesian animal–machine and the Kantian natural purpose, in which, as I shall explain below, the parts produce one another intrinsically. That is, it sets a first milestone in philosophical awareness of the inadequacy of the technical paradigm for thinking about the living.

However, the price of this advance by Leibniz is a second and profound metaphysical ambiguity, already noted when he attributed "vitality" to atoms of substance. If, indeed, the sole reality of the corporeal world consists in metaphysical *substances*, we may well doubt the reality of beings that have no soul. Would they not be mere well-regulated phenomena, while "phenomena" means for Leibniz appearances that are only for witnesses, and receive their being from something else? Following this line of thought, the philosopher wrote: "I restrict corporeal or compound substance to the living or organic machines of nature alone; the rest are for me pure aggregates of substance, which I call substantiated (*substantiata*); the aggregate is only a being by accident" (GP II, p.520).

And conversely, might not the organs of an animal, insofar as they are real, each have a soul—much as Van Helmont imagined, some fifty years earlier, *archaea* in each organ? To this doubt, Leibniz gives a clear negative answer at the beginning of his critique of Stahl in his *Animadversiones* (reprinted in their exchange of letters, Duchesneau and Smith 2016):

> It is enough to conceive of the body alone as containing and driving, without the need to admit any appetites other than the appetites of the soul, so that we do not go looking for the archaea elsewhere than in the latter and in the corporeal spirits that serve as its acolytes. Indeed, what is the point of invoking either a certain plastic formative force [Leibniz is thinking here of Cudworth], or a material hylarchic principle [Henry More] or various chiefs or kinglets spread throughout the limbs to direct their movements, like the cardiagnacte (in the heart), the gastrianacte (in the stomach) and other similar things we have no use for?
>
> (Leibniz 1768, §22)

The material contents of the body constantly change, preventing any putative soul to be in charge of them: "it must not be imagined . . . that each soul has a mass or portion of matter of its own or assigned to it forever, and that it consequently possesses other living inferiors, destined forever to its service" (*Monadologie*, §71).

However, the two difficulties I just mentioned seem less stringent as soon as Leibniz moves onto the conceptual level of "pre-established harmony" introduced in his *Système nouveau* (see McDonough 2017); Let us see in what sense.

Infinitely organized, animals have a soul, which has goals; they are also bodies, hence undergo efficient causes. Already in his *Discours de Metaphysique* (1686), Leibniz no longer opposed efficient and final causes:

> there are, so to speak, two kingdoms even in corporeal nature, which interpenetrate without confusing or interfering with each other - the realm of power, according to which everything can be explained *mechanically* by efficient causes when we have sufficiently penetrated into its interior, and the realm of wisdom, according to which everything can be explained architectonically, so to speak, or by final causes when we understand its ways sufficiently.
>
> (*Tentamen anagogicum*, Leibniz [1696] p.479, my emphasis)

However, this relationship is hierarchical: mechanics explains everything, but according to principles that themselves can only be understood as God's maxims of suitability *(maximes de convenance)* for the choice of this world, i.e., according to final causes. But the two kingdoms of "efficient" and "final causes" belong indeed to "corporeal nature itself."[31] And for this precise reason, souls can harmonize with organisms: since bodies are governed by final causes, they can respond to souls, and souls to bodies. Hence, Leibniz can write: "Souls act according to the laws of final causes by appetites, ends, and means. Bodies act according to the laws of efficient causes or movements. And the two kingdoms, that of efficient causes and that of final causes, are harmonious with each other" (*Monadologie*, §79). Such is the system of *pre-established harmony,* a system that ensures that "bodies act (. . .) as if there were no souls; and souls act as if there were no bodies; and both act as if one influenced the other" (*Monadologie*, §81).

This is why Leibniz can write that in the body "nothing happens that cannot be explained by mechanical and therefore intelligible reasons," against Stahl, who saw a difference in essence "between organism and mechanism" (as is one of his treatises entitled). Here, the mechanistic explanation is a guarantee that nothing happens in an absolutely obscure way, as would be the case if Van Helmont's archaea governed body parts. Admittedly, in practice, we cannot get to the bottom of this mechanism, for its complexity is infinite, yet in principle, we know that it is intelligible, since it requires only fully "intelligible" principles. This configuration also describes the decrees of the divine will according to Leibniz's *De origine radicali:* they are certainly incomprehensible, but at the same time are the result of an infinite computation, i.e., of a process (namely, computation) not heterogeneous to our rationality.

The living body thus becomes the object of a double discourse: as a machine, it can be read as a mechanism; as linked to a soul, its actions are directed by as

many appetites stemming from the same soul. As we have seen, matter would be nothing if it were not supported by a substantial form (and not extension alone), the possibility of which depends upon metaphysical principles. At this level of substantial form, *appetite* (on the side of the soul) and *geometry* (on the side of the body) can be articulated. Matter never ceases to vary within it, yet, as a form, it remains identical to itself. For us, it is more an object of understanding than of perception, since in it I perceive matter that tomorrow will be changed, while I will continue to identify it as the same plant or animal. It is a structure, and the soul attunes itself to this structure.

Leibnizian harmony consists in the fact that the same series of events takes place on the soul's side as on the body's side. The appetites of the soul, in this sense, only aim at what the body has already made accessible to itself. A "simple appetite of the soul," writes Leibniz, can have no "actual result" if "prior movements have not already contributed to it" (*Animadversiones* against Stahl, Leibniz 1768, §16). As such, the machine enjoys its own autonomy: the movements of the organs follow their own rules, and thus concur with what is happening on the level of the soul; this justifies Leibniz's rejection of localized souls for each organ. There is no causal relationship between the soul and the body, in the sense that the soul would cause changes in the body;[32] Leibniz consistently rejects the "reciprocal influence" between matter and thought, each time he presents his theory of the "pre-established harmony." By definition, and due to the *in-esse* conception of truth, nothing outside a substance can account for what happens to it. Because of this self-sufficiency of substances, no two substances can act upon each other, which prohibits any causal influence between them. Subscribing to Descartes's statement of a heterogeneity between thought and matter-extension as two distinct substances, Leibniz thereby admits that body and soul never interact. If "the machine did not itself tend to the same end as appetitive desires, it would not obey them" (*Monadologie,* §20). Proponents of a pilot of the body (using here the famous Cartesian metaphor already dismissed by Descartes himself) cannot account for the fact that the soul cannot command the body to do anything; hence, Leibniz asked Stahl: Why, if the body merely obeys even though it is in itself inert, could it not leap to incommensurable heights, for example? Preestablished harmony answers this question. Without it, "there would be no reason to prevent the soul from commanding the machine" (*Monadologie*, §20).

For Leibniz, life is "perception and appetite"; these are the two dimensions of "monads," the term he uses after 1698 (in his *Monadologie*) to conceive of substances. Monads reflect the whole world from a particular viewpoint, because each substance, according to the *inesse* account, is the reason of all its predicates, and these predicates involve all the actual events that impact it, through innumerable chains of events. Thus, the substance somehow includes the whole world, an inclusion relation that occurs logically as an inclusion between predicate and subject concepts, and ontologically, as what Leibniz termed "expression" (Debuiche 2019).

1.3.3 The vinculum substantiale

Nevertheless, this conception of the living organism encounters a problem that Leibniz attempted to solve by developing the theory of the *Vinculum substantiale,* "substantial bond," which occupies the *Letters to Des Bosses*[33] from 1709 to 1712, thus more than 25 years after the *Discours de Métaphysique*. From a monadological point of view, comparing an animal or a plant to a pond full of fish, themselves full of fish, and so on infinitely, means that life requires some composition of monads. If the organism embraces a hierarchical infinity of monads, how then can we understand that this organism is a single substance? Granted, the constancy of form phenomenologically distinguishes the infinite organization of a living being from an infinite aggregation of grains of sand, since the bodies that enter into the composition of an organism change while that organism remains itself. But how can we understand the relationship between the soul that maintains the identity of one organism—a tree, a mammal—, correlative (as seen above) to its organizational infiniteness, with the monads it organizes, which are variable? The *vinculum substantiale* then designates such relation of the soul to the organic body, which, as regulated, can itself be taken as substance. This relation becomes the organism as an intelligible structure grasped in its relation to a soul. *Vinculum substantiale* means the relation *as* a substance, which I explicate now.

Noticeably, the key Leibnizian concepts of pre-established harmony and monadology proved here insufficient. They cast light on the relationship between body and soul, as well as on the seeming interaction between substances, as we noted, but they do not allow us to mediate these two aspects, i.e., to understand how an interaction of substances can itself give rise to the duality of body and soul. The level of pre-established harmony enables us to understand both physics, i.e., all phenomena as manifestations of forces, and the relations of forces to phenomena, which in turn determines the relation of metaphysics to physics. But pre-established harmony cannot transcend the division between the well-founded phenomena that are bodies, and the soul-entelechies, or monads, that are their metaphysical realities: "It is not possible to prove from harmony that there is in bodies something other than phenomena," says Leibniz in these *Letters* (Letter XXV, May 26, 1709). The organism, however, exhibits this constancy of form that distinguishes it phenomenologically from piles of stones, it "remains the same as Theseus's vessel, or as a river, that is, it is in perpetual flux, and that it is perhaps not possible to assign any portion of matter that remains always proper to the same animal or the same soul" (Letter XVI of April 24, 1709). The problem of the living becomes the ontological problem of a substantial composition of flowing (hence phenomenally unsubstantial) parts.

In the *Letters to Des Bosses*, Leibniz thus crucially distinguishes between *substances*, which are simple, and *substantiés*, which are compounds of substances. A herd is a natural *substantié*, a machine is an artificial *substantié*; hence, their

unity, and then potential substantiality, are derived from the unity of their parts, as we saw. An animal seems, in turn, a natural substance, but a substance made up of soul and organic body.[34] It is therefore ultimately a union of substance and substantiates, since an organic body encompasses substances as a fish in the pond includes many fish, according to Leibniz's monadological schema of infinite organization, defining life. One should thus conceive of this unity of the natural substantiates—i.e., organic bodies—so that the compound of such a substantiate with a substance—the soul of the organism—is still real, i.e., is a single subject. "A multiplicity of substances can constitute a single subject, and even also a multiplicity of substantiates, or substances with substantiates, for example souls with organic bodies" (Appendix to Letter of February 5, 1712). But how does this very special multiplicity do it?

The concept of *vinculum substantiale* comes into play precisely here: the bond that unites these substances to make the organic body into a substantiate *is itself substantial,* it is a substance. This substance, as it were, is added to the monads that make up the compound (think: the fish in the pond. . .). It becomes relatively independent of them, so that it can subsist—as substance—even when these monads emerge from it and disappear. The bond must be said to be substantial if we are to believe that the unity of the organic body survives the dispersion and change of the monads it subsumes. Substantiates in general—the pond full of fish in the proper sense of the term, or the herd of wolves, when we consider natural substantiates—do not admit a bond that is at the same time a substance. Actual living bodies admit it. The fact that both of them are substantiates united by a *vinculum* (substantial or not) allows us to use the metaphor of the pond in order to illustrate what an organism is.

So, what is *vinculum substantiale*? It is itself made up (but not in the sense of *substantié*) of matter and an "entelechy" or soul: the bond of the raw materials (or "passive powers") of the parts of the organic body makes its raw material while the bond of the entelechies (of the various monads in the animal or plant) makes its own entelechy.

The theory of *vinculum* thus includes two essential points:

1 Its *autonomy*: the monads under *vinculum* are metaphysical realities, they can subsist without it; similarly, *vinculum substantiale* does not depend upon the monads it subsumes, since it is only a bond, and this precisely enables us to completely account for the constancy of the form of the organism.
2 A hierarchy: this autonomy of the *vinculum substantiale* goes hand in hand with the relationships of *subordination* that exist between the monads it subsumes. The *vinculum*, a bond of monads posited as substance, indeed possesses a "dominant monad." Leibniz, speaking of this *vinculum*, writes: "it is enough that it makes the unity of monads that are under the dominion of one, or that it makes for an organic body, that is, a machine of nature" (Appendix to the Letter of February 5, 1712, p.164). The *vinculum* thus bonds monads that

are in a relationship of accordance with each other, subordinated to a "dominant monad."[35] The relationship between soul and body is thus reproduced within the *vinculum* itself by the relationship between the "dominant monad" and the others.

An animal or a plant, a natural machine, is therefore not simply the composition of monads: it is, first and foremost, the *substantialization of the bond,* and this substantialization does not result from the bonded monads. This means that it is superadded, in a *contingent* manner, in relation to the bounded monads. Leibniz expresses this in two ways: by the difference between the logical and the natural, or by the concomitant difference between the divine will and the divine understanding, as I explain now.

If the *vinculum* were *logically* attached to the monads it unites, then the same monad could not be *either* a free worm *or* one in an intestine, and so on. That is because this status of being-in-vinculum would be necessary, preventing the monad from being indifferently monad itself or part of a monad. But, in real life, worms are found in these two states. More simply, if the *vinculum* were logically tied to its monads, then the organism's form would be consubstantial with its matter, and we would no longer understand the persistence of form that characterizes organic bodies. The *vinculum* is therefore "naturally" and not "logically" linked to the monads, says Leibniz: "naturally," since it is part of nature, of this nature that exists. In other words, *vinculum* is not founded in the essence of things, but in their coming into existence. As they come into existence, these monads take on such and such a figure (e.g., a free worm, or an intestine worm. . .), but this was not inscribed in their essence when taken as an animal (e.g., a worm) *generaliter*.

For this reason, they could have been something in another state: the *vinculum substantiale* is contingent in relation to their essence. It belongs to this world, to this existing nature, but not to any possible world; it therefore refers not to the divine *understanding*, which knows the necessary laws of essences in all possible worlds in which they can be actualized, but to the divine *will*, which chose to create this actual world, where such and such a worm is in such and such an intestine. Granted, a particular relation, *vinculum*, stands between essences: in any possible world, for instance, a tree and some herbivore are in a relation. Yet, substantializing the relation occurs only in the actual world, when it happens. There is a triple correspondence between relation, essence, divine understanding, on the one hand, and substantialization, actual world, divine will, on the other hand.[36] The *vinculum substantiale*, says Leibniz, "will not only be the effect of the divine understanding [as a relation, therefore posited by the divine understanding like all relations between compatible essences] but also of the will [as substantial]" (Appendix to the letter of February 5, 1712, p.164).[37]

I took some time analyzing this obscure doctrine, not known for a very long time, buried in a set of letters mostly devoted to making sense of the Catholic doctrine of transsubstantiation (just because this doctrine assumes a

metamorphosis of substances analogous to what does the *vinculum substantiale*),[38] because it represents a clear intersection between the *metaphysics of modalities* and the *question of the status of the living*, an intersection which constitutes the proper object of this book. Ultimately, the *vinculum substantiale* is the modification of Leibniz's metaphysics of relations that is required to take account of the problem of the living. The concept of *expression*, culminating in the doctrine of pre-established harmony, had been formulated to reconcile the ontological self-enclosure of substances with the necessary interrelation between them implied by the very concept of nature.[39] But here, Leibniz goes further. Relationships between singular monads have their being only in the divine understanding, since they are not substances but, precisely, relationships. With *vinculum substantiale*, the relation itself becomes substance, which translates into an act of divine will.[40] The substantial bond thus completes the theory of the organism through this inflection in the doctrine of relations, according to which the relation can, in a contingent manner, itself be erected into a substance.

Previously, for Leibniz, the difference between organism and machine used depended on the infinity of organization and, correlatively, the possession of a soul. These two conditions are now strengthened and deepened by that of the presence of a *vinculum substantiale*. Ultimately, this refers to the contingency of a divine will. The distinction between organism and artificial machine implies the possibility of a reference to the divine will as a contingent power of choice, distinct from the order of essences. At the level of this order, such a difference between (natural and artificial) machines would be meaningless. To be circumscribed, the very singularity of the living phenomenon implies a recourse to the divine will. Granted, the divine will as wise, relying upon finality, was already involved in the theory of pre-established harmony, which implied the use of final causes; those causes embraced physics in general, not only living organisms. The *vinculum substantiale*, in turn, resolves to the divine will insofar as it reigns over the contingent, if the living (substantiates) and not physics (substances) is to be understood.

Conversely, any elaboration of the status of the living being that seeks to distance itself from Leibniz's metaphysics will imply a change in the conception of the divine will, of its relationship with the divine understanding, and finally of the category of contingency that enabled Leibniz to think about the relationship between existence and essence. The *vinculum* theory represents an ontological paradox: a relation must become substance. Understandably, nothing less than God's contingent will is required to achieve such a transgression of the categories of thought. This suggests that the change in the way we perceive the living world, which started in the 17th century and of which Leibniz was one of the first proponents, necessarily entailed a reorganization of the major categories of thought. But, as I shall now discuss, the Stahlian conception was decisive in its opposition to both the mechanicism and the Leibnizian vision.

1.4 Life according to Stahl

Georg Ernest Stahl was a physician and chemist, massively influential for two centuries; Kant praises him in the Introduction to the *Critique of Pure Reason*, with respect to his advances in chemistry (even though we know his theory of the phlogiston to be false); and (see Chapter 7) he did sporadically consider his biological theories. We generally speak of Stahl's "animism." Yet, Georg Ernest Stahl's thinking should not be misunderstood as a return to a Renaissance tradition of thought beyond Cartesian mechanism. Classical animism thought of nature as alive: everything was life, whether buried, latent, or manifest. Mechanicism definitively eradicated this type of thinking. Nevertheless, there remains something constant between classical animism and mechanism: neither makes a decisive difference between living and non-living; both kinds of beings are subject to the same intelligibility, which is why the motif of the "great chain of beings" explored by Lovejoy (1936) would survive animism. On the one hand, nature is uniformly animate; on the other, it is pure extension. Granted, as early as Descartes, Henry More elaborated an alternative theory to mechanicism, which was to be influential in the circle of Cambridge Platonists.[41] The other great Platonist, Ralph Cudworth, author of *True intellectual system of the universe* (London 1678), supported "plastic natures" similar to souls, but his treatise, confused and immense, waited several decades before finding a readership, moreover via Leibniz's criticism; nevertheless, what is undoubtedly an important instance of animism in the subsequent history of the organism is Stahlian animism. By working on the very concepts of organism and mechanism in correlation with a detailed medical theory in his *Theoria medica vera* (1708), which joined a broad pathological study to the physiological part, Stahl gave operative consistency to his doctrine. He started from the most common account of mechanicism ("everything is done by figures and movements," as Pascal put it), and then asked what happens to what we are accustomed to calling life, given that nature is not alive:

> All things depended on the very threshold of life, which was lacking and could never be found elsewhere. I wonder what it is, in which it consists, from which it depends, in what ways, by what means it is founded, that life is given, through what, and in view of which the body is said to be alive.[42]

Stahlian thinking moves from a mechanistic account restricted to certain bodies to an animistic perspective required for another category of bodies: precisely because natural beings, as such, have no soul, being governed by the simple laws of motion, living beings must have a soul irreducible to natural things. According to Stahl, this difference is based on a fundamental difference in chemical composition between the two kingdoms, which makes it possible to distinguish between them and which underpins the difference in the way the two types of body react to certain material processes.

1.4.1 Mixtures

As we know, Stahl calls the living body an "organism" ("Difference between organism and mechanism" is one section of *Theoria Medica Vera* (a set of essays collected and published in 1708), simultaneously with Leibniz. It is made of a matter suitable for organic mixing, which differs from raw matter in the following ways: living bodies "exist as a*ggregates*,"[43] in other words, they are a *mixture* of heterogeneous molecules, a "particular mixture or composition, made with matter that is not very adherent or coherent with one another, i.e., apt for easy dissolution or prompt putrid corruption."

Thus, there are three elements in the living body: subtle earthy matter, loose mucous matter, and fatty matter.[44] This is the "mucid-adipose (*mucido pinguis*), in which all the flexible parts of the body were constricted; the more rigid ones were also gathered together at the minimum of this involution": it alone enables both supple movement and great "tenacity."[45] This mixture plays the role of an elementary principle. In this way, as we move from the inorganic to the organic, what was mixed and composed becomes the raw material, the elemental. Such matter satisfies the conditions required for life to exist, with respect to the phenomenological properties of living things: it must be capable of executing movements, facilitate "directions of movement," and be able to "lend itself to all circumstances of proportion, degree, and time."[46]

From this point on, the conservation of the living takes on a new dimension:

> Next to this, it presents the subject of the most special and further consideration that even the whole mode of acting and becoming in this ritual duration or mixture is certainly far different from every respect and effect of the duration of other mixtures; while this vital duration is based on a simple, as they say, formal, incorporeal, and completely external act of the entire material mixture, it is completed.[47]

Since this organic matter, as a mixture, is highly prone to decomposition, its cohesion cannot be understood as a purely material affair. This is why life must be thought of as a principle inherent in the body that protects it from corruption.[48] "That which ought to be understood under the usual term of life" is "this very preservation of a corruptible thing, lest it be corrupted by the very act; which allows him to oppose the body as alive to the body as mixture" (TMV, p.229). Stahl goes on, contrasting the preservation as fact, and the way it is achieved, namely, "it is carried out instrumentally through bodily movements, and from pure successes and social actions it finally arrives at this one formal end, namely the act of conservation" (TMV, p.229). Let us explicate the notions employed here.

As organic matter is exposed to fermentation and putrefaction, it produces corrupted matter, which in turn corrupts the body. For this reason, the body continually expels these corrupted substances, thus preserving itself. Stahl's

animism is based on this chemistry of fatty substances, mucous membranes, etc., and the necessity of fermentation and putrefaction processes within them. The manifestation of the soul is an interplay of expulsion and secretion.[49] It is correlative to an emerging place for a chemistry specific to living processes, an organic chemistry distinct from the brute matter chemistry that Stahl elaborated around the notion of phlogiston (Bognon-Küss 2025). Life is the conservation of the bodily mixture by means of a principle inherent in the body, an "incorporeal principle" manifested by an act that is also incorporeal in itself, i.e., movement in general, and in particular by excretions and secretions. For Stahl, since motion itself is not corporal while bodies are, the non-corporality of movement ties the materiality of organic mixture with the non-corporality of life itself as a pure principle of conservation.[50] The "vital tonic movement" and the heating of the blood are significant modalities of movement as a life-preserving act.[51]

1.4.2 Soul

While considerations on the inadequacy of mechanicism were usual at the time,[52] Stahl was the first to introduce a somewhat tragic representation of the living being, subject to the perpetual threat of its death by matter inside and outside it. The 18th-century discourse on the living then splits into two poles, depending on whether we situate ourselves: with Stahl, on the side of physiology, or with Linnaeus and others, on the side of natural history. There, life is a constant struggle against imminent and certain death; here, it is the peaceful occupation of a place in the natural economy, a place guaranteed to be held beyond the individual's death by another living being of the same species. Such a view is captured by the phrase "balance of nature," to which Linnaeus devoted (with his students) several treatises (Limoges's introduction to Linnaeus 1970; Pearce 2010), and the conceptual space of living things is therefore torn between these two schemes of *conflict*—mostly in physiology—and *balance*—mostly in natural history.[53]

How does this struggle between the living and the inert take place according to Stahl? Movement is certainly the incorporeal means by which the organic mix preserves itself from corruption. This is essentially excretory, secretory, and circulatory. It cannot be thought of in purely mechanical terms. François Duchesneau[54] has analyzed Stahl's critique of the mechanistic vision, which sees secretion as a "correspondence of dimension and figure between specific humoral particles and the pores destined to give passage to each type of humor."

How, then, are we to understand this vital movement? Stahl recognizes it as the act that imposes a harmonic movement onto the body. To grasp his use of such concepts, we need to return to the distinction he establishes between the mechanical and the organism. It is based on the difference between "instrument" and "machine": the machine can, through its mechanism, perform actions, but it does not yet have a use, whereas the instrument is defined by its use. A clock, for example, is a machine, but only becomes an instrument if it is set.[55] A machine is

always a potential instrument. This is why an organ is always a machine, because it is an instrument, since it is intended for a use, but the opposite is not true.[56] The transformation of the mechanism into an organism grants it "dispositions" to achieve ends.[57]

The body as machine, in itself, has no prior motion, but simply presents an aptitude for movement; similarly, the materials of which it is composed contain an "organic energy" such that they "execute or second the affections of the soul." By imposing an end onto the body, namely, its preservation, such a soul makes it into an instrument, or more precisely, a set of instruments. But the soul, according to Stahl, differs from the Aristotelian soul in that, as we shall see, it is conceived after the model of a computing reason.

Movements in the body do not take place through the simple and absolute necessity of matter; their necessity is, as Stahl points out, relative to an end, which is the "continuous conservation of the body."[58] This end, which cannot be reached by purely material processes, is therefore what the soul sets out to achieve; at the same time, it fully determines the movements of the mechanism of the material body. The horror of death and injury, manifesting in any animal behavior according to Stahl, serves as sufficient proof that preservation is the very purpose of the soul. At the same time, the notion of the soul makes only sense in relation to the life of the body: "the soul wants life, which is lasting conservation of its body, for it not only pertains to the soul that the body be and endure (I mean physically), but it pertains to it absolutely, since it is certainly and distinctly conscious of nothing else but this body alone, for without the body it knows not at all what to do, nor what it could do."[59] This is why the soul does not come from outside to animate an inert body: it is certainly not corporeal, but it is absolutely tied to the body in the sense that the body is that of which it is conscious, which may remind us of Spinoza ("the body is the object of the mind").

Thereby appears an immanence of the soul to the body, which can be conceived as a relationship of *knowledge*. The soul's purpose is the preservation of the body, and it therefore "knows" the means to this end. Such is the necessity inherent in vital phenomena: a necessity set by the purpose of conservation, and realized by relations of knowledge. The means of conservation, Stahl insists, are not very varied.[60] It is simply a question of leaving no loss unrepaired, of moderating the acts of secretion and excretion, and then of operating a "*peaceful administration* of life."[61] In this sense, the soul's activity toward the bodily mechanism is as if in continuity with the voluntary behavior of a Hippocratic adult performing a diet. The Stahlian soul is an obscure and unconscious, yet distinct version of the human mind seeking to govern its own body.

The living body becomes thus both the object of knowledge and the instrument of self-administration. Knowledge operates on two levels and in two different modes: the soul "knows" what contributes to conservation, and the body "knows," through habits, what the soul has made it do, so that it can reproduce them. Thus, an animal "retains this idea of an agility of structures and a

proportion of activity to be provided to the same body," and then becomes accustomed to reproducing "types of action" for vital use.[62]

Such a conception implies clarifying the meaning of the word "reason," so as not to imagine the soul—and even less the body—as identical to our conscious, reflective reason, which would render the theory absurd. Extending the notion of cognitive properties to account for animal behaviour sounds, at the same time very strange, and anticipatory of many current controversies: should animals be conceived of as agents (Desmond and Huneman 2020)? And in this case, could these agents feature cognitive abilities? Recently, the zoologist Scott Turner (2013) argued that even termite mounds can be seen as cognitive agents; notwithstanding the legitimacy of such claims, I would emphasize that the authors always need to rethink the notion of cognition to allow for non-conscious, non human-like cognition. This is exactly Stahl's concern; he attempted to do this in the treatise *De differentia rationis et ratiocinationis* published in 1701 in Halle (*About the Difference Between Logos (*reason*) and Logismon (*reasoning*)*). In it, he defended the thesis that the soul "is always one and the same, operating the rational act as well as the acts of sensibility and movement, and all the vital acts themselves." The unity of the soul thus implies the identity of this same agent at all three levels: the human rational thought, the sentient and motor acts of animals, and the totality of life-sustaining acts. If the acts of life seem "regulated and coordinated according to a proper reason," this indicates that what we commonly call rationality does indeed operate within the unconscious, involuntary acts that make up our lives. This order and regularity apply just as much to "organic" movements, i.e., those performed by organs, as to "inorganic" movements in the body, i.e., those performed by no particular organ, such as assimilation, which Stahl says takes place "immediately by a very special movement, I mean by counting, coordination, composition."[63] But the soul responsible for these operations is not the soul as reasoning and deliberating; this Stahlian claim allows him to generalize his view of the soul beyond conscious and rational creatures.

The point here is to distinguish between the two figures of the soul—conscious and intellectual, versus unconscious and vital—, which Stahl respectively called *logismon*, reasoning, and *logos*, reason. To make this distinction, he relied on our common experience of sensibility: all thought and judgment, he says, do not arise from reasoning; for instance, the senses spontaneously distinguish lilies from chamomile. This suggests that there may be acts of judgment and discrimination, such as those that make up the very "administration of life," that may require no reasoning, yet remain rational. Conversely, what the rational soul does, namely processing by images, prevents it to do these administrative acts, which are not figurable.[64]

Thus, the soul perceives without any reasoning the movements of "tension, quivering, excitement, fermentation and irritation" coming from outside or inside the body, and under this "impression" it operates, "in a rational but unreflective way, suitable rational movements which are the opposite of the others."[65]

This rational management of reactive movements, whose purpose is life, does not involve reasoning, but is a matter of reason (*logos*); the Greek meaning of *logos* as "proportion," also conserved in Latin (*ratio*), can be heard in this word, as we shall see in detail.

Stahl must then counter the objection that living beings are not aware of the vital acts that their reason is supposed to govern.[66] Several arguments are put forward. First, the soul is conscious through sensible images, which can only occur in relation to gross parts and movements, whereas vital acts concern fine parts and movements.[67] Second, Stahl also relies on the fact that the soul has "no consciousness of these general and singular operations, either when they are done or, quite often and for the most part, when they have been done"[68] in order to assert that it also knows "no proportion between itself and its organic body."[69] This is why "motor action on bodily things is not at all the very act of intelligence and will."[70]

The soul is therefore an unconscious operation that maintains the body through a regulated and proportional administration of movements. "The soul necessarily will proportions, and is bound to proportions leading mediately or as means to any given end. And so, it holds prescribed and common proportions with the body."[71] The bodily machine itself can be subject to two types of movement: one, ordered and regulated, tending toward conservation, which is the soul at work; the other, deregulated, signaling the presence of a morbid effect in the body. Stahl points this out with regard to the pores in secretion: they are indebted to a "most special relaxing, compressing, attracting, or repelling tonic direction, which acts either quietly and regularly or, from frivolous causes, irregularly and perversely."[72] This double possibility of movement—ordered/disordered—refers to a revocation of natural providentialism, according to which nature would do nothing in vain (to which Leibniz subscribed). Certainly, God does nothing in vain; but "can the same be said for what concerns human nature (. . .) as well as all animal nature?" We know that the former (unlike the latter) is "subject to so many and so profound deviations."[73] In the case of humans, then, the soul, through its passions, is the possible promoter of a singular type of disorder, which it must then repair consciously (through diets, drugs, physicians. . .), a task in some way additional to its role as *logos* of the body.

The relationship between soul and body thereby appears as an agent/patient relation.[74] This is why souls are "the agent immanent in the organic body, exerting immanently such an act, which is the movement or motion of the corporeal organs, from the least to the greatest."[75] Stahl thus specifies the action of the souls: they have been "given energy in order to act in bodies, on bodies, and through bodies, and to harmonize and construe their bodies with such a mechanico-organic reason and proportion that they can satisfy the measure and destination of the activity of their souls."[76] This construction of the body is carried out through *nutrition*, which plays a role in the process of repairing the body, and at the same time brings elements of growth to this same body, which,

insofar as the soul administers "wise nutrition," can grow while retaining the same ordered form.[77] The soul then has a triple power: "understanding, with or without imagination"[78] (this distinction underpinning the *logismon/logos* distinction), "willing so as to truly and really obtain an end"; "moving, by sustaining an action for the sake of the desired end."[79] This triple power relies on the body as its patient and site of application.

The Aristotelian soul was the principle of life, whereas for Descartes, the soul is identified with the mind (= rational soul) and becomes the principle of thought. Leibniz attempted to redefine the soul as a "monad" and separate it from the mind; finally, Stahl, as we can see, unites the soul-principle of life and the soul-principle of thought under the same idea of reason. The unity of *logos* and *logismon*, according to Stahl, is the unity of a principle of life with spontaneous, unconscious rational operations, and a principle of thought performing the conscious acts (judging, feeling, willing) traditionally attributed to reason.

The foundation of this unity is ultimately a concept of vital motion which, being unlikely to be executed by the body itself, requires knowledge of certain proportions. The body's movement has a duration, a degree, an order, a "proportion," since vital phenomena occur "as if the parts could not not act, and could not act otherwise than those mechanical proportions of the parts themselves imply."[80] Thus, applied to secretions, the requisite proportions of matter are essential. "In order for the effect of secretory and excretory acts to occur successfully, or rather to come out, a proportion of matter is required, both adequate to the materials of the organs of secretion and excretion, and proportionate to their purpose, or, as the schools call it, to the ratio of impulses."[81]

This concept of proportion is, thereby, central to the Stahlian doctrine. Thus, the intertwining of the idea of *purpose* and the idea of *proportion* drives the Stahlian conception of the soul as a rational agent. Indeed, for Stahl, the movement that tends toward the preservation of life can only succeed if it respects certain proportions in distribution among organs, in the balance between secretion and excretion, impression and reaction, etc.;[82] it therefore presupposes an agent who both knows the proportions and acts on that knowledge of them.

While it is possible, from a genealogical point of view, to invoke the theory of the equilibrium of humors in Hippocratic medicine, the Stahlian novelty nevertheless consists in assigning this proportion to an agent who both knows and acts.

To do this, movement must of course not belong to the order of bodies; this is why it is immediately linked to the order of the soul, and can be presented as deriving from knowledge. Conversely, since it is incorporeal, and all acts of the soul are incorporeal, these acts are motions.[83] Knowledge and movement are thus of the same (incorporeal) order, hence the metaphysical continuity between *logos* (reason) and *logismon* (reasoning). This continuity allows for an account in which the soul is this administrator of the body's movements, producing in it motions proportionate to one another, and above all, proportionate to the effects

of the physico-chemical environment, so that the latter's destructive effect is offset by the organic reaction and the final goal, namely, the preservation of the body, is fulfilled. The idea of proportion clarifies the unconscious rationality of the logos: only the knowledge of *proportions* ensures the vital purpose. Since the *logos*' rationality (see etymology) is a matter of proportions, we understand that, along with logos and *logismon*, the soul is one, and its unity is granted by the idea of proportion.

The same model of operation, unifying Stahl's *logos* and *logismon*, is visible in the question of *sensibility*. "Sensation" for Stahl is not passivity: rather, it should be thought of as the process of repairing an accidental external movement that characterizes vital movements. Thus, the soul constantly communicates to the small, very delicate nerves of the sensory organs a very subtle tonic or tensile movement; *sensation* occurs when an "accidental movement" encounters the nerve, so that its own movement is altered, thus this accidental motion "is celebrated by the soul itself in its nerves exquisitely and with specialized control, to such an extent that the soul itself perfects and attains the degree of the mode and the dignity of the innate alteration at that very time."[84] In this way, we recognize a process analogous to the soul's preservative reactions to external aggressions.[85] The immanence of the soul to the body, understood as that of an administrator over its operations, is posited by the continuity of finalized bodily movement and knowledge of proportions required to reach its purpose: preserving life.

All this allows Stahl to present as a misunderstanding of his doctrine the Leibnizian objection that the soul could want the impossible. The "soul" as *logos* takes proportions as its object, and since its three operations (understanding, moving, imagining) are united, the will respects proportions in the body's "constitution": this explains the "harmony" of the soul's ends with the body's means, which Leibniz had interpreted as pre-established harmony. "The soul with a rational will is absolutely linked to the proportions of the body, and necessarily, as is obvious, it will have proportions in common with the body."[86] Thus, Stahl can say that the soul is "finite"; this "finiteness" is, along with "activity," what the soul has in common with the body.[87]

1.5 Clarifying mechanism and organism: problems of terms and concepts

1.5.1 Organization, organism, mechanism: Leibniz and Stahl in context

Before beginning the discussion of the constitution of the concept of organism, I need to specify the relationship between the Leibnizian and Stahlian conceptions, an endeavor, of course, focused on the explicit controversy they pursued epistolarily. I therefore need to first clarify the notions of *mechanism* and *animism*, and identify the relationship between the *term* "organism" and the *concept*

of the same name. For the opposition of mechanism and organism, with which we begin this study, covers a major difficulty, which Orsini (1972) previously stated as follows: "While 'mechanical' and 'organic' originally meant almost the same thing, they eventually came to be in complete opposition to each other." Indeed, in defining "*Organisme*," Leibniz immediately equated the term with a kind of machine.[88] This is strikingly at odds with most of our theoretical and historical doxa, in which "organism" and "organicism" have been seen as a repudiation of the illegitimate "animal–machine" fantasy. But it is also an affinity that goes throughout the history of the accounts of organisms, as exemplified by Kant in his third *Critique* (see Chapter 9).

Following this doxa, Stahl and Leibniz indeed believed in the inadequacy of Cartesian mechanicism; both uphold a doctrine that has been criticized as animism. Stahl's account is clearly animist, given the explicit role of the *anima* in it. What about Leibniz? Is the restriction of actual, metaphysical being to animals and plants, as he sometimes tends to argue, a version of animism? Classical animisms see every being, whatever kingdom it belongs to, as a kind of living thing; for instance, belief systems adopted by some North American cultures, for whom rivers and lakes are endowed with a spirit, are textbook examples of animism. For them, pure matter and movement without appetite make no sense. But Leibniz had learned the Cartesian lesson well. Pure matter is governed by strict laws of motion. The vitality of substances is not directly invoked to account for movement. While Leibniz sometimes seems to consider that all substance is alive, so that the non-living, the heap of stones, has a reality only for us (but not in itself), as an object of perception, or as relations given to our understanding, the fact remains that the vitality in question is profoundly changed from that of the Renaissance. The corporeal level of matter and extension is epistemically autonomous, possessing its full intelligibility. It is only at the level of its metaphysical reality that it seems insufficient; yet, the life of a living being ("perception and appetition")[89] takes place jointly and in parallel in both the soul and the body. This alone distinguishes his view from traditional or Renaissance animism. Aristotelian thought taught that the body is the instrument of the soul, that there is a kind of end-to-means relationship, so that the body follows the lead of the soul. But we have seen that the Leibnizian organism is a corporeal substance it has therefore a kind of autonomy, so that it accomplishes through its own laws what the appetite of the soul, joined to it in the *vinculum substantiale,* aims at, and not by incitement from the soul, since any communication between substances is impossible by the very definition of substances. This Leibnizian account is therefore distinct from any mechanicism, while irreducible to classical animism.

Ultimately, this difference between putative animism by Stahl or Leibniz, and the classical (Aristotelian and Renaissance) animism consists in taking Cartesian mechanism seriously. That represents a first rupture with a basic scheme of the living system in post-Galenic physiology, namely a sort of factory controlled

by a soul, in which each organ is an instrument performing its task thanks to an occult natural virtue. Mechanicism introduced the requirement for intelligibility in vital operations. The price Descartes paid for this, as we know, is the suppression of a vital specificity. The Leibnizian concept of harmony makes it possible to combine such a demand for intelligibility with the preservation of an intuitive notion of the living, that of a center of appetites and tendencies, akin to Aristotelian thought or Galenic physiology. After Leibniz, an "organism" came to designate an instance in which the operations performed, whether or not they break with mechanistic laws, are no longer as opaque to the understanding as the Galenic natural virtues, which left the door open to *ad hoc* conceptions.

In this context, and in contrast to the animisms and the post-Cartesian mechanicism, let me clarify the newly coined term "organism" and its derivatives, in order to build a background against which to trace the conceptual history of the concept of the same name. To do this, I will first focus on the concept of "mechanicism," then the uses of "organism." What precisely is meant by mechanicism, if we're seeking an operative term that goes beyond the pure Cartesian doctrine discussed above, and embraces what is discussed under this heading until Kant?

The key to understanding this first mechanicism, which distinguishes it from the later meanings of "mechanicism," both in Kant's views and among the contemporary philosophers of science, is the reliance on laws of mechanics. The intelligibility of the world is anchored in the laws of mechanics, to the extent that these laws make all spatial motion transparent to mathematics; this sets mechanicism at the root of the space of knowledge opened in Cartesian time, which I labeled the *mathesis*.[90] Gaukroger (2006, 2010), in his magnum opus on the constitution of a scientific worldview, granted to mechanicism a key role in establishing scientific rationality as a norm for inquiry, and natural philosophy as the ultimate legislation for a rational conception, whatever the epistemic account given of it. For him, mechanicism combines mechanics as a mathematical description of motion that traces back to Greek mathematics and was developed in the late Middle Ages, with a corpuscularian view of matter to which the former can apply. Numerous discussions and controversies accompanied this fusion, which culminated with the works of Galileo, Descartes, Huygens, and Newton—the varieties of accounts of such articulation, adopting either a kinematic or a hydrodynamical or a static viewpoint, being too complex to be restated here. They constituted the face of natural philosophy inherited by the French Enlightenment (Diderot, and the vitalists such as Bordeu, addressed in the next chapter) and by post-Leibnizian mathematics. Especially, mechanicism will replace an Aristotelian model of explanation as a quest for first principles, ontologically specific to the domain, and possibly non-material, such as formal and final causes, with a model of explanation defined by the quest for basic lawlike motions of elementary corpuscules (Gaukroger 2006). Descartes's view of nature as composed of an assemblage of whirlpools governed by the laws of mechanics exemplifies such an epistemic stance. It led to the view that

explanation starts from the elementary particle and, therefore, goes from the simple to the complex and from the components to the wholes (Gaukroger 2010, chapter 3). This "vertical explanation" will later be opposed by Locke's epistemology, which championed both the idea that explanations should be specific to particular phenomenal domains and freed from the requirement of exhibiting mechanically described causal motion of constituents; namely, he vindicated "horizontal explanations as Gaukroger names them." Later on, Kant in the third *Critique* would keep the notion of vertical explanation as a definition of "mechanicism," with no reference to mechanics and the laws of mechanics—simply framing mechanisms in mereological terms (i.e., explanation goes from parts to wholes) (see Chapter 9).

To understand the divergences between the views here considered when it comes to accounting for the living, one could then distinguish mechanicism taken in either an ontological or an epistemological sense. Ontologically, one finds the thesis that all events are identical to mechanical phenomena at the level of matter-constituent corpuscules, and thereby governed by the laws of mechanics, that is, the Cartesian laws of mechanics or, after the spread of Newtonianism, the laws of Newtonian physics, which include universal attraction. Epistemologically, one means the idea that the laws of mechanical phenomena are sufficient to explain living things, so that we can understand them on the model of entities whose functioning can be explained by these laws alone, provided the assumption of their goal, namely, *machines*. The distinction between Descartes's mechanicism and the *animaux-machines* analogy roughly corresponds to this bifurcation.

The mechanistic ontological thesis posits that all bodies obey the principle of inertia, so that living beings have no force of their own. After Newton, it may add the principle of attraction. It maintains that the laws governing their performance involve no causes other than material ones. The mechanistic epistemological thesis simply states that the laws of mechanics are sufficient to account for vital phenomena, without assuming the nature of the causes involved, or even the possibility of other principles coming into play in the field of vital phenomena.

In this sense, Stahl, endowing the living with other forces and laws, challenged both types of mechanicism; Leibniz, while rejecting or complexifying ontological mechanicism, may well remain in agreement with epistemological mechanicism, as I shall explain now. Stahl starts from a consideration of the very matter of living beings, and thus reaches a contestation of the ontology of mechanicism and a limitation of its epistemological claims with respect to living matter. In the terms of Gaukroger (2010), he contests the corpuscularian matter theory of the first mechanicists, and the ideal of a vertical explanation.

Leibniz, on the other hand, does not consider what specific kinds of substance make up the living, but addresses substantiality itself, through the *in-esse* conception, from which he can criticize the mechanistic ontology as inadequate to the true concept of substance. This leaves open the possibility of a mechanistic

epistemology, possibly even for the living, which is distinguished from the inert by the difference in degree between finite and infinite organizations. Consequently, the epistemology of physicists may still hold for the students of life. The pre-established harmony articulates efficient and final causes, since the *Discours de métaphysique* legitimizes an explanation of living beings in mechanistic terms, which would somehow parallel their monadologic expression in terms of *appetitions*.

This brings us to the difference in terms between Leibniz and Stahl, the latter regularly speaking of *organism* since he is committed to the claim of an opposition "between mechanism and organism," while the former speaks more often of *organization*, with "*organisme*" only coming into play with the letters to Lady Masham from 1704, and then of course in the exchange with Stahl.

In their exchange of letters, Leibniz's first objection was that Stahl's opposition between the mechanism and the organism would leave no room for uniform laws of nature. This would be one way of interpreting Stahl's rejection of epistemological mechanism. From Stahl's point of view, however, Leibniz's criticism is unfounded: the living body, animated by its soul, features a rational and proportionate movement; it can, of course, fall prey to disordered movements, but then these fall under the laws of physico-chemical nature (unless they refer to the register of perversions of the soul). In this sense, the Stahlian living body can be said to articulate two registers of lawlikeness (even three, when we consider the human body subject to the lawlikeness and possible perversion of its mind). Leibniz's second criticism of Stahl is also answered in their correspondence: he would ignore the essential incommunicability of substances, which requires pre-established harmony in order to be thought. But, insofar as Stahl does not admit the Leibnizian concept of substance and replaces it with a lexicon of *patient* and *agent*, this objection falls somewhat short. Metaphysically, it means that Stahl thinks of bodily substance as passive, whereas Leibniz conceives of activity as belonging to the essence of substance *generaliter*; hence, the latter thinks in terms of the harmony, the former in terms of an agent-patient imbrication. But then, for Leibniz, in order to act on the inert passive body, the Stahlian soul must be somehow corporeal, hence his accusations of materialism.

How does this conceptual difference translate into the difference between the terms used by the authors? The words "organism," "organization," and "organized being" used by each of them must be understood in the context of our distinctions. "Organ," as we have seen, traditionally means "instrument." But under the mechanistic stance, in particular the ontological one, "organ" can only mean "part of the body"; organization then means a certain arrangement of parts, capable of functioning in a specific way according to mechanical laws, just as a machine does. "Organization" is therefore neither a mechanistic nor an anti-mechanistic word. To this extent, "organic" can qualify organized matter without prejudging the type of this organization, and its intelligibility in mechanistic or non-mechanistic terms.

"Organization" is however a predicate of organized matter. It is not, therefore, matter itself, and along these lines Cheung (2010) convincingly argued that "organism" initially meant a mode of organizing the matter, rather than the material thing so organized. In the Aristotelian conception, "organization" would thus belong precisely to the form rather than the matter. But our authors have inherited a radical critique of this tradition. What actually exists is the organized being, and the question is how to conceive of it ontologically and epistemologically. Herein lies the reason for Stahl's decision to speak of "organism": if an organized being is to be conceived outside of mechanicism, epistemologically as well as ontologically, then we can, and indeed should, employ a specific name for it, and speak of "organism." Thus, for him, "organism" and "mechanism" name two regions of being.

Leibniz, on the other hand, rarely uses "organism," but "organized being," "organic body" or "organic machine," because organization is a univocal concept, valid for brute or artificial creatures as well as for living ones. Given the total governance of the "efficient causes," underpinned by the laws of mechanics, organization as a particular way of arranging bodily elements can account for the performance of living things without appealing to another set of laws. Why then the need to establish a special kind of being called "organism," synonymous with "natural machine"? Riskin (2016, p.178) insightfully contrasted "organization" and "design," in the context of 18th-century thinkers writing on living beings. The former term dismisses the ideas of external intervention and immateriality of a conception, and the possibilities this offered are exactly exploited in the conceptual developments examined in the rest of this book.

The terminological issue is illustrated when Leibniz considers, after Stahl, the power to develop and propagate, which at first glance sets living beings apart from the whole of Creation, whereas Stahl sees the effect of life as the power to protect the body against its natural disposition to death, Leibniz sees this "vegetative force" of the living as the result of the very structure of the machine, even if the soul contributes to it. The soul does not create life on its own; life is not possible without a certain singularity in the structure of the living body, which we shall call organization, but this singularity is (as we have seen) its infinity, which is the same thing as the presence of a soul, and justifies it. To demonstrate his departure from biological animism, Leibniz takes up Stahl's question: what part should the soul play "under the administration of organic vital actions" (*Animadversions*. . ., §27)? He answers: " the entirety of it is to be attributed to the soul if one considers that the body conforms to the soul by consensus. But nothing of it should be attributed to the soul if it commanded something to the body that the latter would resist doing. It would be a sort of miracle if the soul could bring about something in the body contrary to its nature." This means that the soul's activity is conditioned by the pre-established harmony between itself and bodily nature as organized, a harmony that reflects the harmony between final and efficient causes.

1.5.2 The case for "organism": justifying an anachronism

I must justify an anachronism committed in the preceding pages, since in commenting on Leibniz, I have consistently used "organism." My use is retrospective in the sense that the Leibnizian conception was a moment in the constitution of this basic assumption of modern biology, according to which the living must be apprehended as an organism, but the concept of organism used by 19th-century biologists and already envisioned by Kant is different; moreover, Leibniz however speaks of "organization," or "organic body" concerning the modality of the vital arrangement, and "infinite" or "natural machines" when it comes to organisms.

Leibniz always saw the living being as a soul–body complex: it was even this notion, which was distantly Aristotelian, that he intended to assert against Cartesian mechanism. From there, the question arises as to the specificity of such a body, which can be animated by a soul, and the answer lies in calling it *organized*. The predicate "organized" signals, for him, the possibility of the living; functionnally, this living is then a specifically organic machine, whose organization infinitely deploys its reach. And our question of the specificity of a body likely to be animated becomes that of the essence of organicity, translated into the lexicon of monads (§2.2) and resolved in the theory of *vinculum substantiale* (§2.3).

The notion of (infinite) organization that Leibniz argued against mechanism would somehow survive his own construction. It would even be reinvested, precisely, in the concept of organism as the taken-for-granted support of life, and thus separated from the apprehension of the living in terms of soul and body. From the rarity of the term "organism" in Leibniz to the identity of "organized being" and "self-organization" in the *Critique of the Power of Judgment*, the concept of "organism" became self-evident, and its use as a biological schema became possible. If I took the liberty of having Leibniz speak of "organism" more often than he explicitly mentions it, this is precisely because in his work, such a conceptual history finds one of its earliest moments.

More generally, my theoretical choices relate to my problem and method. I favor the genesis of concepts over the history of terms, exactly along the lines of what Gérard Lebrun (1977) called "discours" and opposed to "doctrine." I aim at reconstructing the archaeology of the concept of organism as it was used in 19th-century biology, while confronting it with the Kantian account of teleological judgments in biology. According to this retrospective point of view, different uses of terms can then cover the same conceptual reality, even if the decision to call a concept by a term other than its author's word must always be justified.

It may be anticipated that the same problem should arise precisely for Kant (below, parts 2 and 3). His "organized being" (*organisierte Wesen*) in the *Critique of the Power of Judgment* inherits from (and reflects) a trajectory of the concept of organism passed through several terms. Following Leibniz, he prefers "*organisierte Wesen*" to "*Organismus*," even if he deals with a concept often referred to as "organism" in biology at the time.[91]

Finally, there seems to be a difference in linguistic contexts. In German, "*Organisiert*" functions like a predicate of an entity: a being is organized or not, the grammar of the term is close to that of the words "*lebendig*," or "living"; for French-speaking authors, "organization" often means not a property of a being, but an arrangement of parts. This nuance of emphasis continued into the 19th century, as witnessed by Richerand's assertion in his *Physiologie*: "Physiology is the science of life. Anatomy is only the science of organization."[92] With such an understanding of "organization," it would be impossible to agree with Kant that "organized" beings are self-organizing. Nevertheless, I work under the assumption that behind the nuances of terms lie conceptual units and overall conceptual changes. Without this assumption, it would be impossible to understand that there was indeed an overall movement in the life sciences and communications among authors between 1685 and 1850.

Despite the lexical absence of the word "organism," Leibniz's thought is essential to what I am addressing here, namely, the emphasis on the organism as a schema for thinking about the living. It marks a transition from the Galenic organism, linked to singular virtues, to the organism as a singular structure. In this sense, while Leibniz initiates a trend in the thinking of life (identifying life with structure), Stahl represents the antagonist position (i.e., a particular animism), and this opposition could be illustrated by the Leibnizian physician Hoffmann's[93] critique of Stahl (even though both taught concomitantly at the Halle Academia).

1.5.3 A shared ground

However, despite their common characterization of the organism as something epistemologically and ontologically proper to the living and conceivable within the context of the *mathesis*, the Leibniz-Stahl retrospectively failed to establish the conceptual ground of biology, because both thinkers shared the same presuppositions. Leibniz *expands* mechanicism, while Stahl *criticizes* it; in both cases, a particular concept of "organism" results from this gesture about the living. Yet epistemological mechanicism, in the sense of the analogy between machine and animal, is their common referent. In both cases, the organicity of the organism indeed pertains to a specific rationality, defined by relationships of proportion ("*ratio*") and purposiveness. This is why the living body no longer signifies a network of occult operations, as with Galen or Van Helmont, but a finalized harmony of concurrent functions. *The coherence of the organism is then always ensured by a specific rationality known as the soul,*[94] *seen much less as vital energy than as the rational administration of certain motions.* The inadequacy of pure laws of mechanics to produce and govern a living being is recognized. Thus, for Leibniz, the soul is produced by God from all eternity, for substances have neither beginning[95] nor end, since they start and terminate their existence by "fulguration"

and "annihilation," according to a famous sentence in the *Monadologie* (§47); for Stahl, the soul shapes and constructs the body. In both cases, one rejects the Malebranchist idea that nature is incapable of forging the complexity of living beings on its own, and must presuppose that they were already made by God at the very beginning, even if they can be later governed by its ordinary laws.

This insufficiency of the purely mechanical laws implies the recognition of an agent immanent to the body, albeit different from it, which imparts the harmonized and rational movements that constitute the conservation of living things. Such an agent is attuned to the body because, either through pre-established harmony or through the life-maintaining purpose of the soul, the body is disposed toward it. Finally, whereas Cartesian mechanicism, assimilating animals to machines, stumbled over the question of the engineer of these machines, Leibniz's and Stahl's criticisms acknowledge and eliminate this difficulty: the organism is—either as an infinite machine, or as the locus of a wise administration—the *internalization of the engineer to the machine.* But in both cases, the model of the engineer's rationality testifies to the fact that both conceptions belong to a Cartesian image of the world, even when they are trying to distance themselves from it, and remain deeply committed to the *mathesis.* Yet, this was nonetheless sufficient to suggest to their contemporaries the radical difference that can separate the organism from the machine.

In this sense, even though it opposed organism and brute matter, the Stahlian conception of life could not fully divorce itself from the Leibnizian vision of a unity of nature. The same rationality is at play in God's implementation of the laws of brute matter according to Leibniz, and in the Stahlian soul's preservation of certain creatures: in all cases, an engineer's rationality embraces natural beings and makes them knowable.[96] It wasn't until Stahl's followers, in particular the Montpellier vitalists, that Stahl's "difference between the mixture and the living" became an opposition that broke with the Leibnizian framework of the unity of nature.

Stahl's distinctive feature actually consisted in opposing the living and the mechanical, and in this sense, paved the way for a definition of the organism that would be radically separate from the machine model. Embedded within the common framework of animistic rationalism, as we have seen, Stahl could not follow the consequences of this idea to the point where they would turn against this framework. Stahl and Leibniz were able to break away from mechanicism while maintaining the need for explanatory models compatible with the laws of mechanics. They asserted the specific intelligibility of the living, one as an "infinite machine" in a kind of quantitative differentiation from inert mechanisms, the other as an "organism" in struggle against the inert chemistry of matter and endowed with a soul. Yet both preserved the schema of an engineer-like reason inserted at the heart of the machinery of the living, reminiscent of the vital principle Aristotle called "soul," and evocative of both the ontological and epistemological specificity of the living. That was their way of preserving an essential

point of the soul–body schema and of Galenic physiology, in which instrumentality is of paramount significance, at the same moment when they began to build the new scheme of life as organism.

Thus, I will now consider the next moment in the emergence of the concept of organism, in which the framework of the soul–body division began to lose its relevance for thinking about the living, even though the achievements of Leibniz's and Stahl's critiques of mechanism remained within such a framework.

Notes

1 II. Quoted in Sloan and Lyon (1981, p.2); see also McLaughlin (2002).
2 *Considérations sur les corps organisés,* Paris, 1762; Jean-René Robinet, *Considérations philosophiques de la gradation naturelle des formes de l'être ou Les essais de la nature qui apprend à faire l'homme*, Paris, 1768. On Bourguet, see Chapters 4 and 6.
3 "Discours sur l'anatomie comparée," p.28.
4 The program of Galenic physiology is as follows: "accordingly, whenever one wishes to examine carefully the usefulness of everything appertaining to an instrument, let him first inquire to what its action is due, and he will find that in most cases the action is derived from the characteristic substance but sometimes from one of the secondary attributes, such as color in the case of the eyes. Next let him investigate the usefulness of each of the other parts [of the instrument] to see whether it is serviceable because of its action or because of some attribute resulting from temperament, as bone is serviceable on account of its hardness. After this, he should examine each contingent attribute both of the whole instrument and of its parts" (Galen, *On the usefulness of the parts of the body*, I, p.19). Galen's membership of the Stoic school explains the persistence of the benevolent nature motif, from which this notion of the "usefuness" of parts derives.
5 About 1615; De motu cordis 1628.
6 On Descartes and mechanism, see now Gilby (2025).
7 "These functions all follow naturally, in this machine, from the sole disposition of its organs, neither more nor less than do the movements of a clock or an automaton (. . .) so that we must not conceive of any other vegetative or sensitive soul in it, nor any other principle of movement than its blood and spirits, agitated by the heat of the fire that burns continually in its heart, and is of no other nature than all the fires that are in inanimate bodies" (in fine; AT XI, p.202).
8 "In the body we find supports, columns, beams, bastions, levers, wedges, integuments, presses, bellows, filters, channels, troughs, reservoirs. The faculty of executing movements by means of these instruments is called function; it is only by mechanical laws that movements are made, and it is only by these laws that they can be explained" (*Institutions de médecine*, I, p.121). It should be noted that the word "physiology" itself was not yet widely used, but rather medicine. Haller was the first to introduce it decisively (*Elementa physiologae corporis humani*, Lausanne 1756–1766). Boerhaave's text is notable for its reference to contemporary technology, which provides a kind of grid for reading the human body. Haller and La Mettrie were among his students.
9 Gaukroger (2010) explained how crucial was the mechanicism, understood as the explanatory recourse to laws of mechanics and the paradigmatic role of devices, in the emergence of modern science and its new role in Western societies. He insists that it was in no way conflicting with theology; after all, God is supposed to have written these laws.

10 *De fibra motrice, et morbosa, nec non de experimentis, ac morbis salivae, bilis et sanguinis* (Perugia 1700).
11 "This philosopher's outline may help us to understand how the laws of motion are sufficient to make the parts of the animal grow little by little. But whether these laws can form them, and bind them all together, is something no one will ever prove. Apparently M.Descaes recognized this himself: for he did not push his ingenious conjectures very far" (*Entretiens sur la métaphysique et la religion*, Xème entretien, art. VIII).
12 See Smith (2006); Oppenheimer (1967). Duchesneau (2018, p.23) recalls that even though Leibniz was receptive to microscopists Swammerdam's and Leuwenhoek's discoveries, his view of preformation, which included the commitment to the idea of infinite organization, contrasted with the latter's preformationist, which assumed the initial divine combination of a finite set of germs.
13 Difference between organism and mechanism followed by Stahl's Theoria medica vera. In 1908, Leibniz replied with *Animadversiones in G.E. Stahlii theoriam medicam veram* in 1709, to which Stahl again replied with *Enodationes*, followed by new *Exceptiones* by Leibniz, and finally *Replicationes* by Stahl, the whole being published in 1720 under the title *Negotium Otisosum*. Duchesneau and Smith (2016) constitutes a translation and presentation of this exchange, whose context was also summarized in Rather and Frerichs (1968, 1970). Besides this scientific edition, on this controversy, see Huneman and Rey (2007). For another analysis of the role of the organism concept in the controversy, see Duchesneau (1995).
14 The quite significant title *Negotium Otiosum* (a futile affair) is followed by a (long) subtitle that illustrates the way Stahl thought about the whole episode: "Shadowboxing Waged Against Some Fundamental Positions of the True Medical Theory by a Certain Celebrated Man, but Undone by His Own Arms Turned Back upon Him. Many people are used to objecting to everything alike; but to rightly object is not in fashion anymore. Those of you who can, if you will, shall judge; but those who will, but cannot, shall abstain." The style of this subtitle nicely exemplifies Stahl's convoluted and abstruse writing style, which may have discouraged many readers (and historians) to carefully read his prose.
15 On Masham, see the entry by Hutton (2020) and Hutton (1993). The correspondence with Damaris Masham began shortly after Lady Masham sent Leibniz a copy of her father's [Ralph Cudworth] The True Intellectual System of the Universe at the end of 1703 (Phemister 2004). On the correspondence between Leibniz and Lady Masham about the Preestablished harmony, see Phemister (2004) and Sleigh (2005).
16 Cudworth dismissive of mechanicism, whereas the specificity of Leibniz consists in admitting the mechanicists' claim to provide a legitimate pathway to true science. On Cudworth, see Hutton (2021); on the rise of mechanicism and its contenders, see Gaukroger (2010); Wolfe (2017).
17 *Monadologie*, §64.
18 *Monadologie*, §64.
19 *Système nouveau de la nature et de la communication des substances* Oeuvres philosophiques, Janet ed., I, Alcan, p.640.
20 An interpretation of the relationship between the plurality of organism parts and the soul can also be found in Koch (1908, §13, "Leibnizens Auffassung des Organismus").
21 I proposed an interpretation of this text in Huneman (2014d). Discussions of other commentators can be found therein.
22 "The nature of an individual substance or of a complete being is to have a notion so accomplished that it is sufficient to understand and to cause to be deduced from it all the predicates of the subject to which this notion is attributed" (*Discours de Métaphysique*, §8).

23 "I believe that he who meditates on the nature of substance (. . .) will find that the whole nature of the body does not consist only in extension, i.e., in magnitude figure and movement, but that something must necessarily be recognized in it which has some relation to souls, and which is commonly called substantial form, although it changes nothing in phenomena, nor does the soul of beasts, if they have any" (*Discours de Métaphysique,* §12).
24 *Système nouveau de la nature et de la communication des substances.* Oeuvres philosophiques, Janet ed., I, Alcan, p.640.
25 "I hold for an axiom this identical proposition which is differentiated only by the accent: that what is not truly **a** being is not truly a **being.**"
26 Lettres à Arnauld, letter of April 30, 1687, p.165.
27 Lettres à Arnauld, letter of April 30, 1687, p.165.
28 "There is a world of creatures, of the living, of animals, of entelechies, of souls in the least part of matter" (*Monadologie*, §66).
29 On the *Regulae* see Marion (2010); on the difference between Leibniz's formalism and Descartes's epistemology, see Belaval (1995).
30 An alternative option would be that God maintains the world at each moment; the doctrine of the continued creation is hold by Descartes, and then by Malebranche, but Leibniz does not subscribe to it.
31 "All natural phenomena could be explained mechanically if we understood them well enough, but the principles of mechanics themselves cannot be explained geometrically, since they depend on more sublime principles which show the wisdom of the Author in the order and perfection of his work." (*Tentamen anagogicum*, Leibniz 1696, p.478). The term "geometrically" refers to the inadequacy of extension alone to constitute corporeal substance.
32 The concept of causality undergoes a profound change in Leibniz. Briefly, insofar as every substance is "simple" (*Monadologie* §1), insofar as all its predicates are inherent to it, it cannot be affected by what's external. Causality therefore has no rigorous meaning if we understand it as an influence between two substances. But in the context of the theory of expression, the concept acquires its true meaning: since two substances always express the same world (for they belong to the same world), but express it from different points of view, the same event will be expressed in both but more clearly in one and more confusedly in the other. This is where we can say that one substance has caused an effect in the other: the causal relation is a relation from the most clearly expressed to the most confusedly expressed. The many difficulties this raises, which Leibniz resolves, are not my subject. Let me simply note, as an illustration of this for our purposes, that the statement "the soul acts on the body" can make sense here; indeed, in the phenomenon of the will, if I want to raise my arm, for example, the representation of this movement in my soul is somehow clearer than the many movements in my body that simultaneously dispose me to this action; hence it is rational to take the state of the soul to explain the more obscure state of the body; in this sense in the will the soul is the cause of a bodily effect.
33 On the *vinculum* in its theological-philosophical context, see A. Boehm (1938). Look (2000) provided a synthetic interpretation of the theory of the *vinculum* (in addition to the translation of the correspondence (Leibniz and Look 2007).
34 "Compound substances are those that constitute a unity per se with a soul and an organic body, i.e., a Machine of nature that results from the Monads. Substantiates are natural or artificial aggregates, bound or unbound" (Appendix to Letter of February 5, 1712).
35 In a wide literature about dominant monads, see, for instance, Duchesneau (1998, 2010, 2018 chapter I); Smith 2011; Look 2000.
36 "The compound substance—or rather that thing which makes the bond of the monads [i.e., the *vinculum substantiale*]—by virtue of the fact that it is not a simple

modification of the monads, nor something which exists in them as in subjects (for the same modification could not be in several subjects at the same time), depends on the monads not logically (i.e., in such a way that it cannot be separated from them, even by supernatural action) but only naturally, so that it requires to be united to the monads in the compound substance, unless God uses it otherwise" (Letter of September 20, 1712, p.175).

37 This also means that while physically—in other words, according to the laws of this world, as posited by God who has chosen it from among several possible worlds—the *vinculum substantiale* requires the monads beneath it, metaphysically, i.e., according to the essences of the monads, it does not require them, since there is no essential relation between it and them (moreover it subsists while they may pass elsewhere, under other bonds). "Although the corporeal substance or rather the substantial bond of the Monads requires them naturally, i.e., physically, it does not require them metaphysically, since the bond is not in them as in a subject" (Letter of August 23, 1713, p.188). Similarly: "this substantial bond is such naturally, but not essentially: for it requires the Monads but does not envelop them essentially, since it can exist without them and they without it" (Letter of May 29, 1716, p.203).

38 In this perspective, Petrescu (2016) offers a reconstitution of the evolution of Des Bosses's and Leibniz's views.

39 About the relations between expression as a mathematical and a metaphysical term in Leibniz, see Debuiche (2013).

40 "In addition to these real [intermonadic] relations, we can conceive of a superior one, which from a multiplicity of substances produces a new one. And it will not be a simple result, i.e., it will not consist of the true or real relations alone, but it will add a new substantiality, i.e., a substantial bond, which will not only be the effect of the divine understanding but also of the will" (Letter of May 29, 1716, p.203).

41 See Nicoglou (2024), on the importance of these views upon the notion of plasticity of the living. On More's anti-mechanism, see Duchesneau (2010, pp.159–171ff).

42 "Paraenesis ad aliena medica doctrina arcendum" (1706), in *Theoria medica vera* (hereafter TMV), p.64.

43 "Demonstratio de mixti et vivi corporis vera diversitate." (1707) §IV, in TMV, p.87.

44 Gaukroger (2010) also insists that the matter theory advocated by Stahl does not cohere with the matter theory proper to post-Cartesian mechanism, according to which matter is reducible to corpuscules, themselves being equivalent as the ultimate building bricks of matter. Irreducible heterogeneity of matter is a tenet of Stahl's chemistry, and this matter theory plays a foundational role in his physiology. (On Cartesian mechanism see also Des Chene 2000).

45 TMV, p.240.

46 "De diversitate mixti et vivi corporis," p.88.

47 "De diversitate. . .," §10, TMV, p.89.

48 There is in the living a "completely opposite reason, since it also contradicts all the principles of dissolution, both material and instrumental, directly depending on a very special and internal cause, entirely proper to itself and completely alien to the whole system of new vital mixtures" ("De diversitate. . . .," TMV, p.72). See also, "finally life is effected, namely the preservation of the body and its mixture, and the vindication of all corruption against adversities, which otherwise is exposed to its material nature and is indeed an evil" ("De alienis a re medica arcendis," TMV, p.76).

49 The "concept of life (. . .) itself, especially concerns negociating secretions and excretions" (TMV, p.178). For the role of excretion and secretion, see Duchesneau (1982).

50 "Motion is truly an incorporeal thing, adjoined to body generically of the same nature and living habit, as the soul itself" (TMV, p.480).

51 See, e.g., *De motu tonico vitali*, 1692–1702. And also: " the adjutant of life, if it is the nature of the animal or the soul (. . .) performs most happily, as much and as little as it can, movement: but that movement is not life absolutely and simply and qualitatively. It performs life through the circulatory system: but this circulatory movement is not life, but only an instrument of life, and indeed a remote one. It performs life through perpetual secretions and timely excretions of matter, not only imitating them but also in the meantime neither secretions nor excretions are life, but only the first, second, and most immediate instincts of life, namely by eliminating alien ones, so that they remain their own and truly pertinent to the body. Thus, finally, life is affected, namely the preservation of the body and its composition, and the defense against all corruption from adversities, which otherwise is due to its material nature" ("De alienis. . .," TMV, 76).

52 For example, in 1661, for Joseph Glanvill, "the whole natural philosophy of the world cannot be established mechanically (make it out to be purely mechanical)" (*The vanity of dogmatizin*g, New York, 1931, p.46). See Gaukroger (2010), chapter 5, about the explanatory limits of mechanism related to chemistry, electricity, and systematics at the time of Stahl.

53 We see here that Foucault got things wrong by focusing on natural history and forgetting physiology. Whatever the distance between the tragic views of Stahl and the 19th-century biology, the gap between life and brute matter was strongly asserted within the classical period, and hence manifests a continuity with the idea that life should be by itself the object of an autonomous science, which *Les mots et les choses* ascribe to the 19th-century *epistémè* of the Moderns.

54 Duchesneau (1976, p.8) See also Duchesneau (2011).

55 "Disquisitio de organismi et mechanismi diversitate," TMV, 23.

56 "What subordination the mechanism has to the organism, and in what way the mechanism can indeed subsist by itself, so that it does not equally simply and directly attain the organism" ("Disquisitio. . .," TMV, 21).

57 "The organism (we are speaking here of that which is between things and physical actions) is entirely proper and essential, that it should have a mechanical disposition; and this not only in general, insofar *as in every corporeal subject a mechanical disposition is present by absolute necessity*" ("Disquisitio. . .," TMV, p.21).

58 "Disquisitio. . .," TMV, 22.

59 *Enodations*. . ., §20, p.78.

60 "I acknowledge that the appetites of the soul are the authors of vital motions, but they are not confused, nor is there an immense multitude of them; they are in fact distinct and of a small number" (*Enodations*. . ., §20). Here, Stahl rejects the archaea that Van Helmont assigned to each of the organs, and more generally, a scheme of the body in which occult and multiple forces would ensure its preservation. He thus defends the same line as Leibniz.

61 *Enodations*, p.131.

62 *Enodations*. . ., §XIX, p.73.

63 *TMV*, p.413. About assimilation here, see Bognon-Küss (2025) and Duchesneau (1976).

64 "I have, however, personally, a deeper reason why the soul cannot have the imagination or the memory of those operations that it administers in the body: namely, that all these operations cannot be comprehended under a conception by figures, of which only imagination and memory, which is reiterated imagination, are capable" (*Enodations.* . ., §5, p.42).

65 "De differentia rationis et ratiocinationis. . .," p.3.

66 Later, Boullier in his essay on "L'âme des bêtes," "The Soul of Animals," would be confronted with the same problem: the soul of beasts drives their organism, and yet it

does not know how such organism works. To do this, the soul does not need to know the mechanism of its machine (*Essai philosophique sur l'âme des bêtes*, II, 9, pp.362 ff). Boullier takes the example of a child playing with automatic toys, pressing a particular spring to trigger a particular reaction: he or she has no need to know what is going on inside the toys in order to use them.

67 This relies on an old tradition of psychology of sensibility and perception initiated by Aristotle and developed by the scholastics and the medieval Arab thinkers such as Averroes (see, e.g., Davidson 1992).

68 *Enodations*. . ., §XIX, 106.

69 *Enodations*. . ., §21, p.106.

70 *Enodations*. . ., §28, p.116.

71 *Enodations*. . ., §21, p.85.

72 *Enodations*. . ., §21, p.92.

73 TMV, p.339.

74 *Enodations*. . ., §21, p.97.

75 *Enodations*. . ., §21, p.100.

76 *Enodations*. . ., §21, p.104.

77 Bognon-Küss (2025, forthcoming).

78 That is, with or without sensible images, in other words: represented and conscious, as in the case of intellectual acts, or non-figurative and unconscious, in the case of vital acts of the soul-logos.

79 *Enodations*. . ., §21, p.108.

80 TMV, p.230.

81 "De diversitate mixti. . .," p.120.

82 The vital motion occurs "in such a way that it conspires and squares with that thing to which it is properly destined, in a mechanical proportion" ("Disquisitio. . .," TMV, 21, my emphasis).

83 *Enodations*. . ., §21, pp.94-95. Stahl refers to Aristotle when he says that thought is a certain movement.

84 TMV, p.450.

85 Stahl uses two metaphors to express the non-passivity of sensitivity, despite appearances: the bird-catcher and the spider, which is sensitive to external disturbances of its net ("The similarity of the matter, only not when it is fitting to extend, is always present in the example of a spider, which, when stretching its web with its threads, other proportionate masses are charged into that thread at an instant, so that they become, it is felt in no other way, when it makes the adventitious movements of the tension movement, when the spider itself is drawn into the web and moves, and thus it touches it" (TMV, p.450)).

86 *Enodations*. . ., §21, p.84; see also p.104.

87 *Enodations*. . ., §28, p.120.

88 For a contemporary analysis of the organism-artifact analogy, which is so pervasive that it still contributes to the epistemic foundations of biomechanics and behavioral ecology, see Lewens (2004). Of course, the reference to Darwinian natural selection, for us implicit in this analogy, was unknown at the period here considered. For a tentative articulation of this analogy and natural selection, see Huneman (2015) and Chapter 11 of this book. Riskin (2016) noted a similar ambiguity in the word "mechanism," distinguishing one passive sense upon which "mechanicism," from Descartes to the new mechanicism à la Glennan (2017) would rely, and an "active mechanism," which comes to be labeled as the exact opposite of mechanicism. She wrote: "Modern scientific accounts of life have been shaped by a struggle between these two competing mechanisms, two scientific principles. One, passive mechanism, the overtly

victorious and therefore more visible, evacuates agency from nature (initially to the province of a supernatural god). It informs, for example, the physiology of the eye viewed as a lens instrument such as a microscope or telescope. The opposite principle, active mechanism, eclipsed but still working from the shadows, avoids the supernaturalism of the first approach by viewing agency as a primitive feature of the natural world like force or matter, an aspect of the very stuff of nature's machinery, and especially its living machinery" (Riskin 2016, p.8).

89 He concedes to Stahl (*Animadversiones*, §12) that "the changes at work in animals differ greatly from the changes at work in plants" but points out that some of these changes, concerning the humors, "have just as much to do with chemistry as those which occur in the fluids of plants"—to finally add: "all bodies are concerned by chemistry, since they are treated under the aspect of physical operations, which consist in an insensible process, not as structure, but as mass."

90 See my Introduction for the use of this term, and the parallelism between Gaukroger's quintessential analysis of the science and philosophy at the same time and the role of mechanics, mathematics, and mathesis universalis.

91 On this point, see Riese (1965).

92 *Nouveaux Eléments de Physiologie,* II, p.2.

93 Hoffmann wanted to create a Leibnizian-inspired physiology, but his critique of Stahl covers the same presuppositions (see Hoffmann 1718). "Both Hoffman and Stahl accept the concepts of purpose and objective. But whereas Hoffmann did so reluctantly and almost without emphasizing it, Stahl made it the touchstone of his doctrine" (King 1964, p.127). As Duchesneau reminds us (2018, pp.30–31), Hoffmann sent his dissertation *De natura morborum medicatrice mechanica* (1699) to Leibniz. He sees in this work an inspiration for Leibniz coining the word "organism"—a word which, as he says, "was of use in the circle of influences constituted around the two prominent physiologists," Stahl and Hoffmann. In contrast, Andrault (2014) traces Leibniz's formulation of "organism" back to the *Cosmologia sacra* (1701) by Nehemiah Grew (pp.19–57). For a comparative view of the non-materialist accounts of life by Stahl and Hoffmann, see De Ceglia (2021).

94 "Whereas the organism subsequently became a specific experimental process in the regulated performance of certain functions, for Stahl the organism is the instrument of an external purpose" (Duchesneau 1976, p.16).

95 Admittedly, Leibniz, like Malebranche, adheres to preformism; but for Malebranche, preformism is a sign of nature's profound inertia, incapable, as we have seen, of creating life, whereas for Leibniz, it connotes the infinite complexification of degrees of organization in nature. For this reason, in his case, it can coexist with an affirmation of the "plastic force" (letter to Lady Masham, GIII, p.374) inherent in singular substances.

96 Boullier's *Essai sur l'âme des bêtes* (Essay on the souls of beasts) belongs to this same perception of the living. Like Leibniz (and Spinoza), he believes that the soul perceives the world through the point of view of the body, which is like the lens of an optical telescope for it, or its "sensorium." By perceiving its body, the soul perceives the world. For the soul to see the universe, "an organized body had to be joined to it" (II, 187, p.482). As with Stahl, "the preservation of each individual and that of the whole species" (I, 3, p.201) is the goal of every organism, and to explain it, it is more rational (because more in line with our ability to infer causes from apparent effects), according to Boullier, to appeal to a soul in the animal that aims at this end, than to the Creator's creation of marvelous automata. The utility of the soul is then the principle of organic functioning: "even if you wanted to deduce all animal movements from a pre-established mechanism, you would still be obliged, in order to find some use

for it, to relate it to the utility of the soul" (II, 16, p.462: this as part of a critique of pre-established harmony; see also II, 7, p.362, the soul is "the final cause of the Creator's intention" in creating animal bodies). According to Boullier, the soul directs the body in response to sensations, depending on whether they are pleasant or unpleasant; as with Stahl, these movements are always proportionate to their cause and end—the soul is an instance that, in a way, pilots the mechanism, which thus appears to be its "instrument": "The physical cause of these movements of the animal, so wisely proportioned to the impressions of objects, is the activity of the soul itself, which has the power to move bodies; it directs and modifies its activity in accordance with the various sensations which certain external impressions excite in it as soon as it is involuntarily applied to them; impressions which, according to whether they are pleasant or distressing for the soul, are advantageous or harmful for the machine (. . .) the soul, as a sensory principle, is subject to a mechanism which transmits to it in a certain way the impression of external objects; as an active principle, it presides over another mechanism which is subordinate to it, and which being for it only an instrument of action, puts into this action all the necessary regularity. The soul of the beast being active and sensitive at the same time, regulating its action on its feeling, and finding in the disposition of its machine what to feel agreeably and what to execute usefully both for itself and for the good of the other parts of the universe, is the link of this double mechanism" (II, 7, p.361). As with Stahl—see §4.1—the organic machine's proper function is to make itself an instrument, and this conceptual distinction makes it possible to rule out mechanicism.

2 Second condition for the concept of organism: Vital properties and vitalism

The animal economy model

One of the major changes in the approach to living matter in the 18th century was the emergence of properties that specifically distinguished organic matter from all others. This idea contributed to freeing our understanding of organisms from the soul–body duality under which the opponents of mechanicism still had to think of them; thus, it overcame the rationalist framework within which Stahl was still constrained to think about organisms. I will study the consequences of such an idea, whose resonance for modern biology cannot be underestimated. Many of the authors considered here are mentioned, cited, or discussed by Kant (as were, of course, Leibniz and Stahl). In an important contribution, Zammito (2018) ascribed to the Newtonian epistemic scheme of experimental method the inspiration underpinning these research programs, and, ultimately, a decisive input toward the gestation of (especially German) biology. I will assess these views in due course.

2.1 Vital properties and fibers

2.1.1 Haller and irritability

Together with Stahl, Friedrich Hoffmann and Hermann Boerhaave elaborated three great monuments of physiology in the early 18th century: the latter was the most recent by a few years, Hoffmann's *Medicina Rationis* dating from 1695, and Boerhaave's *Institutions of Medicine* from 1708.[1] Thus, reading the preface to William Cullen's *First lines in the practice of physicks* (1784), a major work, foundational for the Scottish school of physiology and a landmark for medicine in the second half of the century, one sees that the author successively attempts to take a stand relative to these three references, showing a certain preference for Hoffmann. For Kant himself, those three authors were present enough that in most of the texts in which he discusses life, such as *Dreams of a Sightseer*, he felt the need to situate his thinking in relation to them (as exposed in Chapter 7). Because of this Kantian reference to such triad of authors in a text whose importance in Kant's intellectual evolution has been stressed by both Zammito and

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Beiser,[2] I can therefore focus on these authors for the period of the first half of the 18th century, leaving aside the variety of parallel developments (Malpighi, Spallanzani, Cudworth, More, etc.) that proved fundamental to the fate of physiology.[3] At these times, translating books and adding commentaries, and sometimes even mixing them with other books of other authors, was common practice. In this context, the existence of the book entitled *The modern practice of physic; as improv'd by the celebrated professors, H. Boerhaave and F. Hoffman . . . being a translation of the Aphorisms of the former, with the commentaries of Dr. van Swieten, so far as was necessary to explain the doctrine laid down, and of such parts of Dr. Hoffman's works, as supply the deficiencies of Boerhaave. And render the whole practice of physic compleat: wherein, the various diseases to which the human body is subject, are distinctly consider'd, whence the diagnostics and prognostics together with the method of cure are regularly deduc'd, and the prescriptions adapted thereto from Boerhaave's Materia medica, are added to every aphorism in two volumes*, by James Robert, published in London (Hodges) in 1746, indicates the importance of Boerhaave and Hofmann as medical authorities, as well as the common belief that their systems were compatible. The additional fact that Haller translated Boerhaave indicates that these three physicians were at least doctrinally connected.

Boerhaave's less speculative, more consensual, and more practical character made him an authority, particularly in pedagogy, for the nascent Enlightenment in Europe; compared to him, Stahl was undoubtedly very speculative, Hoffmann very Leibnizian.[4] This Dutchman developed a physiology that was certainly mechanistic, but at the same time he recognized the limits of mathematics in physiology: mathematics certainly helps when considering "mastication or digestion, secretion or excretion," that is, actions involving mechanical work in the organism, but "although I know mathematics, this knowledge nevertheless does not help me to know the powers of arsenic, for example; but if I experiment on it by chemistry, then I can tell you its powers. And the same is true in relation to drugs and poisons."[5]

Thus, in addition to implementing a broader recourse to pharmacological experiment within the mechanistic framework, Boerhaave considered that living beings were made of fluids and fibers, and these fibers were to be considered the primary element of the living mechanism. In this sense, he was part of a conceptual lineage that, from Glisson to Haller, via Malpighi, Borelli, and Baglivi, put forward the living fiber as a specific object of investigation.[6] From this point on, the idea of vitality immanent to living matter gained material support.[7]

Eighteenth-century physiology was heavily dependent upon Newtonian natural philosophy for its methodology, as Zammito (2018) forcefully argued, and here Boerhaave as well as Haller were key figures.[8] According to Zammito, Boerhaave was the first major Dutch scientist who expressed his commitment to Newtonianism; he was probably introduced by DeVolder to the work of the English physicist. Zammito argued that physiology after Boerhaave was committed

to "a decidedly nonmathematical research program under Newtonian auspices, which is what I mean by 'experimental Newtonianism.' Boerhaave's trajectory, in my view, paved the way for that development" (Zammito 2018, p.44).

I consider that Newtonianism in physiology largely took up from Newton the notion of the "irreducible properties" of matter, whose laws of expression had to be stated, without speculating on their causes or origins, in keeping with Newton's famous abstention from hypotheses. The concept of fiber, used since the end of the previous century to describe living animals,[9] was joined to this notion. Physiological thought at the time was thus built around the idea of a fiber with specific properties, which in turn produces certain effects, such as does gravitation, a characteristic property of matter that accounts for the fall of bodies. Glisson, in particular, from 1654 (*Anatomia hepatis*) to 1677 (*De ventriculo intestinis*), was the first to link the notion of fiber to that of a specific property, "irritability," in a doctrine expounded in 1672 in *De natura substantiae energetica*. According to him, "most of the body is fibrous, and this is precisely where vital activity resides. The living fiber is flexible, extensible, resistant, elastic, and irritable, that is to say, it possesses a radical force which, brought into play by stimuli external or internal to the organism, gives rise to changes of form and thus to all vital phenomena."[10] For Glisson, the irritable fiber is merely a glimpse of the living, as an entity capable of increasingly elementary arrangements;[11] for Albrecht von Haller, it became a fundamental concept.

Haller was certainly a pupil of Boerhaave: he therefore shared his attention to fibers and his desire for a mechanical intelligibility of the living world, which of course derives from the Cartesian ideal but, as we have seen, accommodates the use of experience to understand therapeutic and pathological phenomena of a chemical nature. He had a long-lasting influence on German biology, as attested by Richards (2002) and Zammito (2018); he was constantly involved in editing a major scientific publication, the *Göttingische gelehrte Anzeigen.*

What of Haller's notion of vital properties? If we follow Shirley Roe in *Matter, life and generation*, the first mention of irritability is in a note by Haller to his edition of Boerhaave's *Praeselectiones academica*, where he remarks that, as the heart continues to beat once extracted from an animal, the cause of its movement must "remain hidden in the composition of the heart itself." But he actually developed the concept of irritability in the treatise *On the sensible and irritable parts of animals*.[12] Its goal is to promote a "new division of the parts of the human body" (p.2) into irritable and non-irritable.

A bipartition of body parts was not, as such, a conceptual innovation: after Aristotle's *homeomers* and *anhomeomers*, Galen distinguished parts into *similar* and *non-similar.* The novelty of Haller's proposal, which he was aware would have far-reaching consequences, involving changes in "physiology, pathology, surgery" (p.3), is that the criterion for division is no longer the appearance of the part, but its reaction to a stimulating operation. When Foucault (1966) pointed out that Jussieu's classification no longer belongs exactly to the same era as

Linnaeus's, because his classification criteria opened up functional correlations within plant organisms themselves, and were no longer pure signs enabling classification into species, we can see that in the field of animal physiology the Hallerian operation is the equivalent of such a move. The same shift toward new relationships happens, in the former case between natural history and plant physiology, in the latter case between anatomy and animal physiology: to divide a body is no longer simply to cut out large masses from the whole that is the appearance of living nature, but to grasp differences in executive capacities, in behaviors. This shift constituted the second condition of possibility for the operative concept of organism. I will now show how it removes some of the impossibilities in which Stahl's attempt to establish a specific knowledge of the living world was still caught, and why, at the same time, when Haller defined physiology as "animate anatomy," he could not go all the way.[13]

Such a shift is not only purely a modification of notions but also refers to a change of attitude: Haller no longer merely observes; he experiments, and the "new division of parts" is the result of these experiments.[14] As Zammito (2018) insisted, Newton's experimental philosophy, relying on controlled experiments and precise formulations, was here foundational.

Before showing how this new division is produced, let us clarify one point: of course, physiological experiments had been carried out before Haller; Harvey, in particular, on the characterization of systole and diastole, or Spallanzani on digestion. However, the novelty is that the concepts guiding the experiments are no longer borrowed from observation; on the contrary, the classification of parts for observation refers back to experimental tests. This is why Haller can attribute earlier errors in medicine either to a lack of experiments or to its counterpart, the forced use of analogy, which leads to the abuse of the notion of irritability (Winter, Lupo, and De Magni are his targets). What is decisive when Haller talks of irritability, as compared to his predecessors here, is that he endows it with a content correlative to experimental practice and leading to a precise image of the organism, as is visible in the following excerpt:

> I call the irritable part of the human body that which becomes shorter when some foreign body touches it a little strongly (. . .) the irritability of the fiber is all the greater as it shortens more (. . .) I call the sensible fiber in man that which, being touched, transmits to the soul the impression of the contact (. . .) We see that it is only experiments that can provide us with definitions of sensible and insensible parts.
>
> (p.6)

Irritability is thus defined by three parameters: a possible experiment that allows us to observe its presence ("a foreign body touches it a little strongly": experiments will then consist of irritating each of the parts by various means (physical or chemical)); the possibility of a relative measure of the irritability of the parts

("is all the greater. . ."); a clear distinction with the other vital property, sensibility (which refers to the soul).[15]

These three requisites constituted the framework for all discussions and shifts in views about vital properties, as I will consider them later. Such a framework also outlines a preliminary program for the science of the organism: to measure, for each of its parts, its irritability (second part of the *Memoir*) and its sensibility (first part of the *Memoir*). Haller's influential result is that "the most irritable parts are not sensible" (p.40), thus superimposing the sensible/irritable division onto the non-irritable/irritable difference announced at the outset. However, sensibility and irritability cannot be granted the same status of "essential vital properties" because sensibility has a global character that irritability does not. In what sense? Haller shows, particularly through experiments on cut-up intestines (p.45), that irritability does not depend on the soul, since muscles and organs separate from the body exhibit irritability. On the contrary, they feel nothing.[16] Thus, sensibility will depend on the soul, and therefore on the presence, in the part concerned, of the nerves, which are the soul's organ of sensation: "it is only the nerves that are susceptible of feeling" (p.15).

Nerves, however, "have no irritability" (40). This is why sensibility and irritability will vary almost in inverse proportion in different parts of the body. Thus, the skin, the stomach membrane and the urethra, which are highly sensible, have no irritability, even if they sometimes exhibit analogous reactions, for Haller asks us to "be careful not to confuse this property with a kind of vermicular movement due to the corrosion that vitriol oil or nitrogen spirit communicates to the nerves . . . this corrosion has nothing to do with life"; it would occur just as much on inert matter, proof of which is that it "remains twenty-four hours after death" (42). As for the heart, "extremely irritable, it is only slightly sensible." Overall, the human body shows a hierarchy of parts according to increasing irritability and decreasing sensibility, a division that starts with the nerves, passes through the muscle fibers, and ends with the muscle fibers. The degree of irritability distinguishes between muscular and cellular fibers: "when twisted, [the latter] yields, if pinched it bends, if cut it withdraws on either side, leaving a void. But the cellular fiber, if irritated in the living (. . .) shortens; the ends come together, soon it relaxes, and these alternations of contraction and relaxation persist for some time" (49).

Thus, in a systematic cosmological view Haller distinguished three levels of Creation, each characterized by an irreducible property "which cannot be attributed to any cause below the infinite wisdom of the Creator," of divine origin, and whose laws explain the manifestations of this level: raw matter (gravity), living matter (irritability), and soul (sensibility). His definitions of vital properties cannot, therefore, be detached from his philosophical adherence to a spiritualist dualism: living matter has no spontaneity because this is entirely the domain of the spirit, human or divine. The relationship of sensibility to the nerves, and hence to the soul, somehow preserves the spirituality of the body from any immediate

contact with matter in general, while recognizing the specificity of living matter as featuring irritability. Stahl's crude opposition between matter and life, which ultimately implied animism, is thus undermined by Haller: life does not need a soul to manifest itself in all parts of the body; it only requires irritability, a property irreducible to soul or matter.[17]

The reference to a soul was not completely abandoned in the early 18th century, as an epistemic resource for making sense of life. Another influential treatise, Boullier's 1728 *Essai sur l'âme des bêtes,* seemed to concur with Haller's views: for Boullier, "reasoned actions of beasts" are reduced to a sensory principle joined to an organized body,[18] because the organized body alone cannot account for them. Yet the views do not fully match, since this organized body as such has no vital properties, only sensibility. Haller's intermediate, properly living level of irritability, is absent in Boullier's work. By contrast, Haller pinpointed a level lower and more general than that of the soul, namely irritability, a level specific to living beings, and which, at the same time, cannot be reduced to the mechanism of the body. His idea of irritability as the key principle of life has been influential throughout the century in Germany, as the title of the 1790 essay *Abhandlungen über die Irritabilität als Lebensprincip in der organisierten Natur* by Girtanner, mentioned in the introduction, testifies to this influence.

Hence, Haller is not a mechanist in the sense that the laws of mechanical matter govern living phenomena,[19] but rather in the sense that these phenomena are the development of the laws of living systems, i.e., the laws of physics augmented by the consequences of the specific properties of living matter, instilled in them by God. In this respect, Haller can propose the creation of an "animal mechanics";[20] but his concept is an epistemological mechanicism. Like Descartes and Malebranche, Haller inhabited a conceptual space in which productivity in the order of the living should not be attributed to nature, but rather to divine creativity, with nature merely producing and developing what God has put into it. Therefore, he favored preformationism regarding generation, even though this preformationism is less radical than preexistence of germs according to Malebranche, since his preformationist account mostly conceived of dispositions likely to be actualized rather than miniature beings (Roe 1980).

2.1.2 Animated anatomy

Physiology "must explain the inner movements of the animal body, the functions of the organs, the exchange of fluids and the forces by which life is maintained"; it must also explain the forces "by which the forms of things received by the senses are presented to the soul; through which the muscles, which are governed by the commands of the spirit, have strength in return; the forces by which food is changed into different species of juices; and through which, finally, our bodies

are preserved and the loss of human generations is replaced by new germs."[21] This explanation should give a "description of those movements by which the animate machine is activated." This is why physiology is "anatomia animata." Anatomy provides a map of the body's parts, indicating the properties of each; from this, we can *deduce* the mode of action of each part on the others. In this sense, Haller's physiology remained subordinate to anatomy. It is *experimental* only because we experiment on the *parts*, but the division into particular parts is already prescribed by anatomy. Nevertheless, as we have seen, Hallerian anatomy overturned traditional anatomy by introducing vital properties as operative concepts. As a result, physiology no longer explains movements in terms of the faculties of the parts (Galen), nor in terms of pure mechanical laws with the addition of a little chemical knowledge (Descartes, then Boerhaave), nor in terms of the harmonizing action of a soul (Stahl), but in terms of the proper composition of the parts insofar as this leads to a specific type of reaction, identifiable and measurable and thus comparable across parts. The action and reaction of the parts upon one another could suffice to account for the harmony of movements, without invoking an external harmonizer—e.g., the Stahlian soul—and, at the same time, we could become aware of this interplay of action and reaction through experiments, without inferring from a previous knowledge of rational activity directed toward an end what the administration of vital movements should be.

In this way, the fundamental exteriority that affected Stahl's and Leibniz's concepts of organism seems to be reabsorbed, and a certain specific intelligibility of the living can be uncovered. Nevertheless, Haller could still not conceive of the living without the distinction between body and soul, since the difference between sensibility and irritability amounts to internalizing within the living body this difference between the pure living body and the soul. His theory of vital properties thus frees us from the exteriority inherent in the Stahlian concept of organism, hence inducing a first attempt to produce a proper science of the functioning of the living, and Zammito (2018) as well as Richards (2002) emphasized the seminal role it had for elaborating a German biology. At the same time, it displayed the limits of the whole Hallerian conception, namely, the idea of a separation of soul and body, which entails that the life of the animal body has no intrinsic positivity. In what sense? The iconic phrase "animated anatomy" means that the body's map, drawn up by the new anatomy (that of vital properties), is sufficient, as soon as a soul is added, to account for living phenomena. Between a new anatomy, conceived from experiments on body parts, and a rational psychology or pneumatology, i.e., knowledge halfway between neurological introspection and speculation—in the sense of a discourse on the nervous system based on anatomical deduction, which in this case performs rather poorly[22]—, there is ultimately no clear place for a purely experimental physiology, i.e., for a science of living phenomena that has its own sources and is not deducible from any other

science. Granted, Haller extensively talked about vital *processes* such as respiration, digestion, etc., yet he deduced them from the plan that anatomy (aided by chemistry) had already mapped out for them in the body; the soul comes to inhabit this plan.

Compared to Stahl, therefore, Haller dispenses with the idea of an organism as a body under the rational management of the soul, but he retains the idea of a soul that animates the body, thanks to his notion of sensibility. Such a body is already integrally different from brute bodies, because of its irritability; the cause of this difference is certainly unknown in its essence, but it can be ascertained and measured experimentally. Newton's methodology, consisting in assuming an intrinsic property in matter, tackling it experimentally, and couching its behavior in a quantified way, undoubtedly inspired Haller's science. Zammito (2018) showed the Newtonian framework that defined the overall paradigm in which Haller and his followers theorized, insisting that the core of this Newtonianism is rather the reliance on experiments, manifest in Newton's *Opticks*, than the mathematical method, readable in the title of his seminal *Philosophiae Naturalis Principia Mathematica* from 1686. However, an additional distinction should be made. Clearly, quantification plays a role in Haller's "Experiments on parts." It would be crucial throughout the elaboration of physiology in this century, and a major attestation here would be Lavoisier's exploration of respiration as a combustion, since it relied on a precise measurement of quantities of elements inspired and expired by the tested animals. Thus, one should distinguish between two mathematical key operations, quantification and formalization. Both were structuring Newton's physics, making it possible to formulate the law of gravitation, the core of the new natural philosophy, since it held the key to the physical and metaphysical question of the *nexus mundi*, as one used to say with Leibniz, namely the coherence of the universe. For this reason, the discovery of universal attraction became a model to follow in the post-Newtonian natural philosophy. This discovery was epistemologically threefold: pinpointing an irreducible property likely to account for patterns in nature (law of the falling bodies, orbits of planets); quantitatively measuring its manifestations; formulating the mathematical law of its expression. Physiologists, starting with Haller, essentially retained only the first two moments of this epistemological attitude.

In any case, combined with the Stahlian proposition of a struggle between life and death, Haller's theory of vital properties, which made it possible to dispense with the Leibnizo-Stahlian "rationalist" element in this theory, would provide resources for those who wished to break with Haller's own spiritualist or Newtonian dualism. This divorce allowed for the birth of what has been called *vitalism,* namely the affirmation of an original power inherent in living matter, and reducible neither to the Stahlian challenge to mechanicism, still affected by Leibnizian presuppositions, nor to Haller's dualistic, mechanistic physiology. Such an affirmation would nevertheless not have been possible without both.

2.2 Vitalism

2.2.1 Sensibility

Written by the Montpellier physician Théophile de Bordeu, the *Recherches sur les glandes* (1751) and *Recherches sur les maladies chroniques* (1755) questioned the relationship between sensibility and irritability, and more precisely, displaced the Hallerian structure in which irritability represented life as a body and sensibility represented life as a soul. The author set out to establish that sensibility, more general than irritability, is a sign of the life of matter as such, without the need for a transcendent principle to animate it. To this end, he criticized the Hallerian localization of sensibility only in those parts of the organism endowed with nerves; this allowed him to see this property as a correlative of pure and simple animality, no matter how complex the organization of the animal in question. In particular, the dispute centered on the sensibility of glands, which Haller judged to be poorly innervated. In Bordeu's treatise, on the contrary, they have a particular feeling that draws them toward certain substances and away from others. It is a "kind of sensation" that causes the gland to separate from the blood the humor it must secrete; at the entrance to the gland is a sphincter that "directed by nerves, so to speak, attentive and insensible to everything that does not concern them, will only let through what has given good evidence; everything will be stopped, the good will be taken and the bad sent elsewhere,"[23] so that by extending this conception Bordeu can observe that each organ "has its own feeling," and each part "its particular tact or disposition."[24]

Generally speaking, "we have learned," he writes in *Recherches sur les maladies chroniques*, "to consider the living body as an assembly of various organs, each of which enjoys a particular feeling and movement, a designed disposition for such feeling and such movement; whence result the agreement and harmony of all the actions which contribute to general life, and which all depend more or less obviously on the feeling and movement devolved upon the animal fiber of each individual" (p.8). Life, he writes further on, "is *nothing but feeling and movement*" (p.11, my emphasis). Pierre-Jean-Georges Cabanis, another physician, who took on responsibilities during the French Revolution, like many of his colleagues,[25] published in 1802 *Recherches sur les rapports du physique et du moral de l'homme,* which gathered several of his essays. There, he too links movement to feeling: "movement, which all organ action presupposes, is in the animal economy only a modification, a transformation of feeling."[26] Life, or feeling—the two things are now synonymous—belongs to the organs and is no longer the manifestation of a soul whose *seat* must be found, a problem raised by Diderot as a correlative of the notion of soul in the *Encyclopédie's* eponymous article.

As a corollary, the "animal spirits"— one of the major concepts that had been used for two centuries to conceive of the dualistic relationship between soul and

body, and of which Descartes's *Passions de l'âme* was one of the most famous illustrations—gradually disappeared. They were loose particles, tenuous to the point of immateriality, whose fluidity, finesse and imperceptibility made them an ideal middle ground between immateriality (soul) and materiality (body). Defending a dissertation in Montpellier in 1776, a person named M.G. confirmed this disappearance: it is, he says, a gratuitous supposition incapable of explaining the facts, since it is somehow redundant with "*sentiment*"—sensibility—which immanently explains the manifestations of the living. There is as much distance between soul and animal spirits, as between soul and muscles (since in both cases, precisely, we have not yet reached the level of feeling), so animal spirits do not mediate between soul and body; therefore, let us do away with them.[27]

The life of the organism then results from the life of the organs, and more precisely from the action that some exert on others and on the exterior by virtue of their sensibility: "one of the principal engines of the animal economy," writes Bordeu, is the "centrifugal and centripetal forces," which are simply "the effort that the exterior parts make against the interior and reciprocally." By compressing each other, these forces establish "the equilibrium necessary for the movements, so varied, with which the body is continually agitated. (. . .) The body ceaselessly trembles (. . .). These tremors are ceaselessly graduated and directed to maintain the order and regularity of functions, and they are fundamentally subject to the principle of sensibility, which directs everything by laws different from those which govern the movements of dead bodies,"[28] hence an interplay of action and reaction between the organs, linking in particular the three centers of vital activity according to Bordeu: epigastrium, heart, and brain.[29] It is the "force of the heart and respiration" that determines "the movements of all the parts of the body towards its circumference";[30] as for the actions of the heart, brain, respiration and digestion, they are "general functions, common to all temperaments," which are "the source of all the changes that the body experiences."[31]

Hence, this methodological consequence: "the laws of chemistry and mechanics are too far removed from those of nature," so let us "apply ourselves to observing" the phenomena of the organism.[32] Bordeu replaced the Cartesian and then Newtonian systems of the physiologists—first Boerhaave, then Haller—with an empiricism of observation that fitted in well with the clinical skepticism prevailing somewhat later in the Paris medical school.[33]

The sensibility-irritability debate is essential to physiology in the second half of the 18th century, and seems to have been won by Bordeu's supporters, who succeeded in reframing the debate by interpreting irritability as sensibility. This was the strategy adopted by Fouquet, another physician and author of several *Encyclopédie* entries, who, in the entry "Sensibilité," reduced all the vital properties of the various authors to the sensibility of the vitalists. This is also the case for Jacques Lordat[34] in his *Réflexions sur la nécessité de la physiologie dans l'étude et l'exercice de la médecine*,[35] who notes in retrospect that "the term

'sensibility' was not taken in the same sense by the two sides of the controversy, since for the vitalists it designates the faculty of feeling, whereas for Haller it meant the faculty of transmitting impressions to the soul." But then, Haller's meaning is too restricted, since any transmission to the soul presupposes the transmission of a life principle.[36]

If, on the other hand, sensibility is everywhere, with nerves innervating the body in a network too tenuous to be seen, this means that experimentation on parts, Haller's way, will teach the physiologist nothing;[37] for before the experiment, he cannot accurately describe the part that it concerns, especially as the pain caused to the animal will disrupt the experiment uncontrollably. For Bordeu and his disciples, only observation fulfills the requirement of understanding the function integrated into the totality.[38] Physiological observation is, therefore, both non-interventionist and not based on a system of physics. The best formulation of this methodological requirement, related to the critique of experimentation, can be found in Ménuret de Chambaud's[39] article "Observation" in the *Encyclopédie*. From observation, "no change results, not the slightest alteration to the nature of the object observed; it does not make anything appear other than what it is; it is principally in this that observation differs from experiment, which decomposes and combines, and thereby gives rise to phenomena quite different from those which nature presents." Hallerian experimentation thus distorts its object by isolating parts of it. Ménuret deduces that "experimentation on raw inanimate bodies is far more useful and satisfying."

This vitalist critique of experimentation[40] goes beyond the historical controversy between Haller and the French vitalists, as it calls into question the method of biology. It is based on two correlative arguments: (1) Hallerian experimentation, by targeting a part of the organism, does not obtain any results concerning the whole;[41] and (2) it cuts the organism off from its environment, so that it produces results that do not correspond to the natural living conditions of that organism. Precisely, these natural conditions require the activity of the whole organism, not concentration on a single part.[42]

It is hardly surprising to find this double criticism much later in Kurt Goldstein's work, when the physiological experimentation analyzed reflexes as responses to localized partial stimuli. It failed to reconstitute the organism and its behavior as a "set of isolated apparatuses,"[43] because each isolated reflex captured by experimentation is somehow artificial; in reality, it is the whole organism that reacts to a stimulus. In this way, experimentation fails to take account of the total situation to which the organism's behavior constitutes a total reaction, and in this sense, it creates an artificial circumstance in which the organism is cut off from what, for it, constitutes a natural environment. Hence, he says, the inability of experimentation to apprehend the fundamental normativity of living beings: for how can we speak of a norm when an organ is taken in isolation—how can we speak of a normal pulse for an isolated heart? Here we see how vitalist medicine puts forward the three concepts of norm, milieu, and totality, which

will later be at the heart of the debate on the specificity of vitality and biology,[44] and prove crucial in Kant's analyses explored below.

As is often the case, the contours of the doctrine are more easily seen in the exaggerated expression it finds in a disciple, in this case De Sèze in his *Recherches physiologiques et philosophiques sur la sensibilité ou la vie animale* (Montpellier, 1786). He writes: "sentiment is attached to all animal fibers" (p.34); the soul does not receive sentiment "from the fibers immediately, but from the principle that animates them and communicates with it" (p.91). Death means the end of this communication between the feeling principle and the soul, even if, at some point after death, the "vital spirit" still animates the fibers—hence, the irritable muscles. Such "revolution" in "natural philosophy," which De Sèze credits to Stahl and Bordeu against Haller and, above all, Boerhaave, will bring about the "rebirth " (after its Hippocratic birth) of the "reign of observation (. . .) from which will doubtless arise a more luminous theory, the only true one" (p.18).

The shift from the massive role of the soul to that of an undefined "principle" for conceiving the specificity of living things—a shift already sketched out by Whytt[45] and visible in De Séze—would be accomplished by Paul-Joseph Barthez.[46] Barthez was a student of François Boissier de Sauvages, who held the chair of medicine at Montpellier from 1744 until his death in 1767, and who, as a disciple of Boerhaave, had felt the need to attenuate the Dutchman's theses with a certain animism,[47] while subscribing to methodological Newtonism in physiology.[48] Boissier de Sauvages, author of a major treatise in taxonomic medicine, relied on the Stahlian idea of an active but unconscious soul in vital processes, taking up the *logos/logismon* duality: "The soul truly governs the body, and it has in freedom and in nature two faculties capable of choosing from a large number of possible movements that the body can exercise as a consequence of its structure, those it judges to be the most useful. It is this same faculty that directs the animal economy in diseases, and always goes for the most powerful."[49]

For Barthez, the soul is an occult hypothesis, and he replaced it with a force he calls the "vital principle." He can then define the relationship between living and inert nature, and the use of physics in medicine, as follows: "the movements which are the final effects of the play of the organs of living bodies can be subjected to mechanics; the humors formed by the various secretions and digestions can be analyzed by chemistry. But the affections of the vital principle, which produce and renew in a constant order the functions necessary to life, as well as the lesions of this principle, which constitute the essence of disease, are absolutely different to us from the productive causes of the movements that take place in dead nature." Thus, medicine is "independent in all its essential parts."[50] Note the words "to us," which clearly signal the admission of the incogniscibility of first causes. This structural ignorance is echoed when Barthez seeks to specify his vital principle: "I shall prove that the vital principle must be conceived by ideas distinct from those of body and soul, and that we do not even know whether this principle is a substance or only a mode of the living human body."[51]

2.2.2 Swarm

If we are to understand the Barthezian introduction of the vital principle and, more generally, the modification made to the idea of the living, we can reconsider the schema of the sentient fiber from another angle. With Bordeu, life was recognized as an autonomous power, no longer dependent on an incorporeal animating center. The living being was an organism, in the sense of a set of organs, each with its own life, whose interplay leads to a certain equilibrium. Its study consisted in examining these lives and the relationships they maintain with one another. The specificity of living organisms in relation to dead nature lies in a new type of causal link within the organism itself, which needs to be elucidated. Thus, Bordeu notes: "the *general life,* which is the sum of all *particular lives,* consists in a flow of regulated and measured movements, which takes place successively in each part, determines the exercise of its functions. (. . .) In this way, all parts are causes, principles, and final causes."[52]

Such a characterization of the organism poses a problem: how can we understand that these parts or fibers, each of which lives its own life, work together in such a way that the whole organism can live? How can we understand the relationship between the life of the organ and the life of the organism, in such a way that the latter is intelligible other than through metaphors? For it is ultimately to metaphors and dogmatic assertions that this thinking, which we call vitalist, is led: the agreement between the proper lives of the organs, insofar as we do not know what it consists in, can only be asserted; and to illustrate it, we can picture the image of a swarm of bees. "We compare the living body, to get a good feel for the particular action of each part, to a swarm of bees which gather in clusters, and which hang from a tree in the manner of a cluster; it has not been thought wrong for a famous ancient to have said of one of the viscera of the lower abdomen that it was *animal in animali*; each part is, so to speak, not undoubtedly an animal, but a kind of separate machine which contributes in its own way to the general life of the *body.*"[53] We find this image again in Maupertuis's *Dissertation* of 1751. Thus, "a famous physician (Bordeu) and an illustrious physicist (Maupertuis) have agreed to consider man considered from this luminous and philosophical point of view to a group of bees making their efforts to attach themselves to a tree branch, we see them pressing together, mutually supporting one another and forming a kind of whole, in which each living part in its own way contributes through the correspondence and direction of its movements to the maintenance of this kind of life of the whole body, if we can call this entanglement of actions thus."[54]

The essential point is that, in this new image of life, on the one hand, matter is endowed with *essential properties*, with a kind of dynamism of its own; on the other hand, the thought of life must distinguish two levels of analysis, no longer the soul and the body, but *the local and the global.* The local is not exactly thought of as an instrument, or as a part: neither does it determine the whole, as the part would in a mechanistic vision, nor is it determined by it, as in the

Galenic organism, where the parts have a utility that defines them integrally. This hesitation over the conceptual status of the part is reflected in the overly vague sentence by Bordeu quoted above on the causal relations between the parts.

The image of the swarm must be understood as the awareness of a difficulty inherent in the intelligibility of living things: organization implies both the vitality of organs and the emergence, through their coming together, of a vitality of the whole. There is a fundamental aporia here: knowledge of the living being as a singular reality requiring its own principles of intelligibility imposes undecidability on the attribution of the predicate "living" (namely, who is principally "alive"?). We shall see later how Kant resolves this aporia, but it seems that the French vitalists did not avoid it.

Indeed, much later, Eugène Littré and Emile Robin's *Dictionnaire de médecine* (1873) took note of this difficulty with levels of vitality. Of course, their conceptions are far removed from vitalism and belong to another era of biology. But the issue they addressed in the article "*organization"* is much the same. This entry distinguishes three degrees of organization: that of blood, "nothing other than the association of immediate chemical principles"; that of substances endowed with structures—cells and fibers—and finally that of tissues, which for Bichat was the ultimate organic level (see below, §2.4). Organization is therefore both a horizontal gathering of parts (blood, a cell, etc.), and, in a second sense, a vertical gathering of already-organized organizations (blood and cells). Degrees of organization are also different kinds of organization, and, in a logical circle close to that of the swarm, organization itself meant the organization of these generically different organizations.[55] Such a circle, this difficulty, and above all its persistence, signal an epistemological property of the biological field; its recognition by the vitalists then indicates that their theory constituted an important moment in the making of the epistemological specificity of biology and, correlatively, in the institution of its own intelligibility. It may appear as the reformulation, in another context, of the dimension of nestedness that Leibniz handled with the *vinculum substantiale*, which requires another theological grounding, and that he expressed also by an animal metaphor, the fish full of fish (see Chapter 1).

In his unfinished *Physiology* (1720), Diderot distinguished three "very distinct" lives: that of the animal, that of each of its organs, and finally that of "the molecule," which alone "does not cease." Concerning life itself, in the former century, physics and theology would agree with a theory of the pre-existence of germs and the need for an engineer for the living. Diderot recognized that the price of freeing the living from this double patronage was the polysemy of the term "life" and the subsequent conceptual requirement to understand the hierarchy of levels.[56] Diderot, in presenting his synthesis and re-elaboration of this research in a *Rêve de d'Alembert*, made no mistake: such a knowledge of life cannot acquire the content of a system or a science. For him, it culminates philosophically in a grandiose picture of the production of the living world, in all its variety and complexity, from matter endowed with a latent sensibility,

dispersed in scattered elements that over time have combined through "an infinity of organizations and developments."[57]

Of course, the issue of the swarm leads to attempts to overcome it. Barthez's idea of a vital principle could in some way be introduced to counterbalance this splintering or dispersal of life within the organism that Bordeu's conception operates. Therefore this principle designates nothing observable, and can be defined in the negative, as an unknown X endowed with a function whose name matters little: "the thing that is found in living beings and that is not found in the dead, we will call Soul, Archea, Vital Principle, X, Y, Z like the unknown quantities of geometers."[58] If there is an incorporeal vital principle, then in relation to it, we understand that the action of organs according to their own life can nevertheless result in harmony. Obviously, this principle eludes all positive investigation. More generally, in all these vitalist texts, the predicate "living" breaks away from the usual, everyday perception, in which life is identified with animals and plants, those beings that have a particular form and individuality. Bordeu's use of the notion of vital property, and that of the physicians in the *Encyclopédie* and the people of Montpellier who followed in his footsteps, is evidence of the need to treat living phenomena at their own level, without referring them to a soul, a purpose, or even a divine order.

Philosophically, this whole conceptual shift owes to Leibniz, who, as we saw, first emphasized the nestedness proper to organisms, illustrated by the fish full of fish. Recently, Ohad Nachtomy, Ayelet Shavit, and Justin Smith emphasized the legacy of this view by showing how the current evolutionary approach to the origins of organisms sees them as groups of groups of cells, whose unity emerged from an evolutionary process of multilevel selection (Nachtomy et al. 2002). Importantly, the main reference for the study of this emergence in the so-called Major Evolutionary Transitions in Individuality research program—after Maynard Smith and Szathmary's (1995) eponymous book—is precisely hymenopteran insect colonies, since the colonies themselves seem to live a life of their own. Thus, the vitalist metaphor of the beehive gained status within a conceptual inquiry into the origins of the form "organism." As a consequence, some authors see bee or ant colonies as a form of individual or organisms, thus challenging the idea that '"organism" is a type of thing, preferring the idea that "being an organism" comes by degrees, mammals or spiders being more "organisms" than beehives, which are in turn more "organisms" than packs of wolves (Strassmann and Queller 2010; Queller and Strassmann 2009; see Huneman 2020 on this view).

While, of course, the Darwinian idea of evolution is wholly alien to Leibniz's metaphysics, the notion that nestedness and hierarchy are the key to organismality unites both approaches, and found a major instance in the vitalist metaphor of the swarm. From Leibniz to these naturalists and then to the Darwinians, the metaphysical *vinculum substantiale* idea translated into a powerful analogy and finally into an interpretative concept ("multilevel selection," namely the articulation, in a group of groups, of competition between groups, and within-group

competition; see Chapters 7 and 11) and a mathematical modeling (Michod 1999). When expert in social insects Edmund O. Wilson and initiator of the modern notion of multi-level selection David Sloan Wilson together wrote a review paper summarizing the main ideas of this new approach, they famously noted that extant organisms were in the past groups of organisms (Wilson and Wilson 2007): the Leibnizian *vinculum*, turned into the beehive metaphor, now is interpreted as a historical, evolutionary relation. While this *vinculum* was the result of a divine will's contingent act of turning a relation into a substance (see Chapter 1, §3.4), we can see it now as the sedimented result of natural selection at several levels.

What then of the epistemological tools proposed by Montpellier vitalists in their time? The idea of the "proper life of the organs" reactivates an old Hippocratic concept, that of "sympathies":[59] indeed, since the organs live their lives, the life of an animal is made up of correspondences between all its organs, and these can take pathways that are all the more unexpected given that we do not know exactly what connects all the organs.[60] In addition, the nervous system, a preferred vehicle for transmission between the organs, innervates the parts so finely that it is difficult to delineate its pathway. For Bordeu, in particular, the nerves of the stomach and intestine, which innervate the whole body, are the main cause of sympathy. This is why the physician must be attentive to the echoes that the pain of one organ or the action of one organ induces in the functioning of another, however distant. Sympathy is communication regardless of spatial proximity.[61] But this communication highlights the sensory character of living organs as such, as Whytt had remarked, for whom "all sympathy supposes (. . .) the reference of an impression upon the sensory principle,"[62] even if vitalists precisely delocalized this sensory principle with respect to Whytt, by making it a "sensibility."

Because Bordeu, following the Hippocratic tradition and Van Helmont, granted a central role to the epigastrium and diaphragm, he judged changes in the diaphragm caused by the viscera as the cause of disease.[63] The study of sympathies thus revolved around the echoes of the diaphragm in other organs. Cellular or "mucous" tissue can play a transmission role. "Cellular tissue" does not refer to cells, the primary elements of the body, but to the continuity of a "tissue," as underground continuity that links apparently distant organs in a proximity manifested in sympathy. Along with nerves, it is the second vector in the construction of a cartography of the human body that is no longer exactly that of the visible organs drawn up by anatomy. Barthez, on the other hand, attributed various subordinate forces to the vital principle, whose relationships can be thought of in terms of sympathy. He distinguished "synergy" (the concurring of actions in an organ) from "sympathy" properly speaking, namely, the affection of one organ affecting another without there being a mechanical link. Of this affection, he then lists three forms: a relationship with no sensible connection (e.g., between the testicles and the moulting of the voice), a relationship where there is a connection (e.g., intermediate tissues), and a structural resemblance (e.g., between symmetrical organs).[64]

Sympathy, revealed in particular through illness, enables us to draw up a map of the organism, revealing proximities of function between organs, affinities of life, which simple anatomy does not reveal.[65] Thus, Bordeu's concept opens the way to a physiology that can no longer be based on anatomy, as was "animated anatomy," but that must seek the source of its knowledge from pathology, because what there is to know is not revealed by mere sight, even when aided by the scalpel of dissection.

2.2.3 Animal economy

To sum up, in the tradition of the Montpellier school, as well as that of the Scotsman John Hunter at the same time, we find the articulation of the notion of vital property with a new image of the body as an organism. More precisely, the properties of "vitality" or "sensibility," however vaguely defined, replace the galenic "faculties" that in each organ acted in an occult manner to produce its appropriate and useful result for the totality; after Bordeu or Haller, we can do without such finalities, implied in the notion of organ as instrument (still present in Haller) because the very matter of living parts spontaneously produces a certain action. The occult, unknowable character of the galenic faculties reflected the exteriority of purpose to the living body; the immanence of vital properties to the living body in turn drew as the ultimate object of analysis a purpose that is no longer imposed from outside on the living (soul or divine rationality), but rather occurs in the arrangement of localized vital elements. In this way, one gained intelligibility: to assume "faculties" was to invoke a finality that we cannot account for; to observe properties is rather to resort to an approach that has proved its worth in physics. The question of the purposiveness of living things is given a new locus: it boils down to the problem of the relationship of living elements to the "common life" of the swarm, as Bordeu put it.

In this context, 18th-century authors referred to the organism as an "animal economy."[66] Cross (1981) has shown in his article that this name was not accidental and that, by Hunter at any rate, the concept was not without solidarities with the then-nascent political economy. Actually, the *Encyclopédie* juxtaposed entries on *Oeconomie animale*, *oeconomie politique* (by Boulanger), *Economie ou Ooeconomi*e (by Rousseau), and *Oeconomie* (*critique sacrée*) by Jaucourt. We can see that this concept means a field of regular relations between parts, producing phenomena that have their own order, and whose designation by the epithet "animal" means that it is founded on original properties (in itself, or for us only). This is how Buffon used the term in 1749, to express the irreducibility of the living world to the objects of mechanics, and the need to have recourse to specific properties and forces in order to understand it:

> to explain the animal economy and the different movements of the human body, be it that of circulation, blood or that of the muscles etc., by the only mechanical principles to which moderns have recourse (. . .) It is precisely the

> same as if a man, in order to give an account of a painting, had his eyes closed and told us everything he felt on the canvas; for it is obvious that neither the circulation of blood, nor the movement of muscles, nor animal functions can be explained by impulse, nor by the other laws of ordinary mechanics; it is just as obvious that development and reproduction can be explained by other laws.[67]

Economy, generally speaking, means order and balance. This is why, for Scotsman John Hunter as for the vitalists themselves, it is manifested by compensatory relations of action and reaction between the vital centers, the interruption of which constitutes disease. Thus, "animal economy" became the name for the relationship between the epistemologically ultimate element—the vital or feeling fiber—and the global phenomenon we call life, which we observe empirically, a relationship that, as I just said, constituted the locus of the question of life's purposiveness. The frequency of doctoral dissertations devoted to certain aspects of this concept is an indication that thinking of the organism as an "animal economy" was self-evident at the end of the 18th century: we can see that, following a vitalist education, students signed dissertations with the following titles: Pierre Philippe Ferrier, *Dissertatio medico physica, an possibile influences imaginationis in oeconomia animale, et alienum corpus* (Montpellier 1786, supervised by P.J. Barthez); N. Jauber Boisnerf, *Influence des saisons sur l'économie animale* (Montpellier, an VI); Jacques Guitard, *Influence des corps célestes sur l'économie animale* (Montpellier, an VI); Raimond Laroque, *De l'influence des passions sur l'économie animale, considérée dans les quatre âges de la vie* (Montpellier, an VI), etc.

To think of life in terms of "animal economy," as Ménuret de Chambaud does in the *Encyclopédie's* article of the same name, or as Hunter does in his works, is to attempt to identify hierarchies in vital organs and phenomena: the order of processes in "simple life" according to Hunter, the specification of vital centers for the vitalists or Ménuret. The latter writes: "Animal economy is the order, the mechanism, the set of forces that sustain life. This order is established by observation." But he adds: "In a constant vicissitude, causes and effects are reciprocal, the first agents are in turn brought into play by the powers whose action they have determined themselves": this difficulty, namely, causal reciprocity, signals a specific epistemological field and at the same time hinders its uncovering. Especially since, as Rey (1995) points out, we should not forget that these scientists are first and foremost physicians, and "how could a doctor act on a process where the beginning and the end merge?" as Ménuret de Chambaud writes in the entry *Oeconomie animale* of the *Encyclopédie*. This is why the concept of animal economy translates into a need to uncover hierarchies: between parts, between organs, between functions—the primacy of the three "centers" over the other organs, the order of functions with the privilege of respiration, a function which, continues Ménuret, "perhaps gives the impetus to all the others" even though

it requires "the reciprocal and simultaneous cooperation of most of the organs of the lower abdomen."[68] To understand is to detect hierarchies; but if there is indeed circularity (namely, agents brought into play by what they have caused themselves), then the action-reaction principle will be a fundamental operative requirement for explaining the processes of the animal economy.

In addition to the "epigastrium," linked to the breathing function and chronologically first, the centers of the animal economy are the head (center of the nervous system), and the skin, which Ménuret calls the "external organ" after Lacaze.[69] This system of centers articulates an internal life and a relationship to the external environment; in this sense, the idea of animal economy affirms at the same time an internal intelligibility of organic phenomena, without transcendent finality, and a necessary correlation of these phenomena to an external environment, since, within the animal economy, the latter appears represented by its third center. The action-reaction relationship linking the first two centers (epigastrium and head) is redoubled by an action-reaction movement between this pair and the outside, represented by the external organ, the skin. This indicates that the action-reaction interplay grounding the organism's existence can only function by making into one of its centers its simple surface of contact with the outside world. The animal economy is functional by being open to its outside; indeed, vital properties are only manifest, and therefore only active when they are affected by something else: the irritable organ must be irritated. For this reason, in his 1809 *Philosophie zoologique*, Lamarck later spoke of the "circumstances" that shape the needs of animals and are required to understand the phylogenesis he envisioned: in another domain he thereby enunciated a consequence of the constitution of an "animal economy" as an object of physiology based on new conceptions of vital properties.[70]

One of the major objections to the novelty of this scheme of animal economy in vitalist medicine and English physiology is that, in the Hippocratic tradition—arguably the longest and most influential in medicine—man was not conceived as a dual being, but as a unity, made up of humors in balance or disequilibrium. It accommodated both dualistic metaphysics and materialism, and the operative scheme for both psychic and organic diseases was that of a totality with bodily and psychic manifestations, in relation to an environment. Humoralism, the medical theory derived from Hippocrates, which saw illness as the result of a disturbance in the natural balance of the humors, accepted neither a soul directing the body, nor the explanation of vital or pathological facts by mechanical interactions.[71] As Theodore Brown points out, Cartesian dualism in medicine was a parenthesis in this tradition, and one that was greatly misunderstood. For this reason, vitalist thinkers saw themselves as restoring Hippocratic truth after Cartesian wanderings, even though the reference to Hippocrates was also a commonplace in Enlightenment medicine, due to his legendary mistrust of speculation, as well as his conciliatory ambition toward the various schools, so that he was already a model for Boerhaave.[72]

However, despite these superficial invocations, the animal economy scheme is profoundly original. Its main concept was no longer the humor,[73] which implied an entire worldview dismissed by the mechanicism, but the fiber or sensing organ. Only then were vitalist physicians and English physiologists able to take up old concepts such as "sympathies," which at the same time acquired a new meaning. Thus, the "environment" was no longer an element in the problem of the balance of humors, as in the famous treatise *On Air, Water and Places,* but was thought of as a factor of harmony or disharmony in the total sensibility of the organism.[74] Vitalism could then no longer mean a return to Hippocrates, because humoralist models had been supplanted by îatromechanism, and humors themselves were dissolved into ordinary fluids by iâtrochemism (by Pitcairn, for example).[75] The end of humoralism and the critique of its main alternatives (iâtromechanism, iâtrochemism) were bound to lead to new physiological schemes, even if formulated in the old terms (Gaukroger 2010). Thus, when animal economy medicine sought to formulate its theory of the environment, it rediscovered and transformed the doctrine of the six "unnatural things," i.e., the six elements external to the body but capable of acting on it.[76]

The organism now appears as an animal economy, which defines a research program, hence a certain number of theoretical problems: drawing up an order of phenomena, and uncovering communications (the role of sympathies), which requires the definition of their mysterious vectors (cellular tissue, nervous system). Neither physics nor natural history can solve these problems, and the domination of anatomy over physiology had weakened. Granted, John Hunter, for example, maintains the Hallerian idea that physiology, the science of the functioning of living organisms, is animated anatomy, in the sense that it adds to anatomy the consequences of an analysis of the vital properties of parts. Yet, the very logic of the concept of animal economy in its relationship with the notion of "vital properties" implies the possibility, and even, in the long term, the necessity of a break with the image of the body offered by anatomy. Thus, to understand the living world in terms of a hierarchy of processes[77] and communications between parts is to conceive of proximities that are no longer those identified by anatomy. Physiologist and physician Xavier Bichat would then achieve such a break, the possibility of which lay in the need to analyze the animal economy.

2.2.4 Property ontologies and vitalism: Bichat's epistemology of the elementary and organic hierarchies

Xavier Bichat studied medicine and in 1799 received major responsibilities in the Hotel Dieu hospital in Paris, an important establishment in the context of the medicalization of hospitals after the French Revolution, as well as in the "hospitalization of medicine" (in the sense that the taxonomic procedures proper to the hospital pervaded the practice of nosology and medicine).[78] He proposed

major transformations in anatomy, medicine, and physiology.[79] For Bichat, two interrelated elements constituted a model of animal economy that is not derived from anatomy, and that can solve the dispute between vitalists and Haller's followers over fundamental vital properties: the doctrine of *tissues*, and the *division* of "lives" (*vies*).

For a long time, animals had been distinguished by several types of functions. But often, the key to this distinction pertained to natural history: "do all animals have these functions, or only some?" Bichat's distinction did not have the same basis: it did not rely on the types of beings that live these "lives," still less on whether or not they possess certain organs, but on the fundamental *orientation* of functions: whether they relate to oneself (and this is called the "organic life"), or to the outside world (and this is called the "animal life"). This division makes it possible to redefine vital properties on a physiological basis, i.e., from the functioning of the animal economy and not from its anatomical design.

Bichat thereby eliminated irritability as a cardinal property, which stood at the heart of the aforementioned quarrel. This term, he argued, has been used to describe too wide a variety of manifestations. First of all, we need to acknowledge "tissue properties," which a living tissue possesses simply by virtue of its molecular arrangement, but which do not depend on the vitality within it, and constitute "extensibility," i.e., the tissue distends under a "foreign impulse." Bordeu, Barthez, and Haller had confused this phenomenon with irritability, that is, with a truly organic property.[80] But then there are the truly vital properties of "sensibility" and "contractility." The vague concept of irritability became for Bichat "organic contractility."[81] Sensibility, on the other hand, did not refer to a sensible soul, but at the same time, contrary to Bordeu, it was not the principle of life, an expression which, incidentally, no longer made sense here. Then the physiological distinction between lives came into play: each vital property is divided according to the kinds of lives, so that there is an "animal sensibility" (which reports to the brain via the nerves) and an "organic sensibility" (which remains localized in the organ so that the soul is not aware of it); similarly there is an "animal contractility" (which sits in the voluntary muscles) and an "organic contractility" (which "has its principle in the organ that moves"). Moreover, there is continuity between animal and organic sensibilities, since, for example, the very nature of inflammation is to transform the organic sensibility of an organ into animal sensibility, so that we feel our painful limb.[82]

The theory of vital properties takes on its full significance when coupled with the other main advance, namely Bichat's doctrine of tissues developed in his *Anatomie générale*. The support for the vital properties is indeed no longer the organ or the organic part, but the *tissue*, i.e., the ultimate element of which the organs are composed. A fundamental assertion of tissue theory, which Bichat stated to develop in his first opus—applied to the membranes and entitled the *Traité des Membranes* (1798)—prevents us from seeing it as a rudimentary form of cell theory: tissues are differentiated, and there are twenty-one of them,[83] each

irreducible to the others. Each organ, in turn, is made up of a specific combination of several diverse tissues. The combination of the two differential systems, that of tissues and that of properties, accounts for the overall animal economy, defining Bichat's breakthrough in French physiology. Haller measured the sensibility and irritability of animal parts; Bordeu attributed sensibility to organs, and Bichat to tissues, which shifted the threshold for attributing vital properties. As each tissue has a specific degree of each of the four vital properties, the differentiated distribution of tissues in the organism—the geography of tissues, so to speak—entails a geography of vital properties, which in turn underpins the whole animal economy, because the properties of tissues determine the types of relationships they can have with one another, and hence the types of inter-organic relationships.

Thus, the image favored by Bordeu and the vitalists, of a swarm of sensible organs in tune with one another, embedded in a general Leibnizian commitment to the nestedness of organisms, is made comprehensible by the descent from the level of organs to that of tissues. Indeed, from this point onward, the organ should be understood as a construction of several tissues. Its relationships with other organs in the action/reaction interplay of the animal economy can therefore be explained by tracing them back to the determinations imprinted on it by its constituent tissues. An organ's ability to perform its functions derives from the specific properties it owes to this combination of constituent tissues.[84] Each organ, therefore, has a determined initial sum of sensibility and contractility, dependent upon the tissues of which it is composed. This constitutes a sensibility threshold around which the organ varies, since its own sensibility is a secondary phenomenon, dependent upon the initial sensibilities of the elementary tissues[85] that make up such an organ. This threshold of sensibility characterizing the organ helps to explain communications within the overall animal economy; namely, if the difference in the level of vital properties between two organs is too great, in other words if their thresholds of sensibility do not correspond, the two organs will not communicate, even though they are spatially close.

One notices here a double insistence on the *elementary*, in the sense of elementary tissues and elementary properties. The epistemological strength of Bichat's general anatomy, i.e., the reason for its ability to support a theory of animal economy, or even physiology—which retained it for a long time—consisted in articulating the two levels. It characterized tissues by their elementary properties while reducing the vital properties of organs, which for vitalists accounted for organic functioning, to the tissues making up these organs.

More generally, the quest for the elementary refers to two extradisciplinary models: the first is, in line with all the texts discussed here, Newtonian sciences, as Zammito (2018) forcefully explained regarding 18th-century biology and especially its German realizations. In the words of Bichat, while anatomy and zoology, like mineralogy, are "sciences of form," physiology, like physics, is a

"science of *phenomena*"[86] and to understand phenomena is, as Newton did, to reduce them to the irreducible properties that underlie them. His novel stage in physiology indeed involved an approach analogous to Newton's treatment of gravitation, namely the isolation of irreducible properties and their attribution to substrates, as well as rules for apprehending their variation. The latter point follows the tradition inaugurated by Haller, namely the theme of inverted proportions that appear in the evaluation of the two vital properties; the former refers to the properly Bichatian anatomical intuition of tissues at an elementary level.

The second reference supporting Bichat's anatomy is Lavoisier's chemistry. The role of "general anatomy" as knowledge of tissues, as opposed to "descriptive anatomy," which studies higher levels of organization, such as organs, parallels the chemistry of simple bodies, while Bichat explicitly refers to Lavoisier.[87]

From here, the general anatomical scheme developed as a hierarchical edifice, in line with the key Leibnizian idea of the nestedness of organisms. The totality of each simple tissue in the body is a "system" (bone system, mucous system. . .), and a union of elements from several systems forms an organ. The union of several organs contributing to a function is an "apparatus" (digestive apparatus, respiratory apparatus. . .). Bichat thus posited that there are several hierarchically arranged levels of organization (tissues, systems, organs, apparatus), so that the first is fundamental and invisible, while the last is where visible vital manifestations take place. "Organism" meant such a hierarchical construction, where each level is itself organized, and which results from the combination of these organizations of various types. This is why it could be examined at several levels: organ, tissue, apparatus, etc. To the extent that nestedness involved a relation of integration from the higher to the lower levels, we can credit Bichat with having formulated the idea of integration as constitutive of the organism, and as the fundamental epistemological character of this object, after the Leibnizian *vinculum substantiale* and the vitalists' swarm metaphor. Bichat's general anatomy, in its correlation with the physiology it founded, was able to put in place what the swarm metaphor merely indicated, and what the *vinculum* concept developed in a metaphysics that could no longer correspond to a concept of organism emerging as the guiding scheme of a specific science of the living. If I were to search for what Holton (1978) termed "themata," namely these coarse-grained meta-theoretical units of meaning that cross historical boundaries between stages of a science, such as "holism" or "atomism," I would situate the Bichatian moment in a "thematic" story that nowadays culminates with the idea of evolutionary nestedness of organisms sketched in the previous paragraph.

2.3 Conclusion: Vitalism and the idea of the organism

"Animal economy" made it possible to understand the functioning of the organized body without invoking any soul.[88] The action-reaction relationships

between centers and with the environment, the sympathies, the hierarchies between levels of organization—all of these sketched out an intelligibility specific to the organized body that dispensed with an appeal to an organizing and conservative principle—an appeal that belonged as much to the tradition of Aristotle and Galen, as to the more modern conceptions of Leibniz or Stahl. At the same time, as we have seen, this was by no means a return to the humoralism of Hippocratic medicine: "animal economy" marked the birth of a new schema of the organism, which is no longer Aristotle's instrument of the soul, Hippocrates's balance of humors in tune with its context, or Galen's organs as instruments, namely, useful parts endowed with proper roles, but which nevertheless did not fall within the framework of a single mathematical science of nature, regulative of the *mathesis* space of knowledge sketched above (Introduction and Chapter 1, §2).

According to the French vitalists, the notion of vital property gave rise to a new image of the living body as an organism. But the key concept on which this relies is "sensibility," ontologically diffused throughout nature, and therefore, equally realized by human sentience and feelings, as well as by insects' or glands' affinities. The anthropological question was therefore lurking all across vitalistic theories in France, as is manifested by writings by Cabanis or by Diderot (the *Rapports*, the *Lettre à Fauriel*, or Diderot's *Elements de Physiologie* or *Rêve de d'Alembert*), which defended a general hylozoistic view of nature that can be turned into a vitalistic anthropology, to the extent that human sensibility is a biological fact that should be at the center of morals and human nature. In so doing, vitalism enables the concept of organism to be extended not so much into a positive science of the living as into an element of a new image of man "in physical and moral terms" (as written by Cabanis and Lacaze), that is, *anthropology* as a "natural history of man"[89] (Cabanis).

But at this point, the organism as a scheme necessary for biology to think about the living, if this is possible, is not yet real. To complete (for us) its construction, I will need to look at a notion inseparable from that of vital property, the *vital force,* which faces issues parallel to those of vital properties. While vital properties were intended to conceive of the *functioning* organism, another issue tackled by those who then investigated living phenomena concerned the *developing* organism; this question would mobilize concepts of vital forces. Added to the revision of physiology described above, this re-elaboration of embryology would complete the sidelining of the soul/body pair for thinking about life. Nevertheless, I can now address the questions of the organism as it first appeared in Kant, since we now envision the scientific background against which life appeared to him as an object of knowledge. I will inquire into the way Kant's thinking developed on this point in his pre-critical writings (Chapter 3), until it encountered this theme of the vital forces underlying embryological development, which I will examine next (Chapter 4).

Notes

1 See also *Aphorismi de cognoscendis et curandis morbis chronicis* (1709), translated in french by La Mettrie, *Méthode pour étudier la physique,* 1720. On Boerhaave in general, see Lindenborne (1968), Duchesneau (1982). Haller translated his *Institutions* under the title *Praelectiones academicae* in 1739–1744.
2 Beiser (1992, p.81); Zammito (2002, chapter 5).
3 On Cudworth, see Nicoglou (2024), on Malpighi see Bertoloni-Meli (2011); on Spallanzani, see Duchesneau (2010) and Salomon-Bayet (1978).
4 On the reasons for Boerhaave's authority, particularly in Scotland, due to his ambition for concord and conciliation in medicine, see Cunningham (1990).
5 Boerhaave, *Aphorismi*. . ., p.75, 100, quoted in Brown (1974, p.201). Boerhaave here illustrates the tension between various mechanistic credos and chemistry, as explained by Gaukroger (2010, chapter 5). For the role played by nutrition in this emergence of chemistry as a locus of this tension, see Bognon-Küss (forthcoming).
6 On this point, see "La notion de fibre vivante" in Grmek (1980). Moreover, the notion of fiber obviously derives from the examination of muscular activity. For Descartes, then Willis, the addition of spiritus animalis to muscle fibers accounts for muscle activity. In 1667, Sténon "had proved, in *Elementorum myologiae specimen*, mathematically and by a solidly supported argumentation, that the shortening of muscles was the result of a modification of longitudinal fibers, which become simultaneously shorter and wider; and that, moreover, this shortening was not accompanied by an increase in muscle volume (no flow of spiritus arrives); but (. . .) Willis and Boerhaave stuck to Descartes' baseless allegation." (De Wit 1992, II, 10, p.92). For Boerhaave, the spiritus animalis means a link between the chemical processes in the body and its essentially mechanical, hydraulic architecture and functioning.
7 Canguilhem showed how the image of fibers, which initially correspond to the plant fibers of cables and ropes, has been generalized from muscles and nerves to the whole organism, first by Descartes and then by Haller, paving the way for cell theory. For Hook, the cell is a fiber arrangement. In Haller's Elements of physiology, cellular tissue is ultimately composed of fibrils (Canguilhem 2022, chapter "Cell Theory").
8 For Boerhaave, see Zammito (2018, pp.38–47).
9 In this spirit, James Keill published *An account of animal secretions* (1708), entrusting Newtonian attraction with the task of explaining the movements of the animal economy. See Brown (1974); Martin (1990, p.130), and Zammito (2018, pp.44–45).
10 Grmek (1980, p.166). Temkin (1977b) brings the concept of irritability back to the original notion of irritation, which is an anthropological concept (e.g., an angry man is stimulated and reacts) (p.295). Glisson can then grant fibers a "natural perception" independent of nerves. In particular, he generalizes to all fibers the model of the angry man's reactive discharge (p.301), and disjoins irritation and perception of irritation, as Harvey had already done. But he shifts the concept of irritation from the pathological to the physiological register, by vindicating "irritability"; in so doing, he clarifies the physiological presupposition implicit in "irritation" (p.315), and such is his legacy.
11 The notion of fiber correlates with an approach to life in terms of layered models, with increasingly macroscopic levels; it is part of the possibilities opened up by the discovery of the microscope with Leuwenhoek and then Swammerdam.
12 References in brackets in this paragraph are to this work.
13 For a detailed study of this Hallerian project and its realization, see Monti (1990).
14 See Salomon-Bayet (1978), Zammito (2018, pp.83–91).

15 On irritability and sensibility by Haller, and the discussions about them in the second half of 18th century in Europe, one can see the massive study by Steinke (2005), as well as Cheung (2007).
16 "The soul is that being which feels itself, which represents its body and, by means of the body, the whole universality of things. I am I, and not something else, because what calls itself "I" experiences change in all the variations that occur in the body that this I calls its own. (. . .) A finger, a piece of flesh removed from my leg, has no connection with me (. . .) they can give me neither idea nor sensation, so they are not inhabited by my soul (. . .) my soul no longer has a hold on (an amputated leg) and yet [it] continues to be irritable, so irritability is independent of the soul and the will" (p.47).
17 This enables him to distance himself from the materialistic and atheistic consequences that La Mettrie drew from his doctrine of irritability in *L'homme-Machine*. The latter wrote that irritability as an inherent property of living matter dispensed with the need to think of a soul; on the contrary, irritability cannot replace sensibility (since they are defined in their distinction from each other), which implies a soul. This is why vitalist theories such as Bordeu and Barthez, which wish to do away with the soul, understand that they will have to challenge the Hallerian theory of vital properties. Alessandro Dini also recognizes, with Petrini, that Glissonian irritability was rethought by Haller and thus widely adapted by his contemporaries, in particular Zimmerman in Germany, because it represented a "fair third way" between the "mechanism of the Cartesian tradition and the animism of Stahl and his successors" (Dini 1996, p.38).
18 *Essai philosophique sur l'âme des bêtes*, II, 8, p.358.
19 "In the animal machine there are many things that are very different from the common mechanical laws" (*Elementa physiologae*, p.v).
20 See Roger (1963, p.686): Haller was mechanicist in the sense of Newton, but not in the sense of Descartes.
21 *Elementa physiologae*, p.1.
22 On this point, see Bynum (1974), which deals mainly with Thomas Willis.
23 *Recherches sur les maladies chroniques*, §CVIII; it is true that Bordeu appeals to the nerves here: but their sensibility does not come from the brain: "What is this virtue in the nerves? It is their life, an action that is the necessary consequence of their constitution and position. (. . .) the action of the brain on the nerves is only a kind of irritation which has its effect because the nerves are disposed to receive it" (§CXXX).
24 *Recherches sur les maladies chroniques*, §CIX. In particular, Bordeu eliminates the idea that glandular secretion takes place mechanically by compression of the gland: "glandular excretion does not take place, as had been suggested, by compression of the glandular body, but by the proper action of the organ, an action which certain circumstances increase, such as irritations, jerks, and the dispositions of the vessels of the same organ" (*Recherches sur les glandes*, p.144).
25 On Cabanis and others physicians involved in the French Revolution, see Weiner (1993).
26 *Rapports du physique et du moral de l'homme*, II, §VII, 196. This is already the position of Fouquet, author of the long entry "Sensibilité" in the *Encyclopédie*: "mobility is nothing but the mute expression of this (same) feeling (. . .) the intimate and fundamental sensation of its existence (. . .) in each individual is the source of all the movements that contribute to the being's duration and to its preservation."
27 *Essai sur l'irritabilité*, Montpellier, 1776, p.30. Of course, "animal spirits" don't disappear overnight, but vitalism establishes the principled possibility of their suppression, so that in the following century we will not be surprised to find no further

mention of them. Vartanian clearly shows how this concept was used by La Mettrie to transform Cartesian dualism, of which it is an element, into a materialist mechanism (1953, p.233), but precisely, by moving from the mechanistic framework to the framework of vitalist naturalism, it no longer had a role to play.

28 *Recherches sur les maladies chroniques*, p.15.

29 In Lacaze's *Idée de l'homme physique et moral* (1755) we find the first precise formulation of the theory of action and reaction centers. Roselyne Rey sees in the work of Lacaze and Ménuret "the advent of notions such as reciprocal action, perpetual antagonism, resistance and response to resistance, the interplay of action and reaction, all of which affirm the essential solidarity of parts to form a single, organized, complex whole, a kind of entity superior to the elements of which it is composed, achieving a synthesis between very diverse levels of functioning and activity: that, elementary, of organic molecules, that of organs with a life of their own, that of entire systems: nervous, lymphatic, blood; that of apparatuses" (Rey 1987, p.345). On Lacaze, see also Wolfe and Terada (2008).

30 *Recherches sur les maladies chroniques*, §10.

31 *Recherches sur les maladies chroniques*, §8.

32 *Recherches sur les glandes*, §XVI.

33 As exemplified by this passage from *Degré de certitude de la médecine,* by Cabanis (VI): "Why do we need to know the nature of remedies in order to observe the changes they produce in bodies?," we need only "observe the facts" and "give them in the mind the same order they have in nature" (§6, p.94).) Observation must make up for the hypotheses of the various systems of medicine, all of which have always ignored the real mechanism of healing (because knowing it is impossible) but have prided themselves on knowing it from their certainty of a physico-chemical order, thus denying the specificity of vital phenomena. Hence, too, the skepticism of therapeutic knowledge: "curation must be regarded as left, in some respect, to the mercy of fortune" (§6). From this point on, the shift from medicine taught as a systematic theory to hospital medicine takes shape, a shift analyzed by Foucault (1963) and illustrated as follows by Cabanis: "medical subject matter can only be well taught at the bedside of the diseased" (p.124). Boissier de Sauvages, who nevertheless practiced nosological rather than clinical medicine, had already begun to move toward observation: "accept in medicine no principle other than that received through the testimony of the senses" (*Nosologie méthodique*, p.69).

34 On Lordat, see Wolfe (2022), Raynaud (1998), Williams (1994, p.200).

35 Montpellier, year VI.

36 Montpellier, pp.20–21.

37 On this point, see Rey (1993 pp.135ff).

38 Rudolph described the contrast between the observational and experimental aims of the vitalists and Haller in the following terms: "The Montpellierans investigate the functions of organic systems, and study the integration of these functions into the animal economy, while Haller deals with the other end of animate organization, at the level of the particles, cellular elements and membranes he interrogates" (Rudolph 1991, p.83).

39 Salomon-Bayet (1978) shows how "observation" and "experimentation" took on distinct meanings throughout the 17th century and the first half of the 18th century, through the work of the Académies des Sciences, generally constituted by collections of observations, from which emerges the difficulty of gathering and organizing them in response to theoretical questions.

40 It is similarly stated by Vicq d'Azyr, who comments on the dissection of dead animals as follows: "the muscle no longer stiffens under the instrument that wounds it; the

nerve is torn without exciting either disorder or pain; all connection, all sympathy are destroyed, and the bodies of animals in this state constitute a great enigma to the one who dissects them" (*Discours sur l'anatomie comparée*, p.12); then he criticizes the experiment on the living animal as follows: "Amidst streams of blood and convulsions, amidst high-pitched cries and anguish, how can we fail to understand the seat of feeling? Who could flatter himself, in such a general upheaval, to find the traces of natural movements?" (*Discours sur l'anatomie comparée*, p.14).

41 Notice that such an argument would not be convincing in the context of modern philosophical debates about emergence (e.g., Bedau and Humphreys 2008). This criticism would for instance be dismissed by Nagel, who argued that, while the isolation of a part or process prevents us from understanding its meaning in the organism, there is nothing to prevent us in principle from thinking that different physico-chemical theories explaining the behavior of part A in its relation to each of the others could be developed and combined, so that a collection of theories explaining in vitro phenomena related to part A could provide an understanding of A in its organic environment (Nagel 1961, chapter 12, p.440).

42 In his *Discours sur l'anatomie comparée* (1862), Vicq d'Azyr extended Ménuret's critique of experimentation, relying on the need to respect the totality: while he rejected experimentation with arguments similar to those of the vitalist physician, he went on to criticize the observation of parts in operation, and another kind of observation, namely, the comparison between diseased organs and healthy organs. His criticism is as follows: as for "the exact and assiduous observation of the phenomena presented by the various functions considered in the ordinary state of life," it is "difficult to isolate those which belong to each viscera, since the connections between the parts which compose animate bodies are so multiple. Moreover, when we observe the effects of a particular vital action, we do not see its focus: conversely, when anatomy shows it to us, its activity no longer exists, and we can almost never grasp the link that unites them except by the aid of imagination" (p.15). But the same argument also applies to the comparison with the pathological, which is exposed to the obstacle represented by the interplay of sympathies in the animal economy: "If the nerves arranged in the organs of our senses to communicate impressions from outside so often lead us astray, how much must we not be deceived by those within, whose interlacing and networks seem to be designed to deprive us of knowledge of what is going on there? There is no region of the human body which does not respond to several organs, among which it is often difficult to recognize which is affected or which was the source of the trouble; and the alterations which we observe after death are, in a great number of cases, only secondary effects of the primitive vice, or the product of a cause which, in striking a final blow, has left almost no trace of its existence in the places it has left" (p.16). Vicq d'Azyr's method, insofar as he demonstrates the deficiencies of all the pathways to the organism, turns out to be synthetic, with each pathway compensating for the deficiencies of the others. Against Ménuret and the other vitalists, he thus rehabilitated physics and chemistry, which the "mechaniciens" (22) had only been wrong to abuse. This method also stands out for its use of comparative anatomy, because "arranging under the same line" (33) the same organ in different animal species provides a gain in intelligibility over all other. On comparative anatomy, see Chapters 10–11.

43 Goldstein (1934 (1983), p.57).

44 For a conceptual and contextual study of Montpellier vitalism, the origin of the movement, see Williams (2003).

45 *Essay on vital and involuntary motions in animals*, Edinburgh, 1751.

46 Most clearly in his *Nouveaux éléments de la science de l'homme* (1778).

47 Haigh (1967, §1). Sauvages's teaching was essential to the rise of vitalism in France, insofar as he was at the same time the instigator of the most important medical nosology before Pinel: his *Nouvelles classes de maladies* (1738), followed by *Nosologie méthodique* (1772). Initially a disciple of Boerhaave, his "conversion" to animism dates from around 1736, according to Roger French (1972); it goes hand in hand with the desire to find a classification of diseases that does not depart from the simple schema of the body, in the mechanistic tradition, since this method is insufficient for functional diseases. Precisely because medicine must be based on observation, diseases cannot be "defined by invisible internal elements such as principles, or by seats or dispositions within the body," he says (*Nosologie méthodique*, §44). "He redefined pathology to correspond to his animist physiology" (French 1972, p.107). Note that Philippe Pinel was also a student of Boissier de Sauvages.
48 See Martin (1990, p.129) on the *Nouvelles classes de maladies.*
49 *Nosologie méthodique*, §302. On this unconscious soul according to Boissier de Sauvages, his polemic with Whytt and its role in the explanations, see French (1972).
50 *Discours sur le génie d'Hippocrate*, Montpellier, year IX.
51 *Nouveaux éléments*, p.61.
52 *Recherches sur les maladies chroniques*, §3, my emphasis.
53 *Recherches sur les glandes*, §CXXV.
54 *Encyclopédie*, entry "Observation," by Ménuret de Chambaud. On the metaphor of the swarm, see also Kleiman and Wolfe (2021).
55 In the same *Dictionnaire*'s entry "Organ," a definition of "organized character" adds four further degrees of organization to the three types of organization, thereby enabling us to distinguish seven levels of organization, from the molecules of living matter "constituted by immediate principles," through cells, then tissues, then systems of "general use" that have their own "general conformation," then organs, then apparatuses and finally the organism proper. The essential point is that each level of organization is constituted by an assembly of various organized elements from the preceding level, but nevertheless presents properties of its own, and a "use" irreducible to that of the preceding ones.
56 This problem obviously also applies to sentience, since it defines life. Baertschi (1992, p.160) notes that Diderot always hesitates between a sensibility that is a property of matter, which allows organization, and a sensibility that results from organization.
57 *Principes*. . ., §58–2. In his *Lettre à M. de Fauriel sur les causes premières*, Cabanis painted a similar picture of an entire universe traversed by sensibility, which in more or less obvious forms underlies gravity as well as intelligence, that sensibility which is indeed "the true and perhaps the only character without which the vital principle cannot be conceived" (*Oeuvres Complètes*, V, Paris, 1825, p.75).
58 *Nouveaux éléments*, p.16.
59 *Recherches sur les maladies chroniques*, §38 p.111.
60 The theory is summed up in the *Encyclopédie* article "Sympathy," by the Chevalier de Jaucourt.
61 Sympathy has been approached within a mechanistic framework, in particular through Astruc's application of Willis's reflex model in the early 18th century. On this point, Canguilhem (1977, p.99ff): "The notion of reflex is applied to a general phenomenon, that of sympathies, by generalizing its elective application to the case in which muscular contraction plays a role" (p.101).
62 Canguilhem (1977, p.104).
63 *Recherches sur les maladies chroniques*, §40, p.116.
64 *Nouveaux éléments de la science de l'homme*, ch.10, t.I p.33. On Barthez's vitalism, see Duchesneau (1985), Cheung (2008).
65 On sympathies, see also Huneman (2007c).

66 On the animal economy model, see Huneman (2007b, 2008a) and Wolfe and Terada (2008). Notice that the phrase "animal economy" has been pervasively used by the vitalists, but variants of it circulated in the early 17th century; in Stahl's *Theoria Medica Ver*a (1708) one finds "economy of the body" (p.393) and "vital economy" (p.382).

67 *Histoire naturelle*, III, ch. 2, "De la reproduction en général," p.90. The comparison with the painting refers to Buffon's distinction between surface perception and depth perception, i.e., two types of sense (although humans do not possess the latter)—see Chapter 4.

68 On this point, see Chapter 11, the role of the hierarchy of functions in Cuvier's comparative anatomy. And the use of the notions of center and action/reaction is also present in Cabanis's *Lettre à Fauriel* about the diffusion of life from the center to the circumference.

69 *Encyclopédie*, entry "Economie animale"; Ménuret credits the *Idée de l'homme au physique et au moral* (La Caze 1755) for these conceptions.

70 This shift, in which the relationship between the living being and its environment takes on new importance in our view of life, is also reflected in new conceptions of man, as can be seen in Rousseau's theories of education, as well as in the formulation of moral treatment practices by Pinel and the new psychiatry, since in both cases the aim is to transform man by acting on his environment. Rey (1995, p.283) has identified a "double turning point" in vitalism: "from the body as a machine to an organism in which all parts are sensible and mutually dependent; from a problematic of the struggle between two opposing categories—the living body versus the environment—to a problematic of the management of relationships that includes both exchange and conflict."

The new use of the notion of sensibility inaugurated both a new image of man, in exchange with his environment, and the possibility of an ethic and a practice of relationships with the environment. A human is sensible to his environment, and to act on it, to transform it, we need to reconsider our relations with the environment. Thus, insofar as a human's moral ideas derive from his impressions ("All our ideas, our feelings, all our affections, in a word everything that composes our present moral system (is) the product of the impressions we have received during life, and these impressions are the action of the play of the organs, itself produced by immediate or mediate action" (Cabanis, *Lettre à Fauriel*, p.25)), Cabanis seeks both to show that morality is founded in man's nature, in "his faculties and his needs" ("The rules of morality are derived from the mutual relationships established between men by their needs and faculties. These relationships are universal because human organization is fixed, or at least the modifications of which it is susceptible can have no influence on them" (Cabanis, *Lettre à Fauriel*, p.8)), and that certain dispositions of the body, produced by certain external actions, are likely to dispose it: the relationships between men, which are "for the moralist what the phenomena of physical life are for the physician" and therefore offer "various corresponding states of health and disease," can "in turn, provide us, through experience and reasoning, with the means of hygiene or curation that must be employed in the guiding of a moral human" (Cabanis, *Rapports. . .*, p.6, my emphasis).

It is not certain that medicine really succeeded in becoming an anthropological theory, but the fact remains that, as Porter (1995) has established it, it provided the Enlightenment with the images and vocabulary for its human sciences (pp.68ff).

71 For a theoretical and practical characterization of humoralism, see Nutton (1993, pp.281ff). The emergence of mechanicism in physiology is no doubt not unrelated to the fact that Descartes was not a physician, but a metaphysician and geometer, so humoralism was not taken for granted by him; for a long time, this age-old theoretical

framework prevented the question of dualism or monism in physiology from being raised.

72 On Boerhaave and Hippocrates, see Cunningham (1990), and Pigeaud (2001, pp.29–30). From the Montpellier vitalists, see for example Barthez, *Discours sur le génie d'Hippocrate*, Montpellier, an IX; De Sèze, *Recherches physiologiques et philosophiques sur la sensibilité ou la vie animale*, Préface, Paris, 1786. Pinel (*Méthode d'étudier la médecine*, 1802) emphasised Hippocratic treatises on epidemics, such as *On Air, Water and Places* (and see *Nosographie philosophique*, 6th edition; pp.xii ff, and p.xcii, where Pinel suggests an order of study proper to the Hippocratic corpus). Ménuret's entry "oeconomie animale" in the *Encyclopédie* often refers to the Greek physician: "It is a great maxim by Hippocrates, that everything concur, agree, conspire together in the body; remarkable maxim, very true and very useful for explaining animal oeconomy." The exergue of Whytt's treatise, *On vaporous diseases*, is the same famous quote from Hippocrates: *sumpneia panta*.

73 Blood, white, and yellow bile and phlegm were associated with the four physical elements and the four qualities; in medicine, they could even be linked to the four seasons. See Nutton (1993).

74 Hannaway (1993, pp.292ff) shows the transformation of the concept of environment (and its supposed pathogenic effects) in medicine, from the miasmas of humoralism to our notion of environment. Doctrines on the composition of the air, contemporary with vitalist investigations, were no strangers to this change in the meaning of the environment; by the middle of the century, the Royal Society of Medicine had initiated an investigation into the composition of the atmosphere.

75 On Pitcairn see Zammito (2018, pp.41–42).

76 Introduced by Hunan Ibn Ishaq's treatise *Medical questions and their answers* (809–73), the doctrine of the non-naturals owes its form to Johanitius's 11th-century Latin translation. (The "naturals," in turn, were those things related to the humors within the body, and more specifically: temperament, elements, humors, body parts, functions, and animal spirits.) Reappropriating the doctrine, Ménuret writes in the "Oeconomie animale" article in the *Encyclopédie*: "Six principal causes essential to the duration of life, known in the schools under the name of the six unnatural things, namely, air, drinking & eating, movement & rest, sleep & wakefulness, excretions, & finally the passions of the soul maintain by their just proportion this reciprocal agreement, this perfect uniformity in the functions which makes for health; they also become when they lose this equilibrium, the general causes of disease." Note that Ménuret treats physical and physiological causes, as well as mental ones, in the same exact way.

77 In other words, a hierarchy of levels: in Hunter's case, what happens at the elementary level of fibers conditions the process of absorption, which takes place at the higher level of the digestive system. On Hunter in his context, see Goodfield-Toulmin (1969) and Jacyna (1992).

78 As to the "hospitalization of medicine," see Ermakoff (2012).

79 These transformations have been intensely studied by Foucault (1963), Ackerknecht (1967), Gelfand (1980), Weisz (2006) among others. I leave them aside here. I extensively studied Bichat's physiology and anatomy in Huneman (2023a), section I. Here I only consider what serves my purposes, and the reader may check it for in-depth analyses; I therein offered a detailed reading and in context examination of his *Recherches physiologiques sur la vie et la mort* (1801).

80 *Recherches physiologiques sur la vie et la mort*, II, art.7, §7.

81 *Anatomie générale*, Préface, p.36.

82 *Recherches physiologiques*. . . I, art.7, §3. The classification of vital properties is not new. Barthez in his *Nouveaux éléments de la science de l'homme* (2nd ed. 1806), Chaussier in his *Table synoptique des propriétés charactéristiques et des principaux phénomènes de la force vitale* (1800–01), Dumas in his *Principes de physiologie* (1801) and Richerand in his *Nouveaux éléments de physiologie* (1801) acknowledged two major vital properties. The first is "sensibilité" (Richerand, Chaussier) or "force sensible" (Barthez, Dumas), the second is "contractilité" (Richerand), "force contractile" (Dumas), "motilité" (Chaussier), "force motrice" (Barthez). Each of these authors duplicated each of their properties, depending on whether they were perceptible (sensible) or imperceptible. Bichat thus substituted his physiological criterion for the distinction between perceptible and imperceptible, which was the basis for several classifications in use.

83 "Cellular tissue" (the word does not have the elementary meaning it will have in cellular theory proper), arteries, veins, exhalation vessels, lymphatic vessels, bone, nerve tissue from animal life, nerve tissue from organic life, fibrous tissue, fibro-cartilaginous tissue, muscles from animal life, muscles from organic life, mucous membranes, serous membranes, synovial tissue, glands, dermis, epidermis, hairs.

84 *Anatomie descriptive*, "Discours préliminaire," pp.41–42.

85 In his conception of the progressive emergence of living instincts, Cabanis assigns an instinct specific to muscular parts, and sees its genesis in the combination of fiber properties: "the tendency to contraction and extension, which forms the fundamental property of these fibers, is therefore perfectly analogous to all other animal affinities; it follows directly and necessarily from the character of the organization. (. . .) These nuances are modified according to the nature of the functions, and the current state of the organs to which the fibers and their bundles belong: and this tendency, fortified by the easier reproduction of movements brought about by habit, constitutes the instinctive determinations specific to the muscular system in general, and to each muscle, or even to each motor fiber, in particular. Here, then, is another new instinct: that of movement; here is a new series of appetites, whose motives nature shows us with equal evidence, and whose artifice it lets us glimpse and foresee the results. As this instinct develops, it contracts close links, on the one hand, with that of conservation, because in several respects it itself depends on the interplay of nervous influence and blood circulation; on the other, with that of nutrition, because the repair of motor forces is much more the work of the sympathy of muscles with the organs of alimentary digestion than of the renewal and application of nutritive juices" (*Rapports*. . ., 10ème Mémoire, II, p.291). But this project for a genealogical understanding of the properties of systems proves less operative because, unlike Bichat's physiology, it is not based on experimental practice, which would at the same time provide the means to test it. This is why Bichat is much more relevant than Cabanis to the genealogy of scientific physiology.

86 *Anatomie générale*, §2.

87 *Anatomie descriptive*, Discours préliminaire, p.43.

88 In Huneman (2023a, part I), I explained how the devices allowing for an experimental inquiry into death in his "Recherches physiologiques sur la mort" (in Bichat 1801) opened the space for experimental physiology and offered clues for solving the integration and nestedness issues that resisted Haller or vitalism. In Chapter 9. I will summarize these considerations.

89 For the connection between vitalism, animal economy and anthropology as a "natural history of man," see my essays Huneman (2006c, 2008b).

3 Kant's critique of Leibniz and the issue of order in *The Only Possible Argument. . .*

3.1 Introduction: the puzzling status of life in the project of a critical philosophy

The *Critique of Pure Reason* addressed the possibility of a science of nature in general. To this extent, the specificity of life was not mentioned there. In a sense, while to be grasped in its a priori principles (in the *Metaphysical Foundations of Natural Science*), physical science requires considering the concept of "motion" in addition to the synthetic principles of experience set out in the Analytics, one might think that it would suffice to complete these with the a posteriori concept of "life" to obtain a framework that deals with the sciences of life. But this is not the case; hence, one could begin this investigation of Kant's organism by expressing astonishment at the fact that, instead of a hypothetical metaphysical "First principles of a science of life," we find a *Critique of the Power of Judgmen*t. Such asymmetry signals in advance that the very concept of "life" cannot have the status of "motion": on the contrary, it demands a critical investigation of its meaning. In Kantian terms, this investigation will lead to a "topical" difference between the concept of life and the concepts of the physical sciences, because "life"—as far as life is about organisms—has its transcendental locus not in the *understanding*, but in the *power of judgement* (*Urteilskraft*).

Given the central problem of the *Critique of Pure Reason*, life therein hardly appears as a question, except on two occasions. The first, in the Remarks to the "Second Antinomy"; the second, in the "Appendix to the Transcendental Dialectic," whose problematic will have to be closely examined later if we are to understand what is at stake in the *Critique of the Power of Judgment*. In the first instance, we see a negative delimitation of a particular view of the living. A closer reading of this text will show—in §2 below—how Kant dismissed the Leibnizian conception of the animal or plant as infinite organization, which was the first moment of the concept of organism (Chapter 1, §3), and thus leaves open the question of the specificity of the living. This examination will enable me to return to the first concepts from the perspective of which Kant has been led to address the issues he knew to be debated in the life sciences—issues to be

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found in a previous text, namely *The Only Possible Argument for the Existence of God* (1763) (in §3). (The examination of the longer analysis proposed in the Appendix is left for Chapter 5.)

3.2 Rejection of the Leibnizian concept of organic body

Kant was never indifferent to the transformation of concepts for thinking about the living. In his *Critique of Pure Reason*, he already considered that the Leibnizian conception of the organism as an infinite machine to be important enough, and to imply strong sufficiently links with metaphysics in general, to require criticism in the context of the Second Antinomy of pure reason. Thus, the fundamental rupture with the Cartesian mechanism that constituted the first moment in the formation of the concept of organism was already reflected in the first *Critique*. I will first reconstitute Kant's refutation[1] in order to point out the importance in transcendental philosophy of an evaluation of recent conceptions of organism, and then move on to the actual positive elaboration of concepts that would lead to a consideration of the main moments in the concept of organism in the third *Critique.*

For Kant, reason is a "faculty of principles," namely, a faculty capable of unifying the rules given by the understanding, which itself shapes these rules for synthesizing the manifold constituting experience. The "Transcendental Dialectic," section of the *Critique of Pure Reason* devoted to the illusions into which reason necessarily falls—thus generating what we call metaphysics, especially in a Leibnizian sense—indicated that such reason had its own requirement: "with a given conditioned rule, all those that are its condition are given" (A332). Let me explain this point.

"Understanding," in Kant's terms, is a faculty that seeks rules for the phenomena.[2] Reason, in turn, is a faculty that governs understanding by stating principles for the its rules. Reason may be either theoretical or practical. Theoretical reason therefore deals with the principles of the rules of the understanding, and insofar as a principle is a ground, it grounds these rules. As an example, the rules of the orbits of the planets, as elliptical trajectories following the law of areas discovered by Kepler, find their ground in the Newtonian law of attraction. Here, Newton's epistemological operation perfectly instantiates reason as a faculty of principles. It consisted in finding for Kepler's rules of the planets their set of conditions, namely all the laws of physics, including the law of universal attraction.

The set of conditions—"all conditions for a given conditioned"—sought by reason is, by definition, unconditioned in the context of the scientific problem addressed. Reason, therefore, essentialy demands some unconditioned X, always *relatively* unconditioned, since once the problem is solved, this supposed unconditioned X may have conditions out of it. Such a requirement for the Unconditioned is therefore given to our reason, as a guideline for pursuing knowledge,

namely, moving from a relative unconditioned to its conditions, and so on. Kant calls it a "regulative" principle.

"Dialectics," according to Kant, explores the results of the systematic misuse of this regulative demand. In effect, by taking such a requirement to be a principle that constitutes knowledge itself instead of guiding its construction, i.e., that calls for uncovering an absolute unconditioned, reason formulates claims about this unconditioned. But such claims are impossible to make sense of. The reason for such impossibility lies in the fact that the Unconditioned means the totality of the conditions, which is by definition out of any possible experience, while, according to the central claim of transcendental philosophy, concepts only have their validity when applied to objects of a possible experience. Think of the totality of present and future facts, or the totality of events happening in the universe, and, given that all experience should take place in time and space as Kant argued, one sees why this totality cannot belong to any experience. Thus, claiming that the Unconditioned is knowable is, in principle, a fallacy.

To restate the bases of Kantianism, the Unconditioned exists along three dimensions, which correspond to the three kinds of syntheses of conditions one can elaborate, according to the three categories of "relation," since the conditioned and its condition obviously stand in a relation. These categories are substantiality (namely, the relation between a substance and its properties), causation (namely, the relation between cause and effect), and reciprocity (namely, the relation between an action and its reaction). These three categories correspond to the three kinds of relation in judgment: categorical ("S is P"), hypothetical ("if p then q"), and disjunctive ("S is P" or "S is Q"). What is thought as unconditioned, depending on the type of judgment in which the regression toward a supposedly unconditioned is carried out are: the *soul* (a subject in all respects, without any condition), the *world* (embracing all hypothetical judgments, each being the antecedent of the former) and *God* (totality of possible disjunctions). These are, as we know, what Kant called the "Ideas" of reason. Thus, he distinguished between the pure *concept* thought of by the understanding, namely the *category*, endowed with an objective validity relying on a reference to possible experience,[3] and the *Idea*, which arises by bringing to its limits an act of synthesis performed by reason, this act being required by the intrinsic demand of reason and not by the possibility of an object of experience.

The "Antinomies of Pure Reason," which constitute the object of the second section of the Transcendental Dialectic, are the traps into which reason falls when it seeks the unconditioned in the register of the hypothetical synthesis (of type "if p then q") of the members of a series. Therefore, they concern the world and its dedicated discipline, "cosmology." At this point, reason can equally assert that the unconditioned is an absolute *outside* the series, or is the infinite series *itself*. An insoluble opposition thus emerges between a dogmatic position, positing absolutes outside the world—simple substances, limits of the world, free causes, a necessary God—and a skeptical position combined with an empiricist

methodology. The "Second Antinomy," which concerns the decomposition of bodies into the parts that are their conditions, then gives rise to a radical critique of the Leibnizian conception of life. Let us see why.

An *antinomy* is the simultaneous apparent validity of two contradictory claims, a "thesis" and an "antithesis," about the same cosmological question. The first Antinomy concerns the limited or unlimited character of the world in space or time. The second Antinomy concerns the status of the "simple," namely, the basic building blocks of the universe, toward which seems to lead a regression from the whole to its constitutive parts. Each claim has been defended by a school of metaphysics: generally, the existence of the simple is defended by the "dogmatics," such as the Leibnizians, who hold that basic elements exist in the form of the Monads but also by some materialists inheriting the atomistic legacy of Democritus. By contrast, the antithesis is defended by the empiricists or the "skeptics," who maintain either that there is no basic brick because each putative part is still divisible, or that no ultimate point of this division can ever be reached.

For reasons of space, I will not consider here the notion of Monads that Kant elaborated in his precritical writings, which stands in the background of this discussion. In his *Physical Monadology*, an early work, Kant indeed designed a view of monads that responded to the readings of Leibniz developed by Christian Wolff, Baumgarten, and Kutzner. Watkins (2004) summarized Kant's point here as follows:

> it is to establish that one must accept causal relations between substances, that is, physical influx, in order to explain in any detail the relationship between monads (which, according to agreed-on metaphysical principles, possess unity essentially) and the spatiality of bodies (which necessarily entail infinite divisibility, according to the laws of geometry) in terms of activities.
>
> (p.111)

"Physical influx" indeed departs from Leibniz's theory of preestablished harmony, which provided the metaphysical context to the monadology. Monadology answered the question of the *Nexus Mundi,* of the cohesion of the world. Gravitation played such a role in Newtonian natural philosophy. The category of reciprocity, in the *Critique of Pure Reason*, becomes in turn such a *nexus*, within a novel perspective defined by the transcendental notion of nature as the set of phenomena under laws (and, as such, framed by the categories of the understanding) and likely to conciliate both Leibniz's metaphysic and Newtonian science.[4] Once this account is elaborated in the *Critique*, and even before that, Kant would no longer appeal to the notion of Monad, but the Second Antinomy inherits the problem raised in the *Physical Monadology*, namely, the conflict between the geometrical divisibility of space and the metaphysical simplicity and unity of monads.

For us, this second cosmological antinomy raises several issues that recently worried analytic metaphysics regarding non-reductive physicalism (Kim 1999;

Block 1978). While the reductionists *à la* Kim think that the ultimate constituents of the universe are unraveled by physics, the skeptics, like Block, argue that such reductionism is threatened by the "draining problem." This problem arises consists in the fact that fundamental physics, in its continual search for ever more fundamental particles, suggests that no "ultimate level" is truly ultimate, and that the fundamental elements are progressively drained away—much like an infinite regression to the Unconditioned according to the Antithesis.

Against the Thesis, Kant argues that a body cannot be composed of simple parts that are ultimately reached by division, because this would imply that simple parts pre-exist the empirical regression that discovers them. This would amount to granting "an existence of its own, which precedes experience, to a simple phenomenon that can only exist in experience" (*Prolegomena to All Future Metaphysics,* §52). This does not mean, however, that we should endorse the Antithesis, and claim that bodies are composed of an infinite number of parts. As Grier (2001) notices, the sense of composition is not the same in the Thesis and in the Antithesis; the latter assumes that objective matter comes before any form, whereas the former conceives of matter as supposing the a priori forms of space and time, though it mistakenly treats them ontologically absolute. However, we need to better understand the status of division and composition.

The principle of pure reason properly understood (namely, as a regulative principle) demands that we continually strive to synthesize further conditions, which, in the case of the composition of spatial things, means regressing from wholes to their parts. Throughout the Antinomies, Kant distinguishes between regression *in indefinitum* and regression *in infinitum*. The former applies to the first Antinomy, about limits of the world, where the condition always lies outside the conditioned, since each part of space is surrounded by a larger one, and each temporal period is preceded by an earlier one. Thus, the conditioned is not given *with* the condition; hence the operation must be repeated indefinitely. In the second Antinomy, which concerns the building blocks of the world, hence regression toward internal parts, the situation is different. If I perceive a body, its constituent parts are contained within it and are therefore given with it: all conditions are given within the same limits (*Grenzen*) as the conditioned (A524). The whole is therefore "infinitely divisible," but by no means "composed of an infinite number of parts" (A524), because while the parts are contained within the same limits as the whole, the division itself, which determines the parts, is not contained in the intuition of the whole, but occurs only within the regression from each part to its sub-part. Only this regression "above all makes the series effective" (A524). Therefore, although the parts are contained in an aggregate that forms the whole, the series of parts into which the aggregate is ordered is itself never given, but only achieved in the regression. The series is therefore only "successively infinite and never a whole" (A524), so that it cannot present an "infinite whole and its connection within a whole," since this connection does not pre-exist the regression. The possible series of parts are therefore multiple, depending on the

regressions undertaken. The body is *infinitely divisible*, and divisible according to many divisions, but not *composed of* an infinite number of parts.

Now, what happens when we analyze a living being as an infinitely organized machine in the Leibnizian manner? In other words, what happens if we attempt to extend this rule of division to a "multitude (*Menge*) of parts already separated in a given whole, insofar as this constitutes a discrete quantum" (A524)? In the default case of a merely physical spatial thing, the infinite divisibility of space allowed us to draw the conclusion Kant reached; accordingly, his reasoning only addressed a phenomenon as a *continuous* quantity, this continuity being "inseparable from the fact of filling space." But the rule of division cannot then be extended to a whole that is already divided, i.e., to an "articulated (organized) whole" (*Menge*). This marks the core of Kant's critique of Leibniz; let us substantiate it.

The solution of the Second Antinomy rested on the fact that regression determines the parts, i.e., prior to regression there is no partition of the phenomenon, "the whole is not in itself already divided (*eingeteilt*)." We are only given a "multitude of parts absolutely indeterminate in itself," such that although infinitely divisible, this *Menge* is not *composed* of infinitely many parts. But what is distinctive about the articulated whole, such as a plant, is that "the whole is already represented in this concept as divided" (A527).

An articulated whole is therefore genuinely organized, because articulation implies that the division is not arbitrary, but follows a plan, and is therefore determined by a *concept*. In this sense, each part has a priori a determined place, and this is why the articulated whole will be organized. In this text, "organized" means any arrangement of parts according to a concept. Accordingly, both a watch (with its cogs) and a beaver (with its organs) qualify as organized wholes. The Leibnizian doctrine of the living organism claims that the latter kind of organized wholes possesses an infinite number of parts, each of which is itself infinitely organized, made up of parts articulated to one another according to a certain form (see Chapter 1, §3). Leibniz holds that in a certain kind of phenomenon—namely, living beings—"by the infinite decomposition of parts, new organs (*Kunstteile*) are always discovered" (A526).

But this statement is contradictory: on the one hand, we consider division as already completed, since it is represented in a concept (this fact defines articulation (*Gliederung*)); on the other hand, we consider it as an unfinishable series, since we apply to it the rule of regression, which aims to generate an infinite division through regression itself, without the form of this division pre-existing the division. The Leibnizian concept thus simultaneously asserts that the whole is *already* divided, as an "organized being," and that it is divided infinitely, as an infinitely organized being, because the infinity of division is produced by regression according to reason's regulative principle of syntheses.

Ultimately, this error in the concept of an infinitely organized being rests on a confusion in the notion of space. What allows us to apply the principle of regression is that the phenomenon under focus is continuous; hence, as it fills

space, it is infinitely divisible in the same way as space is. However, "as soon as we admit something as a *quantum discretum*, then the multitude of units is thus determined; and by this, is always equal to a number" (A527). This number may be immense, but it will necessarily be *determined*, because otherwise it would be a continuum and not a discrete articulation. Thus, what is represented—whether we like it or not—in the concept of an articulated (organized) whole, is always a determinate number of parts. Of course, an organization can go very far: each visible part can be decomposed into a very large number of distinct parts, and "only experience can decide (. . .) how far the organization of an organized body extends" (A527). But, we can know a priori that in such a body there will necessarily be parts, however tenuous, that are not organized.

Such texts cannot be approached without the horizon of a debate with Leibniz, of which, in the *Critique of Pure Reason,* the "Amphibology of the Concepts of Reflection" constitutes the climax. Kant's leitmotif here is well known and can be formulated as follows: Leibniz's error consisted in treating phenomena as objects of the pure understanding, forgetting that, as phenomena, they must be the object of possible experience, and therefore fall under the conditions of space and time. This error ultimately gave rise to his contradictory use of the notion of organization denounced by Kant. Why is this so? Because Leibniz overlooked the fact that organized beings are phenomena, and that the very notion of organization is therefore dependent on the structure of space. As a result, the opposition of the discrete and the continuous effectively prevents an articulated, and therefore discrete, whole from being treated as a continuous quantity. Yet, to speak of infinite divisibility implies introducing continuity, so the idea of infinite organization mixes the continuous and the discrete. Admittedly, for Leibniz, substances precede space, which is merely the "order of their coexistence,"[5] therefore his assertions concern substances as such. But Kant shows that this category of substance only makes sense when it refers to an object in space and time, i.e., a phenomenon (*Erscheinung),* since otherwise we could not even speak of its divisibility.

The result of these reflections is as follows: we cannot know a phenomenon by conceiving it as "infinitely organized." This means that, *pace* Leibniz, there cannot be on the one hand (artificial) machines—organized "finitely"—and, on the other hand, living beings—infinitely organized. The concept of "organized being," *Organisierte Wesen,* in this Antinomy of the *Critique of Pure Reason,* therefore proves inadequate for accounting for life, because it offers no criterion for distinguishing between living things and machines, as Leibniz expected. All organized beings are articulated, that is, ultimately organized in a finite, determinate way; as such, living beings and machines are homogeneous. Hence, the former instantiate something else than organization. The §65 of the *Critique of the Power of Judgment* is entitled "Natural Purposes Are Organized Beings," but this claim will precisely come at the cost of a modification of the concept of organized being, signaled by this sentence: "(a product of nature) in so far as it is organized and *self-organizes,* can be called a natural purpose" (my emphasis),

a claim I will take up below in Part 3. Remembering that the second step toward the concept of organism was, after Leibniz's and Stahl's critiques of mechanism, the rejection of the technical rationality that inspired these two authors in their approach to the organism (Chapter 2), we now see that the *Critique of Pure Reason* (some time later) echoes such a moment in biological thought by dismissing the Leibnizian assimilation of organisms to infinite machines.

It will appear that in the *Critique of the Power of Judgment*, the idea of organization breaks with that of "articulation." This presupposes that a criterion could be given to distinguish the organization of a machine from a vital organization, whereas the infinity of organization has been dismissed as a criterion. But the value of the critique of this Leibnizian idea precisely consisted in decoupling *organization as articulation of parts* and organization *as organism*. To understand how we then moved from the critique of Leibniz to the *Critique of the Power of Judgment,* I now have to take into account the entire process through which the revision of "organized being" imposed itself on Kantian thought.

The fundamental concepts of the Kantian approach to the living, which would enable him to rethink philosophically the transformations we are exploring, were elaborated from the outset in relation to a major metaphysical-theological use of the notion of purposiveness, namely, the cosmological proof of the existence of God. To substantiate this claim I will turn to the first formulations by Kant of this notion, in particular as part of his revision of the Leibnizo-Wolffian metaphysics in the 1763 opus *The Only Possible Argument in Support of a Demonstration of the Existence of God*, hitherto subscribing to the program so described by Watkins (2004): "considering in detailed ways the continuities and breaks, the shifts and the transformations of Kant's position on particular issues from his pre-Critical to his Critical period."

3.3 Cosmological proof, order, and purposiveness

3.3.1 Purposiveness as order

As expected, *The Only Possible Argument* . . . deals with metaphysical proofs of the existence of God, namely, a purely ontological proof starting from the possibility of possibility itself—this is the "only argument" mentioned in the title, and summarized below—and a cosmological one. The latter corresponds to the "physico-theological" proof discussed in the Dialectics of the *Critique of Pure Reason*. In other words, it does not concern the proof from the contingency of the world, as set out, for example, in §7 of Leibniz's *Theodicy*, according to which the contingent existence of what exists presupposes a necessary being. The *Critique of Pure Reason* would show that such a proof makes surreptitious use of the ontological argument, because it cannot conclude without it from this necessary existence to its identity with the concept of God, in other words, of the most perfect reality (A606/B634).

Like the traditional proofs by the Stoics and, later, by Rousseau's Savoyard vicar in his *Emile,* which Kant praised highly, the cosmological proof of *The Only Possible Argument* . . . is based on the consideration of order and purposiveness in nature. The post-Newtonian theologians of the 18th century, such as Derham and Nieuwentyt, or the French Abbé Pluche in his *Spectacle de la nature,* revived this motif, enriching it with the discoveries of naturalists on the subtlety of the structures of certain animals, such as the insects studied by Réaumur.[6] For this reason, we find in this context an elaborate questioning of purposiveness that would form the background of Kant's continued investigation of natural purposiveness, a purposiveness that emerges in relation to the idea of *order*.

But here Kant is examining the very *notion* of order rather than its instances. Contrary to tradition, he begins by taking his examples not from nature, but from mathematical domains. This is noteworthy, because his definitive rethinking of the notion of purposiveness in the *Critique of the Power of Judgment* would likewise begin with a consideration of mathematical objects. There, Kant considers complex geometrical problem, namely, how to proportion the lengths of inclined planes in such a way that for each of them the free descent of a weight takes the same time as for the others. This problem admits an extremely simple solution: just inscribe all these lengths in a circle, as chords drawn from one end of a diameter. An apparent multiplicity of movements is thus resolved in a simple formula—the equation of the circle—one of the most elementary geometrical figures ever, instead of the intuitive idea that we would need a multiplicity of solutions tailored to particular problems. The circle's many properties enable us to solve a set of complex problems. In other words, space itself, considered geometrically and independently of nature, exhibits a wealth of "harmonious relationships" that are revealed by mathematical science. A multiplicity of dedicated methods is replaced by a unique order that encompasses all solutions, and thus, the circle appears to serve the purpose of solving many geometrical problems.

This harmony internal to space itself is almost more surprising than "the ordinances (*Anordnungen*) of nature" (OPA II, I, §1, Ak. 2, p.95), which so astonished natural theologians. If the latter invites us to seek its cause, this harmony must encourage us to do so as well. On the basis of such harmony, in the same way as tradition proceeds when starting from the spectacle of nature, we conclude to "a supreme principle of the very essences of things, since unity in the principle also produces unity in the whole circle of consequences" (OPA II, I, §1, Ak. 2, p.96): the parallelism in inferences here emphasized by Kant runs from the domain of *existences*, which is concerned by physico-theological proofs, to the domain of *essences*.

Kant's main aim in writing these sentences is to challenge our usual conception of order and purposiveness. The harmonious arrangement of nature usually leads to the idea of an all-powerful, intelligent arranger; by equating it with order in *mathematical* properties, Kant breaks this association between the perception of order and recourse to an arranger. Intuitively, order actually refers to

a conscious choice: "when we discover in nature an order (*Anordnung*) which seems to have been combined for a particular purpose, insofar as it would not have arisen simply according to the universal laws of matter, we regard this combination as contingent and as the result of a choice" (II, 1, §2, p.97). Thus, since the fact that the claws of a cat or a lion are disposed to retract cannot be explained by a general law of matter, a "universal cause," namely, a first author (*Urheber*) "must have so disposed them in order to secure them from wear and tear, inasmuch as these animals must have appropriate tools to seize and hold their prey" (II, 1, §2, p.97). To this intuition, Kant opposes another, more subtle one: "when certain more general dispositions (*Beschaffenheiten*), which usually accompany matter, and independently of the utility they may constitute and for which we may represent that they have been ordered, show without the slightest new preparation, also a particular aptitude (*Tauglichkeit*) to enter into other combinations (*Ubereinstimmung*); when a simple law, which everyone would already consider necessary for the realization of a certain good, still bears witness to a fruitfulness extended to many other things; when all this extra utility and concordance flows from the law, not by artifice but rather in a necessary manner" (II, 1, §2, p.97), then purposiveness rests on the very necessity of natural laws. The situation is thereby identical to that of finality in mathematical figures: the same (natural) law, through its application, produces numerous useful dispositions, even though each of these dispositions has not been individually designed.

Kant's next example is geographical. Owing to the dilation of the air in tropical countries—due to the diurnal heat of the soil—the wind blows from the sea to the land during the day, cooling the coasts. In the evening, the land cools, the air changes density and the wind reverses. It is as if a Creator of nature had wanted to temper the country's climate during the day, without the wind cooling the sea excessively at night. Nevertheless, the mere application of natural laws suffices to produce to this result. It is worth noting that here we a system that would later be described as self-regulating, akin to a geographical homeostasis, which would later play a role in the conception of living things. However, for Kant, this pattern remains firmly in the domain of physics.

Thus, in such examples there is a kind of "natural convergence" that "makes it unnecessary to resort to a useless and contrived art" to account for the final dispositions in things (II, 1, §2, p.97). The allusion here appears to be to the question of God's contribution to the order of the world, about which Leibniz, Newton, an Malebranche disagreed. In addition to the latter's occasionalism, which Kant may have in mind by referring to a "useless and contrived art," the text also resonates with the famous controversy between Clarke, Newton's spokesman, and Leibniz. For Newton, God could intervene in the world to correct the deviations that the laws of motion were bound to produce. Leibniz saw this as an imperfection of divine nature: if God had to intervene, then he had not established sufficiently wise laws in the first place. This is why Kant writes,

"it is not enough to say that God made such a law of nature, therefore the thing is natural; the loyalty must be executable by the natures of Creatures." The laws of nature, designed by God, require no divine action to be executed. Here, Kant seems close to Leibniz. He says of his geographical example: "What a special arrangement of thoughtful choice would do, the air does here according to the general laws of motion" (II, 1, §2, p.97).

But his explicit reference is to Maupertuis, who, under the name of "principle of least action," formulated a law akin to the metaphysical principles of "suitability" (*convenance*), which are often extrema or conservation principles assigned to physics by Leibniz. Maupertuis showed, says Kant, that "even the most general laws according to which matter in general acts, in equilibrium as in shock, in non-elastic bodies as in elastic ones, in the refraction of light as in reflection, obey a dominant rule according to which in each case the greatest possible economy (*Sparsamkeit*) is observed in the action" (Ak. II, p.98). Thus, not only are certain final dispositions far from being the application of a project, they are the multiple necessary consequences of a law of motion, but the laws of motion themselves fall under the principle of least action. We find here both a Leibnizian movement to ascend from the physical manifold to a metaphysical unity, and an anti-Leibnizian gesture to dispel appearances of finality in nature, whereas for Leibniz, the consideration of purposes functions as a heuristic principle in physics, as we saw from the *Discours de métaphysique*. Kant takes up Maupertuis's innovation, namely, the transformation of explicit purposive considerations into considerations of least effort, which are undoubtedly teleological as well, but can be formulated without recourse to the language of intention.

Philosophically, it is worth noting that our three authors here deal with a crucial family of explanatory reasons in science, namely, explanations that account for phenomena by appealing to the notion of extremum. Such explanations treat the fact of a state realizing an extremum of some sort as accounting for this state's obtaining. They often rely upon a principle akin to the principle of least action; contemporary, examples include the minimization of free energy in physics, the maximization of inclusive fitness in behavioral ecology, and the maximization of expected utility in microeconomics.[7] No scientist today would invoke the idea that nature has a purpose; however, these explanatory schemes are essential, mostly because they allow for very general theories in their domain of explanation. While the question of the legitimation of such explanatory schemes lies beyond the scope of this discussion, I emphasize here that the extremal-state explanation, exemplified by Maupertuis's principle, is taken up by Kant through the problem of making sense of claims about finality in nature. Extremal-state explanations seem to explain away purposiveness. Although this view is endorsed by several philosophers and physicists now, and can be given a neo-Kantian inflection, matters are more complex in Kant's own philosophical itinerary.

3.3.2 System and technique

Thus, in his 1763 opus, Kant distinguished between two types of purposiveness: one we might call *technical*, because it refers to an intentional arrangement of materials designed for a certain end; the other would be purposiveness as a *system*, in the sense that all final performances are based on a "relation . . . to order and fitness" (Ak. II, p.98) that flows naturally and unintentionally from the necessary laws of motion.

The second type of purposiveness is clearly more relevant to the study of nature. Let us suppose that I am looking for the finality of a particular disposition in nature, such as the atmosphere. I might say that it is made for human breathing, but at the same time, it allows for pumping, mammal nursing, etc. How am I to decide which of these particular purposes governed the creation of the atmosphere in the plans of the author of nature? Ascriptions of particular purposes cannot avoid appearing arbitrarily chosen. If, on the other hand, I grasp atmosphere as a necessary effect of natural laws, all its utilities are moments of the necessary order that flows from the uninterrupted application of laws. The "technique of nature" is, therefore, not scientifically acceptable as a principle because it is most of the time reducible to systematic purposiveness; hence, in contemporary words, it cannot be taken as a methodological assumption.

Nevertheless, while some apparently technical purposes are actually consequences of an order derived from natural laws, as in my imaginary case of the atmosphere, we cannot, in principle, reduce purposiveness as technique to purposiveness as a system. The former purposes indeed occur as soon as we are in the presence of a "contingent order of nature" (II, 3, §2, Ak. II, p.106). What does this mean?

Natural laws can concur with one another by necessity. "There are several natural laws whose unity is necessary, that is, the same principle of conformity to one law makes other laws equally necessary. For example, the same elasticity, the same weight of air, which are principles of the laws of respiration, are of necessity at the same time principles of the possibility of pumps, clouds, fire, winds, etc. (. . .) As soon as the principle exists in one of these things, it is necessarily found in all of them" (II, 3, §2, Ak. II, p.106). This is a necessary order, in the sense that the different members of this order—in this case, pumps, clouds, etc.—cannot fail to be harmonious with one another, since the same principle accounts for the possibilities and properties of all of them. This kind of order instantiates systematic purposiveness.

On the contrary, we should speak of "contingent order" when "the principle of a certain species of similar operations, according to such a law, is not at the same time the principle of another species of operation in the same being according to another law" (107). The examples given by Kant concern the realm of the living: in humans, it is not the same "properties" that constitute the principles of sight and taste. Their combination is therefore contingent and then "artistic"

(*künstlich*), as it produces some perfection, since it multiplies the avenues of sensing the world. It is therefore a purpose in itself, in the sense of a technique. The contingent order involves the necessity of figuring out a technique of arrangement. "For example, in the construction (*Bau*) of an animal, the organs of sensibility are so artistically (*künstlich*) joined to those of voluntary movement and to the vital parts that, unless one is of bad faith (*boshaft*) (for a man cannot be so irrational), one is soon led to recognize a wise originary being (*Urheber*) who has brought into such exceptional order the matter of which the animal body is composed" (II, 6, §2, p.125).

The world of the living is the privileged terrain of such contingency in the convergence of laws, a contingency that invites us to imagine a divine technique. Life overall is affected by a contingency that makes it impossible to understand without recourse to finality understood as technique. "The creatures of the plant and animal kingdoms present on all sides the most admirable examples of a contingent unity, a unity granted with great wisdom. Here are canals that suck in sap, others that suck in air, devices that elaborate sap, others that make it rise, and so on—a great diversity, of which each singular instance has no aptitude for the functions of the others, and in which the concurrence of each to a common perfection (*Vollkomenheit*) is artistic (*künstlich*), so that the plant, with its relations to such diverse ends, constitutes a contingent and arbitrary unity" (II, 3, §2, p.107). Here, for the first time, we find a thematic coherence between the notion of life and that of a unity of the laws of nature; it is retrospectively crucial since the *Critique of the Power of Judgment* will later manifest this coherence in its very construction, for the introduction is devoted to the unity of the empirical laws of nature while the second part deals with knowledge of living beings understood as organized beings. Thus, the coherence of these two parts of the third *Critique* is already present in *The Only Possible Argument* . . . and is justified by the following consideration: to be able to function, living beings assemble parts whose movements obey laws that are independent of one another, even though each one is necessary, so that their possibility rests on the contingent convergence of these laws. Thus, explaining living beings poses the same problem as understanding the unity of the totality of the empirical laws of nature insofar as, despite their independence, these laws concur with one another.

Here Kant does not yet think of this convergence in terms of the concept of organism. This will be the task of the *Critique of the Power of Judgment;* at the level of *The Only Possible Argument* . . . such a problem is not yet conceivable, because it will require a rethinking of the considerations on order, nature and God set out here, a reworking carried out in the *Critique of Pure Reason*, in part through the revision of the concept of "natural law," as I shall explain later. I simply wanted to point out here that the solidarity between the two themes of the living and the unity of laws, as found in the *Critique of the Power of Judgment*, has its origins in the reflection on the contingent order in *The Only Possible Argument*. . . . In the following section and chapters, I aim to understand

the motives that led Kant toward the problematic of the *Critique of the Power of Judgment*, and to characterize what changed throughout this evolution.

3.3.3 Cosmological proof, purposiveness, and contingency

The originality of *The Only Possible Argument. . .* (hereafter OPA) lies in disassociating the physico-theological proof from the technical motive that traditionally inhabited it. Kant achieves this by showing the inadequacy of the contingent order of nature as a basis for a proof of God's existence, in the same way as it had already dismissed purposiveness as technique in terms of its heuristic utility for science. Certainly, the orders of nature, whether necessary or contingent, "designate by themselves an original (*Urheber*) intelligent being" (II, 6, §1, p.123). Nevertheless, the contingent order of nature can only point to an "intelligent plan" that has joined together independent laws and animal parts—in other words, to an intelligent God, that is, an "architect," not a "creator" of the world, as the *Critique of Pure Reason* will put it. Indeed, these portions of matter that make up a living being, together with their necessary laws, may well pre-exist the God who assembles them, as "Aristotle and many other ancient philosophers" already knew (II, 6, §2, p.125).

The contingent order of nature—i.e., the entire organic kingdom—is thus no proof of a *Creator* God, only of an intelligence that orders the world. The *Critique of the Power of Judgment* will remind us of this inadequacy of physical theology. But we can go further than Aristotle and prove a Creator, because we can consider the necessary order of the *laws* of matter rather than the material things themselves. From this standpoint, Kant reformulates the cosmological proof,[8] which I shall now explain.

Order, he argues, no longer stands at the level of the existence of matter, but of its very *possibility*, conditioned by the compatibility of the various laws of the various material things. For example, matter exists and does not instantaneously collapse: this assumes that the law of gravitation stands together with other laws that, taken together, exclude collapse as an instantaneous outcome. A certain order among the laws themselves—minimally, a concurrence or a compatibility—is thus inferred from the existence of material nature itself. This is why the principle of this order of laws—an order necessarily linked to the laws themselves, which are inseparable from matter—is the condition of the very possibility of matter. "We must therefore admit," wrote Kant, "a wise being, without whom all these natural things would be impossible, and in whom, as in a great principle, the essences of these so diverse natural things concur together by regular relations" (II, 6, §2, p.125). Without such a principle of the necessary order of laws, matter could not exist. As a principle of order, it is what we would call a wise author, and it constitutes the condition of matter's very existence. The necessary order of nature thus proves a creator of the world.

Cosmological proof, properly understood—and here is the novelty of Kant's cosmological argument—, therefore, involves purposiveness as order, not

technique. It is based on the final disposition of nature, insofar as this disposition derives from the necessity of natural laws and does not refer to a precise end in nature. It brings into play, somewhat anticipating, what the *Critique of the Power of Judgment* (section on Aesthetics) will call a "purposeless purposiveness."

However, by shifting the focus of proof from the technical finality of nature to the systematic finality of nature, in the OPA Kant brings the cosmological proof of God very close to the revised "ontological" proof of God that he offered earlier in the same text. Why so? This revised proof (i.e., the "Only Possible Argument" mentioned in the book's title of the book) consists in considering the possibility itself, the possible determinations, and arguing that the fact that there are some possible determinations supposes some substrate of the possible, which cannot not exist, and thereby is necessary. Hence, there exists a necessary being (i.e., God), established via such a *radical proof*, in the sense that it is even more fundamental than the ontological proof since it goes not to the roots of the existent, but more radically, to the roots of the possible.

By contrast, the cosmological proof considered in the text states that the necessary order implied by systematic finality is included in the laws of motion. These laws concern the very possibility of things, not their existence, since whatever matter exists will conform to the laws of motion, which are the laws of *all possible matter.* Hence, the foundation of this systematic order is the foundation of the *possibility*, not of the existent. The reasoning that leads to this foundation starts from the possibility of order, and traces back to what Kant called in the first part of the text the "matter of possibilities." Indeed, for a given possibility, Kant distinguished between *form*, i.e., the compatibility of predicates (which defines logical or formal possibility as conformity to the principle of non-contradiction) and the "matter" of the possible, i.e., the determinations themselves independently of their relations. This "matter" is not reducible to form. The radical proof relied on the impossibility of the non-existence of this matter of the possible; likewise, the OPA's cosmological proof traces back to the foundation of the matter of the possible. "There," said Kant, "essences concur": in other words, in this proof God is not the act creating existences, but the locus where essences concur, as the radical ontological proof led us to believe—or, in Leibnizian terms, the divine understanding.

Yet, because of this quasi-immanence of the order of nature to its laws, Kant exposes himself to the accusation of Spinozism, which Maupertuis had faced before him. What is more, he appears to subscribe to the French Spinozism of the 18th century, as portrayed by Vernière (1954), in which Diderot, Maupertuis, d'Holbach, and many others concurred in their affirmation of the univocity of nature and its productive power. Evidence for this claim is found in the status of contingency as it appears after Kant's transformations of cosmological proof in the OPA. Let us consider it.

Contingency constitutes a cardinal problem for Leibnizian metaphysics, which had to resort to the concept of "moral necessity," distinct from logical

necessity, to account for it. For Leibniz, the events of this world are simultaneously deprived of any logical necessity, since their opposite is thinkable, and yet were bound to happen, once God chose our world to bring it into existence. This is because these events are connected to all the others that have happened since the beginning of the world, albeit through an infinite number of mediations. This connection is such that we can only imagine them different by radically altering the chain of all the other events, thereby imagining a world other than the one that exists. The contingency of events in this world is, in this sense, a *hypothetical necessity*: provided God has chosen our world, these events have to happen. They are, therefore, morally necessary, insofar as they are based on God's will. This will is not ruled by the principle of non-contradiction, which governs only the possible and is insufficient to account for the existence of our world at the expense of other logically possible worlds, but by the "principle of the best," according to which, like a wise and good man, God chooses the most perfect.[9]

For Leibniz, contingency as a hypothetical necessity refers back to the divine will; but this raises a problem at the level of this divine will: how could God have chosen another world without derogating from His goodness, since any alternative world would, by definition, have been less perfect? Was His choice not prescribed by His own definition of perfect being? If God, being what He is, namely, perfect, could not decide otherwise, what then distinguishes moral necessity from logical necessity? The whole Leibnizian metaphysics is permeated by this difficulty concerning the status of contingency.

However, in *The Only Possible Argument. . .* , reference to the Leibnizian divine will is eclipsed. God is the principle of the order of laws, through which they could not be otherwise. God's act consists, by virtue of His existence, in bringing into existence the laws that govern possible matter, and not the singular existing things themselves. The Leibnizian problem of contingency stemmed from its recourse to God's will and the aporias arising from it; such a problem is dissipated in *The Only Possible Argument. . .* . On the other hand, it seems that the world is brought into existence, as it is, by a God who, in bringing laws into existence, brings into existence the matter inseparable from these laws, without reflecting on how He might arrange them. In this respect, Kant comes close to a certain kind of Spinozism, the position that Leibniz denounced because it totally suppressed contingency and divine freedom by making singular things derive from the sole necessity of a divine nature devoid of understanding and will, ultimately from a God who "is nothing but this necessity of matter or this principle of necessity acting in matter as it can." The Spinozist flavor is tangible, and Spinoza was not a venerable reference at these times, to say the least.

A decisive discussion of this occurs in the "Eighth Consideration" of the Second Part of the OPA, devoted to elaborating the concept of divine omnipotence as the most appropriate charateristic for absolute power. If God is all-powerful, it is easy for Him to make a work of art such as an animal body. But "what is always astonishing is that something like an animal body should have been

possible" (II, 8, p.152): in other words, the question and enigma of divinity is displaced from the *fabric of existence to the foundation of the possible*, in line with the general argument about foundationality that is defended in the OPA's radical and cosmological proofs of God. Kant explains his thought as follows:

> Even if I could fully perceive all the fibers, all the muscles, all the nerve fibers and the mechanical disposition of this body, I would still remain stunned: how is it possible that so many different combinations have been brought together into a single whole, that the functions intended for one end have allowed themselves to be accommodated to those through which another achieves its own, that, moreover, this same combination (*Zusammenfügung*) still serves apart from this to maintain the machine and repair the after-effects of its contingent injuries, in short how was it possible that a human could be of such fine fabric and despite so many causes of destruction, still last so long.
>
> (Ak. II, p.153)

The world of the living was, we recall, the privileged locus of the contingent order, i.e., of purposiveness as technique. Here, Kant grants living beings four traditional characteristics: unity, accommodation of organs to one another—in other words, a Leibnizian vision of the organism as harmony—, conservation and repair. The existence of an organism, insofar as it is subject to several independent laws of nature, therefore contingent upon them, requires divine engineering. Thus, the living does not mean any frontal opposition to the laws of inert nature, as in Stahl's animism or Bichat's vitalism; there is no conflict of forces, but rather an unprecedented convergence of a multiplicity of laws. Yet Kant goes beyond this inference. The divine engineer could not bring together different materials—different laws of nature—in a work of art if the materials themselves were not a priori lending themselves to possible convergence. In other words, the Creator's technical act, which brings into existence these divine works of art that are organisms, presupposes an a priori convergence at the level of the essences of the materials He arranges. Thus, *divine technique,* which grounds existence, also presupposes a convergence at the level of the *possibilities* it will bring into existence. "So much unity and harmony are possible because there is a being which, in addition to the foundations of effectivity (*Wirklichkeit*), also contains those of every possibility" (Ak. II, p.153).

Accordingly, while previously (and traditionally) technique, namely, the contingent order of the laws of nature as manifested in existent things, required an intelligent creator, now the very possibility of this contingent order requires a principle of convergence of the possible, in the same way as the necessary order of laws (i.e., systematicity) initiated an ascent to the real foundation of the possible. In this way, contingent order also lends itself to a cosmological proof. But this is no longer the traditional proof, leading back to the divine engineer: rather it rejoins the proof developed by *The Only Possible Argument. . . .* It is only in

this way that living beings, through their purposive performances, prove a "creator," but one in an unorthodox sense of "creation," as it will appear.

Now—and this is the almost Spinozist point of this section devoted to Kant's radical proof of God—the idea of God that we access here no longer lends itself in any way to the usual language that Leibniz brought to its highest elaboration, language in terms of divine "choice," "understanding and will," etc. "For one may well," writes Kant, "by analogy with what men perform, form a concept of how a being might be the cause of some existence (*Wirklichkeit*), but by no means of how a being can contain the basis of the internal possibility of other things; and it seems that this thought stands too high for a created being to reach it" (Ak. II, p.153,). Indeed, we might think that God assembles heterogeneous materials, each of which follows precise laws, and thus creates a new machine, to which Hé assigns the goal of self-preservation. Human technical activity provides an analogy of divine creation as a positing in existence; and more generally, from the moment God's relationship to the world is grasped as such a positing, the language of human action (choice, will, reflection, and the like) naturally suggests itself as a way to express such a relationship. But insofar as the only rigorous cosmological proof must be placed on the *level of possibility* rather than that of existence, we are deprived of this lexical field with which to express God's relationship to the world; indeed, we are left with no language at all. Just as the aforementioned section of the *Critique of Pure Reason,* devoted to the refutation of the Leibnizian concept of organism, later dissociated the living from technical analogy, so here this analogy is excluded from the cosmological proof of the OPA, precisely at the moment when such a proof comes to embrace the contingent order, that is, living beings.

3.3.4 The rule of order and Kant's "genetic epistemology"

There are, as it were, two degrees in Kant's 1763 cosmological proof: one that stops at the contingent, artistic/technical order of nature, the other that traces back to an order within possibilities, but can no longer rely on a technical analogy. This is the new movement of this proof, which Kant summarizes as follows:

> Embrace with your gaze, as far as you can, all the inappreciable utilities (*Nutzen*) that a created thing offers, at least in possibility, under a thousand relations (the coconut tree alone provides innumerable to the Indian). Envelop in these relations the most disparate members of creation. When you have properly admired the products of immediately artistic dispositions, do not forget, in the pleasing spectacle of the fruitful relationship that the very possibilities of created things maintain with complete harmony, and [the spectacle of] the non-artistic series of such diverse beauty that presents itself, to admire and praise that power, in whose original source the essences of things find themselves simultaneously ready to enter into an excellent plan.
>
> (II, 6, §4, p.132)

The primacy of necessary order over contingent order invites us to re-examine everything that passes for apparently contingent order, in order to determine whether it is not reduced to a necessary order when it is further investigated. "The causes of even the most advantageous constitutions (*Verfassungen*) will be sought in such universal laws, which, apart from any other incidental consequences, contribute with a necessary unity to the production of these effects" (II, 6, §3, p.126). This runs counter to the ordinary method of theologians in their physical-theological argumentation. These consider "all perfection, all beauty, all natural harmony as contingent, as an effect ordered by wisdom, whereas many of these flow with necessary unity, from the most essential laws of nature" (II, 5, §2, p.117). But Kant has already shown the arbitrariness involved in any designation of singular finality.

What is more, this approach profoundly sterilizes the science of nature. Believing itself to explain nature, theology in reality merely transforms it into an accumulation of supernatural facts (since each one is external to universal natural laws), thus dissipating it. On the contrary, the rule of Kantian natural philosophy is not to scatter nature into particular final performances, but to bring it back under the unity of necessary laws: "in any search for the causes of such and such effects, care must be taken to maintain as much as possible the unity of nature, that is, to bring multiple effects back to a cause already known, and not to admit for diverse effects as many new and diverse acting causes, under the pretext of a great apparent dissimilarity" (II, 4, §2, p.113). This is radically opposed to the natural theology that had found a home in England, where it was sometimes justified by Newton's work (think of Derham, for example). But it fits the characterization Kant later gives of reason in the Dialectics of the first *Critique*, namely, a faculty for syntheses.

By transforming the cosmological proof, Kant proposes a revision of both theology and physics. This is based, once again, upon the epistemic privilege given to the necessary order over the contingent order. But for it to be possible to see a necessary order where we are accustomed to seeing a contingent order, we need a new type of physical consideration, which Kant had introduced shortly before, in *Universal Natural History and the Theory of the Heavens* (1755). As the subtitle indicates, this investigation is presented as Newtonian: "An Attempt to Account for the Constitutional and Mechanical Origin of the Universe upon Newtonian Principles." It is preceded by what Wilson calls an "aggressively mechanistic *Vorrede*" (Wilson 2009b, p.259). I will refer to it here schematically as "Kantian genetic epistemology."[10] (Of course, this has nothing to do with "genetics" in biology!)

Since Newton himself was unaware of such an approach, he attributed the very creation of the solar system to a direct act of God, and thus opened the door of his system to ordinary natural theology, as denounced by Kant. To explain "the origin of the system of planets, their revolutions and the positions of their orbits," Newton indeed resorted to an "immediate divine act," because he

"judged that here a mechanical origin is impossible," since in a space he believed to be empty the planets could not have produced order (Ak. II, p.121). "If it had occurred to him to ask whether [celestial spaces] had always been empty, and whether, since these spaces at least in their very first state would perhaps have been filled and in cohesion, the action of these would not have then been possible, an action whose consequences would subsequently have been maintained" (Ak. II, p.122), then Newton would have avoided the idea of a divine act and found the hypothesis of *Universal Natural History.* In contrast, Kant's genetic epistemology consists in seeing the present order as the result of the action of general laws upon disordered matter, over a relatively long period. We therefore dispense with the need for a single divine act to establish order. The "first state of nature" is "the general dispersion of the original substance of all celestial bodies" (Ak. I, p.227); and Kant sees "in all its decomposition and dispersion (of matter) a *beautiful and orderly whole* developing *very naturally* from these laws. This is not produced by chance and contingency, but we notice that natural properties *generate it by necessity*" (Ak. I, p.227, my emphasis). The purpose of the text is precisely to describe the formation of the order of the solar system from this dispersion, through the application of the two forces (attraction-repulsion) that govern matter according to their laws.[11]

As for *The Only Possible Argument. . .* , Kant recapitulates therein the hypothesis of the *Universal History of Nature and Theory of the Heavens* (II, 7) and gives as an example the homogeneous arrangement of watercourses, so useful to man and animals, and the rarity of overflowing floods (II, 6). Far from being the work of divine Providence, these can be explained by the continuous action of the laws of nature on an initial state characterized by large surfaces of water spread out in depressions. Kant concludes: "Thus, out of tumultuous disorder came order and regularity" (II, 6, §4, Ak. 2, p.129). If the guiding concept in Kant's consideration of nature at this time is, as in Leibniz, harmony, the fact remains that it is no longer pre-established by a divine supernatural decree, but is (post-)established by the prolonged application of the laws of nature. This is why Kant differs from both the Newtonian and Leibnizian positions in the debate between Leibniz and Clarke, because, against Newton, Leibniz avoided divine intervention in the world at the cost of a pre-established harmony, which Kant can avoid.

The apparently contingent order cannot result from the immediate, present application of the laws of nature: that is why we believe in divine technique, and why Newton himself had recourse to it. But if we assume a relatively long period in which we allow "the operation of general laws" to act, we can arrive at this same ordered configuration, having allowed necessity alone to work, without recourse to any extramundane artifice. Genetic epistemology, therefore, makes it possible to reduce contingent order to necessary order. The renewed physical theology proposed by Kant thus presupposes this new physical approach, which grasps nature as the product of a certain becoming. In the

end, the genetic epistemology of *Universal History* and the theology of *The Only Possible Argument. . .* are complementary. From the outset, *Universal History* formulated the rule of natural philosophy reiterated in *The Only Possible Argument. . .* , the rule of the primacy of general causes over particular final dispositions: "the naturalist must (. . .) find the natural causes [of final dispositions] in the most general properties of the air, without having to conjecture particular organizations" (Ak. I, p.224). And *The Only Possible Argument. . .* is the systematic development of the new thinking on the relationship between nature and God formulated in the *Universal History*, which runs counter to the whole of English natural theology: "there is a God precisely for this reason that nature itself, in chaos, cannot proceed otherwise than in a regular and orderly manner" (Ak. I, p.228).

In this way, Kant overcomes the part of divine activity that still remained in Newtonianism, just as he had done away with the submission of the world to divine will and the resulting aporias in Leibnizism. He discards everything in Newtonianism that lent itself to the interpretation of English naturalist theologians. Against them, he opts for a reading of Newton that was fashionable on the Continent, particularly among Buffon and—as always, above all—Maupertuis, which restricted God's role in the *Principia* to a minimum, in order to increase that of natural power. Nature, matter itself, acquires a "tendency" toward order, insofar as natural laws impart to it an inclination toward order, and this inclination is based on God as the sole principle of the laws of the possible and the necessary foundation of their solidarity. The absence of finality and the passivity of matter, considered in its becoming, now appear as a trend toward order. There remains something undeniably Leibnizian in this affirmation of the activity of matter and its tendency toward perfection, even though Kant will constantly reject any "appetitions" within matter, culminating in his proscription of hylozoism in the *Metaphysical Foundations of Natural Science*. (See Chapter 7.)

Insofar as material elements have a tendency toward order, genetic epistemology ultimately leads us to see in them, conversely, the seeds of order. This implicit notion of the germ of order, which derives from the genetic epistemology of the *Universal History of Nature and Theory of the Heavens,* contains the condition of possibility of the theory of the formation of living bodies that Kant evokes in *The Only Possible Argument. . . .* In this text, Kant's position on the question of the formation of living organisms necessarily brings into play the valorization of nature's ordering efficiency, inspired by Maupertuis and Buffon, which genetic epistemology was intended to bring to light. This position can only be analyzed once one has set out the problem as it was debated in Buffon's work, and in the work of those in relation to whom he takes a stand, Maupertuis and Diderot. Before doing so, however, I need to identify the consequences of the OPA's renovation of physics and theology for the status of the living being at this point in Kantian thought.[12]

3.4 The troubled status of the living in *The Only Possible Argument. . .*

Initially, Kant's position seemed clear: the inorganic belongs to the necessary order, while the living belongs to the contingent order, displaying a technical arrangement of matter resulting from divine activity. However, genetic epistemology's extension of the necessary order to the apparently contingent one and its critique of the finalist reading of nature blurred this initial distinction. Is life the result of a specific divine technique, or does it derive progressively from the necessary order of the laws of nature? Reading the *Only Possible Argument*. . . , it is hard to decide on an answer. Kant is constantly hesitating about the status of living things.

Chapter 2 of the OPA, which we have seen distinguish between the necessary and the contingent order, presents a singular move in this respect. After exposing the animal and vegetable kingdoms as the privileged locus of the contingent order, Kant goes on to describe inorganic nature as that of the necessary order, exemplified by the case of the coastal winds discussed above. But he immediately extends this to organic nature itself, which may prove to be more pervaded by the necessary order than it initially appears. He writes:

> On the contrary, inorganic nature above all bears innumerable testimonies to the necessary unity which presides over the relation of a single principle to a great number of effects suited to that principle, in such a way, that one is led to suspect that perhaps, where in organic nature itself several perfections seem to have at their foundation some particular dispositions, they may precisely be a necessary consequence of the same foundation, which has already linked them, in its essential fecundity, with many other beautiful effects, so that in these kingdoms of nature too there may well be more necessary unity than we think
>
> (II, 3, §2, Ak. 2, p.107)

The rest of the text bears witness to this hesitation over the seemingly legitimate identification of organic nature with divine technique as contingent order. Indeed, the latter sometimes appears obvious: "the constructions of plants, of animals present a constitution of which the general and necessary laws are not sufficient to account" (II, 4, §2, p.114).

Yet at the same time, in the following consideration, Kant recapitulates the rules of his perfected physical theology, renewed by the consideration of necessary order at the expense of contingent order, and writes: "not only in inorganic nature, but even in organized nature, a greater share of necessary unity will be assumed than appears at first sight. Even in the construction (*Bau*) of an animal, it is permissible to suppose that a single disposition (*Anlage*) is endowed with a fruitful ability to produce many useful consequences, effects for the obtaining

of which we would first have found multiple particular dispositions necessary" (II, 6, §3, p.126).

Further on, however, he returns to the difference in treatment between the living and the non-living. The science of the latter, he says, is simpler than the science of the former, because it brings into play coarser configurations, and consequently considers less precise phenomena. This claim respond to those who would imaginatively accuse him of wanting to understand the solar system when we do not even understand a tiny living creature. Kant then points out that there is another difference between them, e.g., between the solar system and a blade of grass, that plays a more important role than the difference in size:

> People will tell me: "We are not capable of making clear the natural causes by which the most vulgar blade of grass is produced (*erzeugt*) according to laws that are fully understandable mechanically, and we dare to embark on the explanation of the world's system as a whole!" But has any philosopher ever succeeded in formulating just the laws of the growth and inner movements of an already existing blade of grass, with the same clarity and mathematical certainty as the laws of all the movements of celestial bodies? The two objects are of an entirely different nature. The great and astonishing is infinitely more intelligible here than the small and admirable, and the production (*Erzeugung*) of a planet and the cause of the force of projection that moves it and determines its revolutions can be more easily understood than the production of a single snowflake, in which the geometrical arrangement in hexagonal stars offers a more exact allure than does the curve according to which the revolution of a planet takes place.
>
> (II, 7, p.138)

Note that the blade of grass stands on a par with the snowflake. What is being contrasted here is not the living and the non-living, but, on the one hand, the solar system, a direct result of the laws of nature, and thus "the most elementary (*roheste*) basis of nature" (II, 7, p.138), and, on the other, particular productions of nature which have in common that they cannot be directly reduced to the necessary order, and hence require divine technique. This is why one of the characteristics of the solar system, as opposed to blades of grass or flakes, is its imprecision, its inaccuracy: "In the planetary regions close to the common center, we see realized a greater approximation to perfect order and measured exactness, which near the limits of the system, or on its sides far from the ecliptic, degenerates into derangements and aberrations; as was to be expected in a constitution (*Verfassung*) whose origin is mechanical" (II, 7, §2, p.143).[13] The properties of the solar system are actually the distant result of laws, they have not been designed and realized as such. As ultimate consequences, which God did not intend for themselves, they cannot possess the precision, the exactitude,

in short the perfection of a work directly realized by divine technique, since at the end of the chain of consequences several effects resulting from the same laws can interweave and produce irregularities, such as we see at the edges of the solar system. And conversely, "an immediately supernatural disposition (*Anstalt*), because it does not presuppose, as their consequence, universal laws of action of matter, is thus not disturbed by particular side-effects, but leads to the execution of its plan with the utmost possible correctness" (II, 7, §2, p.143).

But once again, while Kant points out the characteristics that distinguish the two types of order (precision, imprecision), he gives no clue as to what might characterize the living. It is not entirely a contingent order directly instituted by God, since there is undoubtedly more necessary order in it than meets the eye at first glance. It does, however, have as much precision as the snowflake, and as such, like the snowflake, indicates an immediate production of divine technique. *The Only Possible Argument*. . . thus seems distinctly hesitant as to the status to be given to organic nature. *The Universal Natural History and the Theory of the Heavens* tended in turn to see a mere difference in complexity between organic and inorganic, and to combine caterpillar and blade of grass as two realities whose production requires more work and time to elucidate their causes than the galaxies:

> Give me matter, and from it I will build a world! In other words, give me matter, and from there I will show you how the world should come into being. For if we have matter endowed with an essential force of attraction, it is not difficult to determine the causes that may have contributed to the disposition of the world system considered as a whole. (. . .) Are we in a position to say: Give me matter, and I will show you how a caterpillar can be generated? Are we not stopped at the first step by ignorance of the true constitution of the object and the diversity present in it? We should not be surprised, then, if I dare to suggest that the formation of all celestial bodies, the cause of their movements, in a word the origin of the whole present constitution of the universe, *may be glimpsed long before we can explain clearly and completely*, from mechanical causes, the production of a single blade of grass or a single caterpillar.
>
> (Ak. 1, p.230, my emphasis)

The words "long before" should be emphasized here, as they show that Kant nonetheless leaves in principle open the possibility of such a complete mechanical explanation of these beings.

Later, the *Critique of the Power of Judgment* would clarify Kant's spontaneous comparison between grass and snowflakes, in other words, between organism and natural beauty: in both cases, there is a real purposiveness, but in the former case, this purposiveness is objective, in the latter, subjective. However, to legitimize such a comparison, we need to investigate the concept of finality in the *Critique of the Power of Judgment*. Similarly, the apostrophe concerning

the blade of grass may conjure up in advance the famous "there is no Newton of the blade of grass" in the third *Critique*. However, in *The Only Possible Argument*. . . , in the absence of such an investigation into the purposiveness and meaning of the concept of organism, this passage instead brings the blade of grass and the snowflake together in reason of their formal perfection, whereas in the *Critique of the Power of Judgment* it would contribute to underline the specificity of biology in relation to the inorganic sciences of nature, and hence part ways with the snowflake.

In short, the critique of the concept of contingent order and the disqualification of a technical analogy to describe God's relationship to the world ultimately renders the status of the living uncertain. It's difference from the non-living tends to be eclipsed. There seems to be no a priori criterion for determining its specificity. Although Kant repeatedly affirms in the OPA its irreducibility to the inorganic, he provides no a priori reason for this irreducibility, because there is no reason to methodologically separate the sciences of the living from the sciences of inorganic nature. In the dual perspective defended here of the genetic epistemology in physics and the primacy of necessary order in theology, there is no a priori reason to preserve the specificity of the living, or to account for the empirical difference that separates it from the inorganic. The theory of the formation of organized bodies will show us just how close Kant is to Maupertuis's theses, and to the aporias they encountered in his attempt to establish a criterion for the specificity of the living. To address this, I need to reconstruct the third moment of the concept of organism, namely the deployment of the concept of vital force and its investment in the conceptions of epigenesis, in particular that of Maupertuis, Buffon, and—a contemporary of Kant's *The Only Possible Argument*. . .—Caspar Friedrich Wolff.

Notes

1 I examined in detail Kant's critique of Leibniz's view of living being as "natural machines," infinitely organized, in Huneman (2014d). Here I summarize these detailed arguments.
2 And the phenomena, or *Erscheinungen*, in Kant's account, are the appearances framed by the forms of our sensibility and the categories of our understanding: I assume that this basic claim of Kant and its justifications are well known.
3 The deduction of the validity of these categories is done in the Transcendental Analytic, in the "Deduction of the Transcendental Categories." "Deduction" means here the justification of some concept's objectivity (and not any ordinary deductive inference). The text is notoriously difficult, see for instance relevant comments by De Vleeschauwer (1934, 1962), Allison (2003), Gram (1968).
4 See Puech (1990); Buchdahl (1965); Watkins (2004) on this thematic of the *nexus*, and Kant's conciliation.
5 Space is "the order of existence of states which are simultaneous" (*Initia rerum mathematicarum metaphysica* [April 1715]; GM vii 17; L 666); see comments in Arthur (2013).

6 On this natural theology and these authors, see Gaukroger (2010), chapter 6.
7 On the various connections between the two latter instances, see Okasha (2018), Andre et al. (2022). For an analysis of the theological groundings of Maupertuis's principle see Fichant (1973).
8 In Huneman (2019b), I gave a detailed analysis of this shift in the argument for proving God, which is at the same time a deflationist take on the very endeavor of proving God. I explained why this "radical proof" proposed in 1763 by Kant as the "only possible argument" becomes absent from the proofs the *Critique of Pure Reason* surveys and systematically deconstructs. I argued that the transcendental move operated by critical philosophy neutralized the "radical proof," by changing the meaning of the categories of modality.
9 Nachtomy (2011) proposes another account of Kant's conception in the OPA, in relation to Leibniz's; he claims that Kant still accepts one notion (among two) of possibility held by Leibniz.
10 For an assessment of the scientific value of this essay, often credited to be the formulation of the Kant-Laplace hypothesis, a first naturalistic account of the origin of the solar system, see Palmquist (1987).
11 Cooper (2023b) addresses the way Buffon's methodology inspired Kant's genetic epistemology. Wilson (2009) details the way this essay sets some of the ideas about life Kant will pursue throughout his career. Even though I shared the idea that a genealogical approach to Kant's various texts dealing with organisms is necessary for a correct understanding, and reveals that the worry for life and organisms did not pop up in 1790, I discern in the present book many more discontinuities than Wilson does.
12 Given that I do not intend an exegesis of Kant in its philosophical context but rather a parallel reading of Kant and the contemporary biology focused on the notion of organism, I overlook several important figures of the time, starting with Christian Wolff. As Kantian scholars know, Kant received Leibniz's thought through Baumgarten and Wolff, often teaching metaphysics based on the authors' textbooks: "Kant saw Leibniz's philosophy through the Wolffian lens" (Wilson 2009, p.297). Christian Wolff played, historically, a noteworthy role by naturalizing the notion of Monad, giving it a less metaphysical overtone that allowed its retranscription later in German biology, as emphasized by Angleraux (2023), until the romantic biology started to appreciate the dynamic view of nature proposed by Leibniz himself. On Christian Wolff's Leibnizian ideas of organic bodies, see Fichant (2003), Duchesneau (2018, Chapter II) and van den Berg (2013), who argues for a foundational role of C. Wolff in the formation of Kant's ideas on teleology. The divergences between Kant and Wolff about Monads are examined by Puech (1990), Watkins (2004), among others. However, even though he's no historian of philosophy, Kant intentionally targets Leibniz's ideas of infinite organization in the first *Critique*, as well as Leibniz's general idea of space, time and reality (in the section "Amphibologies of Reflections"); and the discussion of order and system in *The Only Possible Argument. . .* directly engages Leibniz's system of theological proofs, metaphysics of contingency and theodicy.
13 Interestingly, concerning some system apparently well ordered, the fact that a lack of precision is the hallmark of natural origin whereas absolute perfection signs a technical origin, would constitute much later the backbone of Darwinian arguments such as Gould's ones (see *The Panda's Thumb*, or *Ever since Darwin. . .*), or François Jacob's famous opposition between biological "tinkering" and "engineering" (in *Le jeu des possibles)*, which infers the epistemic superiority of a natural selection explanation over an intelligent design.

4 Vital forces and epigenesis

4.1 Introduction

If the irreducibility of vital *properties* is a condition for the concept of organism, then a third condition of the concept of organism is the idea of a vital *force*. For German natural philosophers at the time of Kant, this notion emerged during discussions on epigenesis, and particularly through the work of Caspar Wolff, who introduced it into German science at the end of the century. But to grasp the significance of Wolff's *Theoria generationis* (1758; German version *Theorie der Generation*, 1764) for our purposes, we need to go back in time a little. In 1741, Swiss naturalist Abraham Trembley conducted the curious experiment described in his *Mémoire pour servir à l'histoire d'un genre de polype d'eau douce, à bras en forme de cornes* (1744), of an animal reproducing in the manner of plants (the youngling is formed from the body of the adult). Above all, the polyp is constituted in such a way that, when cut in two halves, two analogous animals are created, which are endowed with the same strange property of identical preservation.[1] As Roger (1963, p.395) pointed out, this demonstrates "the polyp's power of regeneration";[2] noticeably, it is no longer the regeneration of a leg or limb, but of the entire animal. This seems to be where the explanatory power of the mechanistic model ends: no machine can repair itself and also multiply itself after sectioning. Trembley's experiment suggested a power inherent in living matter that goes beyond the powers of mechanical arrangement alone.

Similarly, theories of the pre-existence of germs fail to account for these phenomena: how can we understand that the polyp, right from its inception, has a sufficient quantity of germs to meet its multiplication needs? If we want to maintain the pre-cellence of an ordered structure in the process of generation, we need to move on from a theory of the pre-existing germ, which contains the whole organism, to a theory of pre-formed local structures, always virtually present in the body of the adult, so that an accident would induce a vital force to reform this potential structure. Haller's study of the chicken embryo,[3] and later Charles Bonnet's, were to follow in Trembley's footsteps here.[4] Bonnet's theory

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dispersed the pre-existing germ into a multitude of scattered germs corresponding to the various limbs and sensitive to circumstances.[5]

At the same time, the question of the polyp's soul arises: can it be conceived in such a way that it can multiply? Was it foreseen from all eternity in sufficient numbers to cover the contingent multiplications that would have to occur in the polyp's existence (which seems somewhat aberrant)? And where is it?[6]

Suggesting a kind of vital force inherent in the polyp's body, rather than its being just another manifestation of divine power, Trembley's polyp indicated the idea of a heterogeneity of the vital in relation to the material. This heterogeneity was poorly explained by the idea of a soul added to matter and making it into a living thing not to mention anything about the unintelligible duplication of souls, which would require an account of the scission and regeneration of the polyp. To this extent, it induced conceptual advances akin to those proposed by the theories of vital properties.

Trembley's experiment was preceded by Bourguet's *Lettres philosophiques* (1729), which distinguished the growth of organic matter from that of inorganic matter, describing the latter as "intussusception" whereas the former was merely "juxtaposition": living beings grow "by the addition of new molecules throughout the interior at once."[7] With this gesture, Bourguet was already shifting the living/non-living difference from the level of structures to the level of processes, as Jacques Roger[8] pointed out. Trembley's experiment is to some extent part of this shift.[9]

4.2 Thoughts on epigenesis and *The Only Possible Argument. . .*

4.2.1 Newtonian epigenesis

From the turn of the century, and in addition to the polyp, certain phenomena such as monsters and hybrids made it difficult to maintain the theory of the pre-existence of germs, despite attempts to incorporate them without significantly altering the conceptual framework. Thus, conceptions of the generation of living organisms began to emerge, highlighting the power or force inherent in living matter, as discovered by Trembley. Epigenesis reemerged, albeit freed from the Cartesian mechanism by the polyp model. It is no longer simply the application of physics, but an expression of natural productivity.[10] Without repeating, once again, Roger's famous 1963 analyses, let us point out that the two most notable of these attempts, those of Maupertuis and then Buffon, appeared under the sign of Newtonianism, which was the epistemological model for the physiology of vital properties, as Zammito (2018) forcefully argued. For these authors, Newton represented a way of scientifically addressing forces in nature that were irreducible to matter and to extension, and thereby safeguarding the post-Cartesian conceptual matrix of *mathesis* without falling into the difficulties of Cartesian mechanism.

4.2.1.1 Maupertuis

Focused on the curious phenomenon that one used to call "white negro," Maupertuis's *Vénus Physique* hypothesized an attraction between the elementary parts that make up the animal.[11] The "white negro," as well as the phenomena of sextidigitality and, more simply, the resemblance of the offspring to both father and mother, disqualify both the ovist and animalculist versions of the pre-existence of germs,[12] since these would imply that the animal, having been germinated in one parent, would be the portrait of that parent to the exclusion of the other. Maupertuis then turns to Newtonian force: "Why, if this force exists in nature, should it not take place in the formation of animal bodies?"[13] In the seeds of the father and mother, there are elementary organic parts which, in fertilization, attract one another in Newtonian style, thereby forming a new animal whose form was nowhere present in miniature.

One difficulty remains: how does the elementary part of the eye present in the mother's seed match that which represents the eye in the father's seed? In his 1754 *Système de la nature*, Maupertuis attempted to give full scope to his answer:

> If all parts have the same tendency, the same strength to unite with one another, why do some form the eye and others the ear? Why this marvelous arrangement? And why do they not all unite in a jumble? If we want to say something about this that we can conceive, even though we can only conceive it on the basis of some analogy, we must appeal to some principle of intelligence, to something similar to what we will call desire, aversion, memory.[14]

Thus, in each part of the animal there is a kind of instinct, which guides it to join with its fellows. Maupertuis justifies the term "instinct" by noting that "this instinct, which makes animals capable of such a great multitude and variety of operations, will suffice well to arrange and unite the parts of matter" (§LX). This is confirmed by the common use of the term: bees, spiders instinctively construct their dwellings, and the same is true for the "elements of animals" (§LX), except that in one case, "the workers build with foreign materials, in the others the materials are the workers themselves" (§LXI). From this emerges a theory of generation in which "all the difficulties insurmountable in other systems disappear in this one: the resemblance to parents, the production of monsters, the birth of half-breed animals; everything is easily explained" (§XXXII). In this sense, Maupertuis at the end of the treatise offers the solutions for specific problems; for instance, about failures of generation, the surplus or deficiency of organic parts representing such and such a limb yields "monsters by excess," or "monsters by defect" (§§XXXV ff). Thus, he has demonstrated the superiority of his system over the other two possible ones concerning generation.[15]

In this way, Maupertuis can compare the animal body to a swarm of bees, as we have seen. Moreover, insofar as living parts—by virtue of their being material—have "instinct," i.e., something to do with *thought*, the difference between the living and the inorganic becomes blurred. Maupertuis draws up a system of nature similar to those we know from Diderot or Cabanis (Chapter 2), in which inorganic, organic, and human are continuously connected. Thus, speaking of crystals, he writes: "if the too simple figure of these bodies prevents you from perceiving the analogy that lies between their production and that of plants and animals, mix parts of silver, nitrate and mercury, and you will see the birth of that marvelous plant that chemists call the *tree of Diane*; whose production perhaps differs from that of ordinary trees only in that it takes place more in the open" (§XLVII). Hence, "the least active parts of matter will have formed metals and marbles; the most active animals and human" (§XLIX). Thus, the same force, namely a kind of intelligent attraction, governs the organic and inorganic worlds, but manifests itself in different degrees.

The vocabulary of *instinct* applied to elementary parts caught up in a movement of attractive nature evokes a Leibnizian vision of Newton (attraction and appetition . . .). Cabanis, some thirty years later, remembered this, since the passage in *Rapports. . .* devoted to embryogenesis uses Maupertuis's own vocabulary, and makes the embryogenic process the locus of the genesis of the fundamental vital property of sentience, emerging from its rudimentary versions in the inanimate world, namely attraction and chemical affinity.[16]

4.2.1.2 Buffon

George Louis Leclerc, Comte de Buffon, was one of the most important naturalists in the 18th century, and the author of *L'Histoire Naturelle* in eight volumes, a major publishing success in the field. In Volume III, he proposed a theory of development that shared the same epigenetist commitment as Maupertuis's. Yet, their theory differed: Maupertuis attributed intelligence to all matter, while Buffon did not. *L'Histoire Naturelle* returned to the use of attraction: generation is inconceivable without a force, modeled on the Newtonian physics, which acts not on surface but on volume: a "penetrating force,"[17] linking the elementary parts of matter, which he called the "organic molecules."[18] These molecules attract one another, but to prevent random aggregation, Buffon coined the concept of the "interior mold," in order to resolve the same difficulty as Maupertuis. This is the analogue of what we call a "mold," but our senses only perceive surfaces, so that we perceive only an exterior mold; now, as the forces at work in the living body are penetrating, the mold is not a surface mold, but an "interior" mold.[19] These molds enable food ingestion to develop the body: "as these (organized) bodies have a certain form which we have called *the interior mold*, the organic parts, driven by the action of the penetrating force, can only enter it in a certain order

relative to this form, which consequently cannot change it, but only increase all its dimensions, both inner and outer."[20] In addition to the explicit use of penetrating forces, the action of the inner mold implies the implicit use of a principle of affinity, which, unlike Maupertuis, Buffon neither names[21] nor interprets anthropomorphically: "each part of the organized body, each inner mold, admits only the organic molecules that are proper to it."[22] The assumption of these molds is based on sound analogies: "in my explanation of development and reproduction, I first admitted the mechanical principles received, then that of the penetrating force of gravity that we are obliged to admit, and by analogy I thought I could say that there were other penetrating forces that were exerted in organized bodies, as experience assures us."[23]

The incogniscibility of the inner mold, accessible only through analogy, refers to the essential difference between human action, which handle surfaces, and nature, which penetrates volume. Since the human mind, as he writes in "Nomenclature des singes,"[24] grasps only one dimension at a time, and our senses apply only to surfaces, we cannot penetrate matter and know only how to skim it:

> Nature, on the other hand, knows how to stir and stir it thoroughly; at the same time as its movement reaches the surface, the penetrating forces with which it is animated operate within it; it produces these forces by almost instantaneous acts. (. . .) Man can only use the force he has; limited to a small quantity of movement which he can only communicate by impulse, he can only act on surfaces, since in general the force of impulse is only transmitted by contact with surfaces; he therefore only sees and touches the surface of bodies; and when, in order to get to know them better, he opens them, divides them and separates them, he still only sees and touches surfaces: to penetrate inside, he would need some of that force which acts on mass, which creates gravity, and which is nature's principal instrument (. . .) if only he had a sense attuned to it, he would see the depths of matter; he could arrange it in small ways, as Nature works in large: it is therefore *for want of an instrument* that man's art cannot approach that of nature.

Thus, for Buffon, the mold enables organic molecules to be arranged in such an order that they can form an organism similar to that of the parents, in this sense acting as a medium of transmission. "I do not think I need to warn how much this resemblance to the parents, this mixture of parts of the same species in half-breeds, or of two different species in mullets, confirms my explanation."[25]

At the same time, the inner mold refers to the identity Buffon establishes between reproduction and development (and growth): when the animal eats, the size of its body increases while the order of its parts or their shape remain unchanged. Food is therefore transformed into a matter homogeneous with the animal, and capable of integrating with it in the appropriate places: this

integration of matter must therefore be controlled by a mold. But then, what makes the animal grow are the parts capable of integrating with it, in other words, the "organic molecules" that are scattered in infinite numbers throughout the matter. Consideration of development proves the necessity of "penetrating forces" and "organic molecules," writes Buffon. The "analogy between development and reproduction"[26] implies that the theory of organic molecules and the inner mold will enable us to understand reproduction.

Buffon's inner mold answers the problem that vitalists had to solve in their search for *order in the animal economy*: how could the finest living elements give life to what is called living in ordinary discourse, a plant or an animal? For Buffon, the inner mold enables organic molecules, whose life consists in attracting one another, to produce a "macroscopic" living form capable of preserving itself throughout its own life and that of its lineage. In other words, as Jacques Roger put it in his paper "Chimie et biologie"[27] Buffon's problem, like that of the vitalists' isomorphic approach to the animal economy, arises from the distinction between the two levels of the *organic* and the *organized:* how can their relationship be made intelligible?

This is not without its difficulties: Buffon certainly avoids the picture of animate nature seen in Maupertuis, even though he too makes use of the spontaneous generation taught by Needham, and whose experiments he sponsored.[28] For the author of *Histoire naturelle*, the fundamental difference is between the organic and the inorganic. The latter lacks penetrating forces. Organic molecules are scattered throughout matter, and Buffon goes so far as to suggest that "the brute is only the dead,"[29] a bit like the shells of seashells or the scales of turtles. In other words, the goal of nature is the organic,[30] which becomes primary, with the inorganic arriving in nature as a waste product of the organic. For Buffon, nature is originally alive and can produce life; hence, of course, spontaneous generation can be taken for granted.

Thus, in Buffon's theory of reproduction, mechanical development is replaced by some God-given germ, a formative power whose ground is the penetrating force, and which is guided by a constant informing structure—the inner mold—whose status can be no better founded than that of a well-founded analogy.[31] Buffon thus calls for a theory of epigenesis, but an epigenesis that, unlike the Cartesian treatise *On the fetus*, cannot be understood by the resources of mechanistic physics alone.[32] Beyond epigenesis, Buffon points out that the existence of living matter is, as such, the implementation of forces that are intelligible yet original, and which necessarily deploy their effects under the control of what might be called an informing form, i.e., not a plan, divine or established by a rational soul (two kinds of theory that Maupertuis had grouped together), but an instance immanent to living matter. In other words, Buffon indicates that, as a solution to the insoluble problem of the pre-existence of germs, epigenesis cannot be conceived independently of a reconceptualization of living matter, which highlights regenerative force experimentally demonstrated in Trembley's polyp. In terms of the genesis of living organisms, this is a requirement similar to that

of vitalists, who endowed animals with irreducible properties. The introduction of a vital force is the analogue for epigenesist thinking of what the notion of vital property was for the concept of "animal economy."

Like the vitalists, Buffon relies on a Newtonian-style epistemology, but whereas the vitalists transferred a methodology (the use of vital properties), he transferred content (penetrating forces). On this point, and despite his proximity to the vitalists, Haller might the Buffonian theory of generation[33] too extreme. The use of penetrating forces seemed to him to exceed the rules of sound Newtonian methodology, according to which one could only conclude that *vis insita* was the result of muscle irritability, while the rest lay beyond the reach of experiment and therefore remained hyôthetical.

The introduction of forces into living matter by Buffon and others, ultimately converging with the living matter of the vitalists, would later be taken up at length, leading to multiplying the forces in the living world.[34] In 1771, Galvani observed that frog thigh muscles contract under the influence of electricity and published his findings in 1791 in *De viribus electricitatis in motu musculari*. Galvanism was thus born and proved to be a serious candidate for the status of an essential vital force.[35] In 1795, the Dane Brandis proposed in his *Essay on vital force* to identify the vital force with electricity. In 1798, in his *Beweis dass ein beständiger Galvanismus den Lebensprozess in dem Tierreich begleite*, Ritter took up the theses of galvanism, identified with the vital force, extrapolating this to the whole of nature, in a move whose effect on the nascent Naturphilosophie was profound.[36] With this circumscription of forces, Reill (2005) defines what he calls "Enlightenment vitalism,"[37] characterized by skepticism toward mechanicism and physical causality (unlike Romantic vitalism, which dogmatically affirms vital causality). The success of "animal magnetism" is emblematic of this epistemological context.[38] The vital force can therefore be conceived on the basis of the multiplication of essential forces—magnetism, galvanism, etc.—that occupied 18th-century scientists. Such a force appeared therefore to be both irreducible and capable of being identified with several other forces that thinkers of the time discovered and saw as reducible to mechanical forces. The problem of such identification became one of the epistemological features of this notion.[39] This issue is the flipside of the assertion of the vital force's irreducibility to mechanism. During this period, we witness a proliferation of non-standard forces, whether chemical or biological, for which scientists lack rigorous models—unlike Newtonian forces. Intussusception is part of this multiplication of the concept of force, which would be a focal point of the *Critique of the Power of Judgment*.

4.2.2 The Kantian position regarding the living in The Only Possible Argument. . .

One should assess Kant's position on the question of the formation of living things in *The Only Possible Argument*. . . against the backdrop of this conceptual

situation. This question is first addressed in the "Fourth Consideration" of the second part. There, Kant states a rule for any knowledge of nature, according to which one must seek the greatest possible unity of causes. Then he acknowledges that there are phenomena that do not fall within the effects of the necessary order of the laws of nature, namely, living beings. In this sense, "it would therefore be absurd to consider the *first* generation of the plant or animal as a mechanical effect of the general laws of nature" (II, 4, §2, Ak. II, p.114).

As an implicit consequence, the recognition of the impossibility of natural necessity in *creating* living beings "nevertheless leaves open a double question," concerning the generation of the *descendants* of the first living beings created by divine technique. "Is every individual," asks Kant, "constructed directly by God?" And if so, how does it relate to this "supernatural origin" (II, 4, §2, Ak. II)? In the case of a divine creation followed by a simple development (*Auswicklung*), we encounter the Malebranchist theory of the pre-existence of germs, which Leibniz took up: living beings are already present, in germs, within the seed, and God prepared them for this purpose at Creation. Natural laws merely develop them. According to Malebranche, "it is very much that these simple and general laws are sufficient to make all these admirable works, which God *formed in the first days of the creation of the world*, grow insensibly and appear in their time. It is not, however, that the little animal or the germ of the plant has precisely the same proportion of size, solidity, and shape between all its parts as all animals and plants. But it is that all the parts essential to the machine of animals and plants are so wisely arranged in their germs, that in time, and as a consequence of the general laws of motion, they must take on the figure and form we observe."[40]

For Kant, such a theory intends "to do the part of natural philosophy [i.e., of the laws of nature] by allowing it to amuse itself in the game of successive development" (Ak. II, p.115). But then, nature's role is virtually nil: if God miraculously made all living things at Creation, and nature had only to develop them, to unfold them as it were, then the formation of living things is just as supernatural as if God miraculously created, at each fertilization, a new living thing directly. "The difference is not in the degree of immediate divine action, but only in the *date*" (Ak. II, p.115).

By refuting the idea that an organism can be infinitely organized, as we saw in *Critique of Pure Reason*, Kant also dissolved one of the essential reasons for the theory of the pre-existence of germs, and why Leibniz was able to sympathize with it. It was precisely the infinity of organized parts that made it impossible to believe that natural laws alone could arrange them, since infinity requires the infinite power of God. "We will never understand that the laws of motion can construct bodies composed of an infinite number of organs," remarked Malebranche.[41]

Should we then "believe that some individuals of the vegetable and animal kingdoms, though fruits of immediately divine origin, would have received the

power, incomprehensible to us, to *produce* their descendants, and not merely to *develop* them [by enlarging pre-existing germs]" (Ak. II, p.115). This solution was undoubtedly favored by Kant, since he writes further on, when criticizing those who see in nature innumerable traces of divine technique: "The philosophical dimension [*das Philosophische*] of this way of judging is even narrower when each singular animal or plant is immediately subordinated to [divine] creation, than when, except for a few immediate creations, the other [living] products are subordinated to a law of reproductive capacity (and not of mere power of development), because in this case nature is better explained according to order" (II, 6, §4, p.135). Nevertheless, it is difficult within this hypothesis to propose a theory whose difficulties are not as great as those of the pre-existence of germs. "How, for example, can a tree, by its internal mechanical constitution, be capable of forming and shaping the nourishing juices in such a way that there is in the bud of its leaf or in its seed something which contains a tree in miniature or which, at least, is capable of becoming a tree, that is what none of our knowledge allows us to understand in any way" (II, 4, §2, p.114). The physics available to us provides no way of imagining this *producing* (and not merely developing) power that we would have to attribute to organisms in order to overcome the theory of the pre-existence of germs. And Kant is obviously referring here to the two major theories that have attempted to do so and that I exposed:

> The inner molds (*innerliche Formen*) of M. De Buffon, the elements of organic matter which, according to M. De Maupertuis, combine to form the nucleus of the organism and combine themselves according to their reminiscences in accordance with the laws of desire and aversion, are *at least as incomprehensible as the thing itself*, if not arbitrarily imagined.
>
> (Ak. II, p.114, my emphasis)

Kant adds that, despite their obscurity, these theories must not dismiss the type of general explanation by natural laws that they seek to implement: "in order not to accept such explanations, are we forced to fall back on the other thesis, no less arbitrary, according to which all those individuals for whom a natural generation (*Entstehungsart*) is not conceived, are of supernatural formation?" (Ak. II, p.114). In this statement, the words "one does not conceive" mean "not yet, for lack of an adequate theory": the mistake of the preformationists consists, as it were, in turning a difficulty of fact into a principled impossibility.

We must therefore distinguish between the rational *requirement*, derived from the position of OPA on cosmological evidence and genetic epistemology, that animals be granted productive power, and the *theories* put forward to explain this productive power. The inadequacy of these theories does not affect the requirement that refutes the theory of the pre-existence of germs, whose philosophical value is undoubtedly inferior, in that it resorts too much to direct divine efficacy. Whatever our difficulties in understanding reproduction, we must, Kant

concludes, "more than we usually do, grant to the things of nature a great possibility of producing their consequences in virtue of general laws" (Ak. II, p.114).

To this extent, OPA offers a metaphysical justification for Buffon and Maupertuis's experiments in the theory of generation. The valorization of necessary order leads to an increased recognition of nature's productive power, of which the generation of living beings is a privileged manifestation. Conversely, however, the difficulties of Buffon's and Maupertuis's theories reflect the ambiguities to which the Kantian discourse gives rise with regard to the status of living things (Chapter 3, §4). For, in these theories, the distinction between the living and the inorganic seems to be blurred. In Maupertuis's case, everything appears permeated by a silent life, in as much, in order to come together, the basic elements must already fear and desire, and therefore, in a way, live. According to Joseph Needham (1968, p.214), Maupertuis was an "epigenetist-mechanist," inasmuch his doctrine tended to erase the specificity of the vital. In this sense, we understand that Kant would come to regard his doctrine of generation—the only one that still seems somewhat plausible to him in the age of *The Only Possible Argument*. . .—increasingly inadequate.

In other words, if we are to meet the demand of OPA for a natural explanation of the generation of living beings, we currently only have unsatisfactory theories available, because they offer nothing to account for the difference between ordinary natural productivity and that of living beings. In the words of the 1763 treatise, nature within living things would have to be capable of reproducing by itself, in accordance with the effects of necessary order, what originally resulted from a divine technique. Hence in each case, clearly in Maupertuis and more subtly in Buffon, we encounter a kind of *circle*, because divine technique is already presupposed in simple nature, as the presence of desire, aversion, memory, etc. Thus, the only way these theories render the generation of life natural is to project the characteristics of life onto nature. Hence, the non-understandable character of these theories. But their difficulty then echoes that of the OPA, namely the absence of any *concept* of the difference between the living and the non-living, which would allow us to think of the reproduction of the living beings through the very laws of the nature of the living.

While Kant ultimately aligns himself with Maupertuis and Buffon regarding of the pre-existence of germs, one notices the inadequacy of the text concerning the status of living beings, since the categories of necessary order and contingent order, of purposiveness as technique and purposiveness as system, cannot adequately account for it. But conversely, once the theory of pre-existence has been rejected, the absence of a satisfactory solution to the question of generation places Kant in a dilemma from which OPA cannot escape: *on the one hand, the philosophical impossibility of the pre-existence of germs, and on the other, the scientific impossibility of natural theories of generation*.

Sharing with Maupertuis the basics of the genetic epistemology (see Chapter 3), Kant followed him almost as far as his system of generation; he was

led to glimpse this all-living, self-producing nature of Maupertuis or Diderot's *Rêve de d'Almbert:* a vitalist nature, suspected of Spinozism or materialism. But ultimately, he rejected it on the basis of genetic epistemology, because of the problem of generation. Hence, the unsatisfactory nature of the OPA, insofar as this problem reflects on the entire conception of nature it proposes. Would it not be necessary to reorganize the metaphysical theory of the two kinds of in order to account for the status of living things? But conversely, is this reorganization possible as long as the question of the formation of living things remains stuck in the aporias of Maupertuis and Buffon?

The development of critical philosophy constitues the internal reason why Kant would have to take up these problems raised by the OPA, first in the Appendix to the "Transcendental Dialectic" (in the first *Critique*), then in the *Critique of the Power of Judgment*. Nevertheless, changes in the understanding of generation would provide an external motive for escaping the dilemma posed by the living in the 1763 treatise. These modifications were largely the work of Caspar Wolff, author of *Theoria generationis* (1764) (translated as *Theorie der Generation*, 1764) and his followers. I shall now turn to them in order to show how, through embryology, the notion of vital force became an operative element of the concept of organism.

4.3 Epigenesis: the second moment of the organism concept

4.3.1 Wolff and Haller on chicken

To sketch out what is at stake in these controversies about generation, let us start with Haller in mid-century. His return to preformationism, following an epigenetic temptation motivated by the consideration of Trembley's polyp can be read as a rejection of the conceptions of Maupertuis and Buffon (which he had already criticized). Beyond that, in this entire intellectual constellation, seeing matter as the reign of more or less related forces undoubtedly inclined toward a physics far removed from the spiritualist Hallerian vision, in which God alone ordered things, having merely added irritability to a certain kind of matter. We know that, against Needham and Buffon, but with Bonnet, Haller had supported Spallanzani in experiments that disproved spontaneous generation.[42] Nature cannot by itself create living beings; hence, Haller defended a version of the theory of the pre-existence of germs supported and developed by Bonnet.[43]

His opponents are clearly identified in the prologue to the text setting out his theory of preformation: "if the marks of birth do not prove that there is a formative soul; if it is not either chance that can build this beautiful animal machine, *nor a certain blind force of attraction of inorganic parts*; it follows therefore that the fetus was made and fabricated when conception took place."[44] Buffon's conceptions, here referred to in italics, are deemed an intellectual impossibility. And it is out of intellectual necessity that Haller introduces preformation, because

"epigenesis is totally impossible". "If we reflect on the structure of the body, we will easily see that *the animal could never have been without a heart*, since it is in the heart that resides the principle of all life and movement"[45]—from this point on, as "a heart could not exist without arteries," the embryo will comprise arteries from the outset, and necessarily a whole vascular system. Indeed, since the viscera are made up of vessels, it will comprise its viscera from the outset. Thus, even though we cannot see anything in the embryo, the structures must be there, invisible and tenuous but existing. While development does not unfold an animal in miniature, it does solidify existing structures and make them visible. Haller's fundamental contribution concerns the growth rates of the elements, illustrated by his tables showing the changes in bone length at different moments of genesis, enabling him to write that "the growth of man, like that of the chicken, decreases in rapidity as it advances."[46]

Here, Haller is already writing against Caspar Wolff, the epigeneticist.[47] Describing the genesis of the chicken, he looks at what Wolff saw, but at the same time, he cannot see the same thing: beneath the embryonic jelly, there is for Haller, the invisible but necessary pre-existing structure. This structure appears because it was already there; nevertheless, we can initially infer its existence by the following deduction. "It must have had muscles above all; for the little animal has movement, and tends continually to bend; we must also believe that it is irritable, so it has muscles, albeit hidden under the appearance of a jelly."[48]

Caspar Wolff, for his part, describes the building of the chicken embryo in successive phases, in which new parts are created (rather than simply made visible), requiring the action of a force inherent in living matter, known as *vis essentialis*, which drives the process. In the *Theoria Generationis*, the embryologist studies the genesis of a plant and that of an animal embryo, a chicken. The fact that he finds a similar pattern in both cases implies that it cannot be the heart that, as Haller asserted, sustains development through its faculty of irritability, since plants have no heart. This is why Wolff attributes the driving force of development to an "essential force," *vis essentialis*, so named because it appears essential to living phenomena, whatever they may be.[49] As an initially unorganized fluid, the animal or plant embryo requires an organizing force. This force affects the capacity of animal and plant fluids to solidify into defined structures: fluid secretion and solidification are the constant and necessary operations through which fetal development takes place. The "essential force" is accompanied by the coagulation of fluids; in particular, in plants, sap tends to coagulate faster than animal fluids.[50] Since organicity depends essentially on vessels and vesicles,[51] the essential force that carries fluids within it is the foundation of organicity.

But Wolff's major innovation consisted in coupling these theses with an observational device. Haller would criticize him for asserting that what he did not see did not exist, but the point of Wolff's argument is to show that where we cannot see a pre-existing organ, this organ cannot exist *because there is something else*, a transitory embryonic form, in its place. To the continuous development that

makes the invisible visible, Wolff substitutes a series of forms that cancel each other out, and the manifestation of the "essential force" consists precisely in this process of negating and positing. Wolff's reply to Haller made that clear:

> We see that several parts of the body, for example the chest, at a certain moment, are not yet existent, cannot yet exist. It is not because we have not observed the chest that we conclude that it does not exist; rather, it is because at the very place where the ribcage should have developed, we see the 'amnion' forming, which represents, as we know, the lower extension of the trunk in the fetus, that we conclude that the ribcage we do not see *cannot exist, and therefore exist.*[52]

But Haller could not understand him. He therefore integrated Wolff's observations into his own theory, asserting that the negation-position process is the development of the same organ, for example the heart, but understood in an extremely broad sense, as the section on generation in the *Elementa Physiologae* expressed it:

> By my experiments I have convinced myself that these same changes are a true example of development, i.e., of an animal part, which builds itself up by manifest causes, so that it appears, and is indeed quite different from what it was before, *and that nevertheless it is entirely the same part, which has only built itself up and modified itself by development*; I have seen the phases of the heart succeed one another by their respective causes; and first it is in parabola, then in laces, after the parts come closer together, and it is shorter, finally it reaches its state of perfection.
>
> (My emphasis)

The formation of the heart is a fundamental issue between Wolff and Haller. Indeed, since the heart is the principle of irritability, it is necessary for Haller that it be present from the beginning to the end of embryogenesis, so that it can support his conception of life. As Shirley Roe has shown, there could be no experimental proof between Haller and Wolff that would have settled the debate.[53] The positions were too heterogeneous for any observation to acquire the status of a referee, if only because the function of an observation was not the same for either of them.

4.3.2 Seeing and knowing: Wolff's epistemological inflexion

On this point, it should be noted that the two major theoretical debates in which Haller got more or less explicitly involved, one against Bordeu and the other against Wolff, involved the relationship between vision and theory. The Hallerian response to Bordeu was: if you cannot see nerves, you cannot have sensibility; to Wolff: if a part is not seen, you cannot say it does not exist. This is a

dual epistemological system of disciplinary priorities, which his opponents must somehow modify: anatomy (vision of nerves) precedes any physiological assertion, and observations concerning the genesis of the living must be submitted to conceived physiological necessities (the presence of the life principle entails preformation, so that we see the invisible). The critiques against Haller, carried out on two distinct fronts by Wolff and Bordeu, led to changes in the conception of living matter and its relationship with the purely material and the spiritual, since in both cases a dynamic immanent to living matter is introduced, here on the side of the animal's functioning, there on the side of its production.

Besides, one notices here a new epistemological arrangement, not only of anatomy, physiology, and the doctrine of generation, but also beyond that, of conceiving and seeing in the order of biological knowledge.[54] With vitalism, the notion of "animal economy" was built by breaking with an anatomy-based map of the body; with Caspar Wolff, the theory of generation became a conceptual framework that applies to a specific field of corroboration, that of the step-by-step description of what can be positively observed at each moment in the embryo. Theorizing consisted then in enunciating the compatibilities and incompatibilities of each of these phases. Nothing negative—the invisible, the infinitely small, etc.—must be introduced into the discourse, not out of a petition of principle or positivist caution *avant la lettre*, but because the robustness of the theory lies in the fact that it is the serialization, or ordering, of what is seen. Buffon and Maupertuis extrapolated from physiological considerations on the essence of the animal, but in essence, there was no break in epistemological ground with Haller. Wolff, for his part, links possible conceptions of generation to the required description of the phases of the embryo. Thus, in a vocabulary perhaps reminiscent of the (Christian) Wolffian[55] metaphysical school, he invokes the necessity of a force that cannot fail to act, if there is no obstacle in its way—which is also a reminiscence of the intrinsic force of Leibnizian monads. "I say (. . .) that branching is—if vessels in general are to be formed—in itself necessary, and vessels when formed must each time branch, unless some particular cause intervenes which impedes it" (§39). Branching in this way distinguishes animals from plants, as does the presence of a heart; it also refers to the "impulses" and "pressures" (*Eindringen, Durchdringen)* that the heart exerts on the walls.

The analogical basis of Maupertuis's and Buffon's conceptions is thus rendered obsolete: through analogy, both linked their speculations on generation to physics and physiology, which led them to a picture of the intrinsic power of nature. Caspar Wolff, on the other hand, abandons the Buffonian assimilation of generation to growth through nutrition:[56] the latter is continuous and respects the initial form of the body, the former is discontinuous, and on the contrary, the inventory of provisional formations, not present in the adult form, is the very condition of its theorization.

The existence of *transient structures*, therefore, signals the major novelty in Wolff's approach. It induces a discontinuity between embryology itself and physiology, to the extent that the embryological structures cannot any more be deduced from physiological necessities, exactly as physiology in the *économie animale* scheme of the vitalists could not be a mere "animated anatomy." Epistemologically, this discontinuity systematically imposes new relations between vision and conception: the ordering of structures visible to the naked eye (and later through the microscope) replaces deducing from physiological roles chronological priorities within a hypothesized continuous development.

"Generation," in the title of Wolff's treatise, is an ambiguous term: back then, it meant at the same time development and reproduction. While the previously hot controversies between ovists and animalculists touched upon reproduction, for us, Wolff's theory is about development. All in all, "generation"—namely, by Wolff, development—, appears as a phenomenon that requires its own specific means of investigation, aimed at detecting and sequencing the phases of embryogenetic processes. Embryology no longer has to provide the exact mechanism of what it describes; its own intelligibility is, once again, the uncovering of necessary relationships between temporal sequences. The specificity of the embryological field thus consists in the extreme solidarity between the description of sequences and the intelligibility of operating processes. This is the meaning of Wolff's opening statement, which follows the passages just quoted:

> We can conclude from this that the parts of the body have not always existed, but have been formed little by little; and this formation may have occurred in any way. I do not say that epigenesis occurs by an conglomeration of particles, by a kind of fermentation, by mechanical causes, or by the activity of *the soul, but I only say that it occurs*.[57]

From being analogical and "philosophical" (in the sense that, for Diderot, his vision of nature is a philosophy), epigenesis became, with Wolff, the framework of a scientific theory now capable of establishing itself by delimiting its own field. This, of course, came at the cost of the impossibility of being understood by Haller and Buffon alike, i.e., by those who, against the backdrop of Newtonian references, are unable to dispense with the desire to establish the laws of generation just as there are laws of attraction, even if that means designating them in an ultimately metaphorical way, like Buffon did with the "interior mold."

Descartes also defended epigenesis, but derived it from the universality of the laws of his physics across all matter.[58] In this sense, the post-Cartesian mechanist could just as easily accommodate a theory of the pre-existence of germs, as long as there was agreement that development was produced by the simple laws of physics. Epigenesis took on its distinctive meaning, incompatible with the pre-existence of germs, only with Wolff, when he began to think of it in terms

of the description of incompatible embryological events. The debated question of whether the female or the male holds the bulk of the seed (i.e., ovism vs. animalculism) lost its central status in the question of generation. Buffon's theory of organic molecules was objectionable because it could in principle dispense with the key fact of sexual generation; in turn, Wolff's theory took place at a level where the contribution of the two gametes is no longer an issue of priority, because the object of investigation is the process that starts with the fertilized egg. The transient structures to be described, whose compatibility and incompatibility classes Wolff reconstructs, are then co-essential to such a process.

If one wants to schematize the positions, we can situate Wolff's account. Preformationism and epigenetism shared a binary, oppositional conception of *structure* and *process*: these terms were previously never coextensive, either because, in preformationism, the process comes after a structure that is integrally present at the outset and unfolds it, or because, in epigenetism from Harvey to Buffon, structure designates the final term of the process. The singularity of descriptive embryology, according to Wolff, is that the process is, at the same time, the *appearance* and *disappearance* of transitory structures, which must then be described.

Wolff is not the only one to observe and describe; but the status of the description changes, and especially as compared to Haller, since Wolff presupposed neither the continuity of one or more organs during development (organs that would be potentially present at the outset), nor the presence of a law that would a priori make development intelligible. The concept of "germ layer" enables us to positively characterize his approach and to measure its distance from previous epigenetism.[59]

Certainly, as Bernard Balan shows, the rigorous formulation of the germ layer theory is due to Pander in 1817 (*Beiträge zur Entwiclungsgeschichte des Hünhchens im Eye*),[60] Von Baer, and ultimately to the German embryological school rather than Wolff.[61] This school definitely dismissed Buffon's "geometrical morphology perspective," based on the presumption of a mechanics of development. And it was able to do so because it marked "the crucial distinction between primitive embryogenesis, characterized mainly by the establishment of germ layers, and organogenesis, which constitutes the essential preoccupation (of Wolff and Haller)" (Balan, 1988, p.250). Hence Von Baer's rejection of "the crucial distinction in the (Wolffian) theory of epigenesis, between production in the form of liquid excretion and deposition, and organization" (Balan, 1988, p.253) since in this primitive phase the two are merged.[62]

These caveats being made, however, we find in Wolff's text the possibility of the germ layer concept, i.e, the idea that organic forms first appear as *folds* (particularly the intestine), which curl back on themselves to produce a tube. In his 1767 work on the formation of the intestinal canal and intestine, Wolff best explored this idea. Embryonic structures are created by folding tissues, with these folds determining a zone within which, by the same folding operations

and by suturing the edges, an organ is built; Wolff saw this clearly in the chick's intestine. Here appears the dual idea of (1) the differentiation of blurred zones, from and within which a set of organs will be built,[63] and (2) the generic identity of developmental operations such as folding or suturing, that the organogenesis of particular organs merely repeats in an increasingly local fashion (precisely, within the zones thus delineated). Instead of hypothetical laws of Newtonian inspiration, as stated by Maupertuis or Buffon, but with no empirical content other than analogies, Wolff's embryology correlates to its descriptive operations a reference to a science of continuous transformations that is rather topology (iterated folding, curling, etc.) than Newtonian physics and its mathematical formulation through infinitesimal calculus.

This constituted the framework of the germ layer theory, to which Von Baer and Pander would be able to provide content by shifting the focus to the primitive phases (e.g., by specifying the three main germ layers, etc.). Von Baer would acknowledge this originality by calling Wolff's work on the intestine "the greatest masterpiece we have in the field of observational science."[64]

More generally, Wolff's use of the "germ layer," even if inchoative, indicates the specificity of the living as an object of knowledge, by constituting it as the correlate of a new epistemological approach. According to this approach, one should neither classify—here we break with natural history—, nor reduce to the laws of mechanics—here we give up the idea of a physics of the living (which was Buffon's and then Lamarck's project, after Descartes's epigenetic explanations)—, but to *describe*, on the basis of a theory of transforming patterns that would appeal to the nascent topology.[65]

4.3.3 Force

The essential force invoked by Wolff is thus different from the force used by Buffon or Maupertuis in their embryogenetic systems: it is a force which, unlike the force of attraction, is not provided with a law, or rather, whose knowledge is not manifested by the notation of a law.[66] Embryology organizes temporal sequences, whose course follows the events within the germ layers. The essential force ultimately represents the demand for continuity of this course, the presupposition of the unity and self-identity of living organisms, whose observation yields only a series of heterogeneous, discontinuous formations. The part of the plant where the vessel is to appear, which is a "cavity," is solid, says Wolff, so "these cavities must be hollowed out in it, in a certain way, by a certain force, by means of a certain instrument."[67] The sap itself possesses this force.[68] The notion of essential force is fundamentally linked to the idea of the incompatibility and discontinuity of phases. Since the heart *does not exist* at the beginning of generation, contrary to what preformationists such as Haller or Bonnet claimed, for whom the heart appears first, an essential force must drive the distribution of nourishing juices: "Since the heart does not yet exist (. . .) we see that it is

impossible for this movement of the juices, by which the vessels are formed, to be attributed to the heart. It is rather clear that here a force finds its place, which is not different from the root of this force in plants, and which for this reason I call by the same name" (§34).

Through Wolff's essential force, life appears as a self-identity preserved in time and emerges secretly from its transitory manifestations. Thus, the difference between preformationism and epigenesis could be roughly formulated as follows: there, life is a form, here it is a force; there, time is external to its essence, here time is the very condition of its manifestation. This profound change, correlatively and necessarily, affects the procedures by which the living can become the object of knowledge. It is operational only with Wolff, because he alone connects force to time, abandoning the Newtonian ideal of a lawlike force, in favor of a force conceived as the methodological correlate of the order of appearance and folding of germ layers and patterns. This is also why embryogenic time is not exactly the usual empirical time, nor the time indexed by the variable *t* of mathematical physics: it is a time reconstructed *as order,* i.e., more precisely as relations of compatibility, incompatibility, and conditioning between transitory formations. For *vis essentialis* is indeterminate in essence, Wolff can posit the autonomy of embryogenetic dynamics without relating it to a model of knowledge whose laws are established elsewhere,[69] as Lamarck would do with fluid dynamics, which grounded the intelligibility of the physiological phenomena (including his postulated "complexification force"). The insistence on description here follows from the rejection of any external model of intelligibility, whether hydraulic (in Descartes, then exemplarily in Lamarck) or psychic (Maupertuis's mnemic molecules). The "theory of generation" then fits into the field of knowledge about the living in the following way: anatomy, says Wolff, learns "by experience the combination and structure of an organic body," but cannot explain this structure; physiology explains the "operations that organic bodies are capable of producing," and, "on the other side" of anatomy, the "theory of generation" "explains on the basis of reasons (. . .) what we know historically in anatomy."[70] In Wolff's words, anatomy is like a "theorem," of which physiology is a "corollary," and of which the "theory of generation" is the "demonstration."[71] Thus, the theory of generation is certainly causal, to the extent that causes are reasons: it could as little as a history of France be called a "theory of generation" if it were not "giving the causes of the determination and combination of the parts."[72] The "force" supports this requirement for causality, but its specificity, namely, its new relation with time, indicates that this requirement will no longer lead to a "physics of the living" in Buffon or Lamarck.[73] As Wolff puts it: "up to now, there has been no theory of generation, and no concept of this science."[74]

In other words, through the deployment of the field of embryology, we see the undissociability of the notion of life and a specific force, brought about by a new epistemological configuration in which the connection between time and force differs from that in Newtonian physics. Wolff's idea of an essential force is in no

way revolutionary, apart from the fact that it brings with it this new configuration by which the vital force comes to mean something other than what it referred to in Buffon or Maupertuis, or in Haller as *vis insita*. While Zammito (2018) sees Wolffian embryology as a move toward materialism that continues the epigenesis according to Maupertuis or Buffon and the general trends toward the notion of a creative nature, I prefer to insist on Wolff's epistemological shift: first because it brings to the fore the notions of discontinuity and transient formations in the embryological process, definitive of the new approach, and correlative of the novel roles of description and topology instead of other mathematical tools, and second, because this will explain why Kant paid so much attention to the most recent embryology (see Chapter 9).

This shift constitutes the third condition of possibility of the organism in the modern sense: a certain self-identity that emerges, in the dimension of time, as a force postulated to bring heterogeneous moments into relation. From this point on, the intuition of vitality sensed in Trembley's polyp gained the status of an organizing scheme of knowledge. In this manner, one could formulate in a non-metaphorical way the idea that the organism has the resources to produce itself according to a certain law, which is not Newtonian and mathematically expressible, in accordance with Zammito's distinction between an "experiential Newtonianism" and a mathematical Newtonianism as divergent inspirations for natural scientists,[75] but warrants self-conservation throughout changes.[76]

In the *Critique of the Power of Judgment* (§65), Kant spoke of the "formative force" of living beings, as opposed to the "motive force" of inert beings. Admittedly, Kant borrows this explicitly from Blumenbach, not Wolff. But through the former, who would have an important discussion with Wolff on the question of whether to speak of a "formative force" or an "essential force," Kant refers to Wolff, because Wolff showed that the organism cannot be conceived without an intrinsic epigenetic power spread everywhere, a force that is certainly impossible to pin down in its laws, but that must necessarily be postulated as soon as something is to be perceived as alive. To say that the organism organizes itself is only possible in virtue of the Wolffian transformation, which has freed the conception of this "organization" from any physical model using mathematical laws in the sense of differential equations. My examination of the third *Critique* in Chapters 8–10 will make use of this first diagnosis.

4.3.4 The debate

Since Kant explicitly took up Blumenbach's *Bildungstrieb*, the formative force, how does this relate to Wolff's thinking? Goy (2014) interestingly contested my interpretation (given here and in Huneman 2007b) by showing how Blumenbach was much closer to Kant's views, even though she accepts a "systematic proximity" between Kant and Wolff; and clearly, I do not argue that Kant read and meditated the *Theoria Generationis,* which was published shortly before

the essay discussed in Chapter 3, where Kant sets a kind of preformation versus epigenesis dilemma with no clear winner.[77]

In what follows, against Lenoir and Goy, I intend to move the focus of the discussion on Kant, embryology, and German biology, from the reference to Blumenbach to the implicit presence of Caspar Wolff. To explain this move, let us first indicate the terms of the debate between Wolff and Blumenbach—the relation with Kant will be addressed later in Chapter 9. For Wolff, the "essential force" does not impose its form on the organism. For Blumenbach, this is insufficient: whence could the essential force form a chick from this embryo, and a crocodile from that one? In other words, the essential force must be *formative*. He adds, therefore, to the *Bildungskraft*, operating the embryological work under Wolff's description, a *Bildungstrieb* that guides it toward the species' adult type. In this respect, Blumenbach's *Bildungstrieb* is opposed to the simple essential force, *vis essentialis*, with an indeterminate aim, imagined by Wolff.[78] A volume, which is the juxtaposition of three texts on the *Bildungstrieb* edited by Max Born in 1781 and includes one extended view by Blumenbach entitled *Uber den Bildungstrieb* and a shorter one by Caspar Wolff, exposed the elements of the controversy.

Blumenbach retained Wolff's characterization of the living world in terms of a specific type of force. Nevertheless, he multiplied these forces. I already indicated that the dispersion of forces in the living world belongs to the fate of the epistemological transformation analyzed here, which grasps the organism as organizing itself from within. Blumenbach, at the beginning of his *Institutions of physiology* (Göttingen, 1786),[79] in addition to solids and fluids listed within living organisms, enumerated several forces that are designed to receive and expel fluids (§2). Not a single fiber, he said, is devoid of vital forces, which "belong exclusively to organic matter" (§42) and are distinct from the forces proper to the soul (this text concerns humans), as well as from those that move all the bodies of nature. Such vital forces are five in number, and some are spread throughout all similar parts: contractility,[80] irritability, which belongs to muscle fibers, and sensibility, to nerve fibers (here, Blumenbach follows Haller); a "life of its own" which consists in "the forces in virtue of which only certain parts of our body perform the special functions with which nature has charged them" (e.g., the mechanism of secretions) (§47); finally the "formative force (*Bildungskraft*), which is the efficient cause of all formative and reproductive acts." (In this last sentence once again, we see how development and reproduction are entrenched in these late 18th-century treatises.) This *Bildungskraft* introduces "generative and nutritive materials (. . .) into favorable reservoirs (and there) elaborates them suitably," transforming them into parts susceptible to one or more of the other four forces. These introductory statements show that Blumenbach's physiology synthesizes some of the achievements we have seen introduced by Haller, Bordeu and the vitalists, Buffon, and Caspar Wolff.

In clarifying his thinking, Blumenbach defends his "formative force," showing that it overcomes the difficulties of the theory of pre-existing germs. The

system of germs, in order for them to develop, presupposes the formative force: "Why multiply beings without necessity?" asks Blumenbach, who therefore retains only this force (§600). In a certain sense, he confers a broader extension than Wolff to his own "essential force" since, like Buffon, he equates generation and growth: in all organic bodies there is "a particular force as old and durable as they are, in virtue of which they assume by *generation* the form that suits them, preserve it by *nutrition* and, if it is altered, repair it as far as possible by *reproduction*" (§590). Thus, the formative force, by Blumenbach, answers the four questions of development, reproduction, preservation, and growth by nutrition. Even further than Wolff, he extended this force beyond that to other natural productions (problematically, bearing in mind that the five forces originally belonged only to the living kingdom): "all the works of nature are stamped with the seal of this force of formation" (e.g., crystals) (§593), but the effects of such a force are simply visible in the living kingdom.[81]

In his 1781 essay *Über den Bildungstrieb*, Blumenbach then suggests the concept of *Bildungstrieb* and indicates that it owes its genesis in part to Trembley's polyp. Contrary to Wolff's essential force, this formative trend does not act on matter from the outside, but proceeds from it, in the same way that irritability proceeds from the constitution of animal matter.[82] Life, he said already in his *Handbuch der Naturgeschichte*, is characterized by reproduction and nutrition. Therefore, it requires a so-called organized matter and a vital force that runs through it:

> destined to nourish themselves in the manner of which I have spoken, and to reproduce other beings of their species, it is necessary that these [organic] bodies have the necessary organization for the incorporation of the juices which are suitable for them, for the assimilation of food and the reproduction of the species; they need vessels, veins and organs which respond to this purpose, and which are for this effect animated by what we call the *vital forces*.[83]

Thus, vital force and organized configuration articulated together grant life its very possibility: "by imposing on organized bodies these great operations (feeding and reproduction), nature has put them in a position to carry them out through their organization and the *vital forces* attached to this organization" (§6). Such initial organization lies at the heart of Blumenbach's theory of generation, since the vital force as formative impulse only acts on a substrate that can be modified in accordance with its ends, namely a matter that is already organized. The formation forms a "substance that is raw in itself, but capable of being organized in given circumstances" (§8), which the author clarifies as follows: "it seems to me that this purpose [=understanding the formative action] is fulfilled by admitting that the previously crude seminal substance, but organizable when it has reached a sufficient degree of elaboration and arrives in its own time and under certain circumstances at the place of its destination, then becomes susceptible of

receiving a *vital force* which acts there in accordance with a purpose (*Zweckmässig*)" (§9).[84] The last words are an addition from the fifth edition, subsequent to *Critique of the Power of Judgment,* as I will examine in Chapter 9.

However, Wolff—authoring an essay in the same volume—could not accept that a force imprints its design on the matter it forms: for him, "essential force" is merely an indeterminate power, whereas Blumenbach's *Trieb*, though immanent in living matter, builds according to a plan. Against Blumenbach, to whom he replies in his simultaneously published 1789 essay *Von des eigentümlichen und wesentlichen Kraft der Vegetabilischen sowohl auch der animalischen Substanz*, he argued that, while the essential force is involved in all the activities of living matter, including nutrition, irritability, and sensibility, as a force, it is *simple* and always produces a *single* invariable effect. There is actually no reason why, considered in isolation, this force sometimes produces one part, and at other times another. If we accept a formative trend (*Bildungstrieb)*, "we ultimately reject the principle of reason," he continues with an implicit reference to Leibniz. It is therefore the circumstances of the force's action that will determine the specificity of its product: "(it) does not produce the different parts of the organic body solely by itself and according to its nature, but rather with the help of innumerable concomitant causes; and what it does by itself alone, becomes a completely simple effect, like attraction or repulsion, and is completely apart from the formation of organic bodies."[85]

Wolff develops this in his considerations on the stability of the species by examining what he calls *materia qualificata vegetabilis*:[86] the essential force produces the plant as such, but the "mode of vegetation," i.e., the species to which the plant will belong, in other words its form, depends on the material on which this force acts. This is what he calls "qualified matter," and such matter is transmitted from generation to generation. The "qualities" of this matter are "attributes peculiar to the plant substance by which the forces of vegetation are variously determined and which thereby have an essential influence on the process of vegetation" (*Objecta meditationum. . .*, §18). In particular, these qualities relate to the degree of solidifiability.[87] This means that the generation of a given plant (or, ultimately, animal) results from the action of the essential force on an already qualified material. Contrary to Blumenbach's formative trend, the Wolffian force does not create the form, but is guided in its production by the pre-existence of such pre-organized matter (since this matter is not yet an organism, but presents traits that will guide the organization).

In this sense, Wolff repeats within the theory of epigenesis what governed Buffon's concept of the "interior mold": the organization of a certain kind cannot arise from absolutely nothing; it must be preceded by its conditions. At this point, the theory of epigenesis connects with a certain notion of heredity and constancy of form, i.e., a notion of the heritable type, even though this connection would appear most neatly in the reflections on the species itself, which were

conducted, among others, by Kant, in treatises that received most attention by Lenoir, Sloan and further historians of biology.

My argument is quite different here from the debates on the relevance of Wolff's and Blumenbach's treatises to Kant's views: I focus on the space of knowledge in which the biologists—embryologists, naturalists, physiologists—develop their discourses, rather than empirically attested links of influences. They may disagree, but disagreements take place in a space of knowledge that conditions their possibility. The disagreement between Blumenbach and Wolff regarding the nature of the formative trend or essential force evolves in a space where, as I tried to show, embryology detached itself from physiological inferences, and assumed a novel relation between description, explanation and discourse, which implied (1) the Wolffian notion of transient states, (2) the reference to topological concepts, and finally, (3) the requirement of a specific force as a warrant of an underlying continuity of the individual's development. Blumenbach, like Caspar Wolff, conceived of embryology along these lines; hence, they occupied the same space of knowledge. Therefore, I argue that Wolff's *Theoria Generationis* set a new stage for Kant's thinking, as well as for his contemporaries, about his dilemma of generation. And Kant's reference to Blumenbach, well founded for sure (I have no reason to doubt it), does not contradict this diagnosis, any more than his not having read Wolff in detail. After all, we are familiar with the fact that many philosophers defending Platonist arguments never read Plato. The whole discussion just mentioned, about the forces in embryogenesis, their relation to the other vital forces, and their metaphysical status, was developed in the same space of embryological knowledge opened by Wolff's *Theoria Generationis* and the three epistemic shifts (1–3) I just recalled.

The next section will directly address the relevance of the concept of organism for Kant in his critical philosophy, as it has been elaborated based on the epistemological novelties in the space of knowledge investigated until now.

From now on, two directions are open to me, which will be pursued in the next two chapters and which explore the insertion of Kant's thought about life within the space of biological knowledge, whose conditions of opening I started to investigate. The first consists in tracking the problem of the living beings, hesitant in *The Only Possible Argument*. . . , until its final account given in the *Critique of the Power of Judgment.*

In the second direction, I would take a closer look at how Wolffian theory relates to the issue of species stability and species boundaries, which just emerged as the figure of the *biological type* in the previous discussion on the directionality of the formative force. Changes in the perception of living things, which emphasized the internal "animal economy" as the reason for visible dispositions, were reflected in natural history and taxonomy as a demand for classifications corresponding to the underlying animal economies. But this, in turn, reactivated the problems posed by the very definition of species, the primary category of any

biological classification, on the basis of which varieties can be defined. Kant's "biological" work indeed focused precisely on this concept of species, substantially addressed in his opuscules on human races written from 1775 to 1787.

I will therefore study how Kant kept handling the theme of order in the critical perspective of the *Critique of Pure Reason* in 1781 (Chapter 5), and then I will focus on the "biological" work he carried out on species and varieties, and the ensuing consequences on the delicate positions concerning the living, positions between which *The Only Possible Argument . . .* oscillated (Chapter 6).

Notes

1 On this point, see also Ratcliff (2004).
2 Vartanian (1953) studied the decisive influence of Trembley's polyp, particularly on La Mettrie (p.241). On the microscopes, used in these observations, which in turn added to their fame, see also Wilson (1995).
3 *Mémoires sur la formation du cœur dans le poulet*, Lausanne, 1758.
4 On preformationist responses to the phenomenon of regeneration, see Bodemer (1962, pp.20–31).
5 *Considerations on Organized Bodies*, Amsterdam, 1776, especially I, §§48–52. On Bonnet see Duchesneau (2006), and Bognon-Küss (2019), who defends an encompassing and powerful notion of preformationism that accounts for several theoretical avenues in the debates about the nature of life, regeneration and nutrition at these times.
6 For Maupertuis, the polyp forces us to think of a "principle of life spread throughout every part of the animal," *Vénus physique*, ch. XII, p.107.
7 *Lettres philosophiques*, p.71. On Bourguet, see Duchesneau (2018 chapter III): his filiation with Leibniz's theories of organic bodies is unraveled. On the history of "intussusception," which was not coined by Bourguet in this book, see Bognon-Küss and Demarest (2020).
8 Roger (1979); see also his Roger (1988, p.121).
9 On the polysemy of polyp, and its use in political organicism, see Schlanger (1971, pp.71–77).
10 On epigenesis before this reactivation, particularly in Sennert, Harvey, and Descartes, see Balan (1988). Jane Oppenheimer points out that Harvey's position cannot be fully described as epigenetic, because for him, modes of generation can differ from one species to another, and sometimes agree with preformationism: "the common claim that Harvey supported the cause of epigenesis to the exclusion of others has little basis in fact. Harvey was more cautious than most modern investigators in pointing out that 'the principles of the various animals being so various (. . .) the manners of generating animals are equally various' (*Anatomical exercises. . .,* 384), and if he considered that some animals were 'completed by a succession of parts' (*Anatomical exercises. . .,* 344), he knew that others were 'made entirely at once' (*Anatomical exercises. . .*), 'formed and transfigured from matter already concocted and grown' (*Anatomical exercises. . .*, 222)" (1967, "Analysis of development: problems and concepts," p.129). Bodemer (1962) suggests that, while the phenomenon of regeneration was more easily compatible with epigenesis, it nevertheless mainly prompted a revision of preformationism, and was not often mobilized by early epigeneticists, particularly Caspar Wolff. It was only when epigenesis began to gain ground that Blumenbach, Wolff's most important successor, was able to incorporate it into his 1781

text *Uber den Bildungstrieb*. On the decline of preformationism that conditioned this success of epigenesis, see also Hoffheimer (1982) and Bowler (1971).

11 For a general overview of Maupertuis, see Terrall (2002).

12 Ovists locate the pre-existing germs in the ovary, animalculists in the sperm. See also Hoffheimer (1982).

13 *Physical Venus*, XVII, p.120.

14 *System of nature* §XIV (in this §, references in brackets go to this text).

15 The three possible systems are: a kind of Epicurean atomism ("the raw, unintelligent elements, by the mere chance of their encounters, would have formed the universe"), a theory in which living things result from the intervention of an incorporeal agent on matter, be it God or soul in the manner of Stahl ("the supreme being, or beings subordinate to him, distinct from matter, would have employed the elements, as the Architect employs the stones in the construction of buildings"), and finally that of Maupertuis, which appears by contrast to be the system that grants matter power and autonomy, and thereby renders superfluous any other type of substance ("the elements themselves endowed with intelligence arrange and unite to fulfill the Creator's views," §LXVII).

16 "In the formation of certain much more perfect animals, such as birds, the organs are formed successively (. . .) certain very essential organs are formed at various times and in separate portions; (. . .) these come together by virtue of a very powerful particular attraction and merge into an organization which then becomes common. Thus, for example, the two ventricles of the heart remain isolated at first, with their respective atria. (. . .) But soon drawn toward each other, they move forward, seeming to sense each other and to call to each other by lively oscillations (. . .) The above observations would seem to lead us to suspect some analogy between animal sensibility, plant instinct, elective affinities, and the simple gravitational attraction, which is exerted at all times, between all parts of matter." (*Rapports*. . ., Mémoire 9, II, p.263).

17 "Why, then, do we not want to admit penetrating forces acting on the masses of bodies, since moreover we have examples of this in the gravity of bodies, in magnetic attractions, in chemical affinities?" (*De la génération des animaux*, HN III, chapter 4, p.90). It is by "a force similar to that which produces gravity" that "these organic molecules penetrate organized bodies," which "produces development, and makes nutrition" (*De la génération des animaux*, HN III, p.79). The analogy with gravity makes it possible to explain nutrition through organic molecules: "just as the force of gravity penetrates the interior of all matter, so the force that pushes or attracts the organic parts of nourishment, also penetrates the interior of organized bodies and makes them enter by its action" (HN III, ch.3, *De la nutrition et du développement*, p.67).

18 "Animals and plants, which can multiply and reproduce by all their parts, are organized bodies composed of other similar organic bodies, whose primitive and constituent parts are also organic and similar, and whose accumulated quantity we discern with the eye, but whose primitive parts we can only glimpse by the reasoning and analogy [with salt crystals] we have just established. This leads us to believe that there are in nature an infinite number of organic parts actually existing, living, and whose substance is the same as that of organized beings, just as there are an infinite number of crude particles similar to the crude bodies we know, and that as it takes perhaps millions of small cubes of accumulated salt to make the sensible individual of a grain of sea salt, it also takes millions of organic parts similar to the whole to form a single one of the germs contained in the individual of an elm or polyp" (*De la reproduction en général*, HN, t.III, chapter II, p.28, 1749). Note the use of analogy, which will also be one of the motivations for the introduction of the concept of the "interior mold."

19 HN III, chapter 2, *De la reproduction*, pp.50–51. Gravity is the *fact* that points to the *possibility of* a solution to the mystery of generation through a theory of penetrating forces: "I know in nature a quality called gravity, which penetrates the body inside, I take the idea of the interior mold in relation to this quality; this idea therefore encloses only a comparison, and consequently no contradiction" (HN III, chapter 2, *De la reproduction*, p.53).
20 HN II, ch.3, "Nutrition and development," p.67.
21 He speaks of "affinities or attractions" (HN III, 3, p.97), which marks a double reference to the chemistry of the time (affinities) and Newtonianism. On the Newtonian analogies in the 18th century, see in general Wolfe (2014).
22 HN II, chapter 4, p.79.
23 HN, III, chapter 2, *On reproduction in general*, p.77.
24 *Histoire Naturelle* (A), XIV, 1770, chapter 1, p.11.
25 HN III, chapter 4, *De la génération des animaux*, p.102. The image of the mold is borrowed from Bourguet, as Roger (1979) notices.
26 HN III, ch.4, p.97. He adds, "development cannot be satisfactorily explained without employing the penetrating forces and affinities or attractions we used to explain the formation of small organized beings similar to large ones."
27 Roger (1979, p.57) points out that this distinction is already present in Bourguet's work, since he is interested in the growth of the organized by adding organic parts. Note that when Bonnet defends preformationism, he uses precisely this distinction between juxtaposition and intussusception, since he compares epigenesis to crystal growth, i.e., to juxtaposition (arbitrary addition of parts). In contrast, preformationism takes into account the "forces of relationship" that enable such and such a part to go to such and such a place, which corresponds to the intussusception of the living. On Bourguet's theories of generation, see Schmitt (2014).
28 On this Buffon-Needham alliance, which is off topic here, see Roger (1979), and, on their differences, see Roe (1992).
29 HN III, chapter 2, "Sur la reproduction," p.57.
30 "Nature does not tend to make the brute, but the organic, and when it fails to do so, it is only because there are disadvantages that stand in the way" (HN III, chapter 2, "Sur la reproduction," p.56). Note the Aristotelian tone of this passage: nature is a tendency, which sometimes fails to achieve its ends because it is prevented from doing so. But the Leibnizian inspiration should also be detected here: natural substance as an enveloped living force, which unfolds its effects if not thwarted. These theses are also based on a principle of economy: "the living is what costs nature the least" (HN III, chapter 2, "Sur la reproduction," p.58). The use of such extremal-state considerations is reminiscent of Leibniz.
31 See Balan's criticism: "one might have thought that this physics which the theory of epigenesis needs to be explanatory was provided by Buffon, but Buffon's application of physics to physiology is never more than speculative, and it does not even save the essential contribution of Harvey's work" (Balan 1979, p.111).
32 More than by Descartes, Buffon's scientific project is, of course, inspired by Newton, whose *Treatise on Fluxions* he had translated. We have already seen his use of gravitation. The forces at play in living things are "penetrating"; they also refer to heat, necessary for generation. In this way, Buffon links the theory of generation to the theory of the earth (which brings heat and gravitation into play).
33 Nevertheless, with regard to embryology, Joseph Needham felt that overall Buffon is closer to us, because "Haller believed that the amniotic fluid had nutritive properties, and that the nutrition of the embryo in the womb was accomplished first *per os* and then

per umbilicum. He denied that the placenta had any respiratory function, and on the whole, his doctrine of respiration was retrograde" (Needham 1959, p.195).

34 Rey (1992, p.406). On vital forces in Germany just after Haller, see Steigerwald (2019): "Authors in numerous German language publications insisted on a special principle to account for the distinct characteristics of organic life, and they debated whether irritability, sensibility, a reproductive force, or a general *Lebenskraft* best characterized that principle. Many of these authors situated their arguments within a longer history, citing earlier physicians, physiologists, and naturalists in support of their positions, enlisting the authority of Albrecht von Haller and Johann Friedrich Blumenbach, in particular. The intensity of these debates left a lasting legacy, and many subsequent figures felt the necessity of taking a stand on vital forces, especially in the context of their attempts to set out the conditions for a science of life" (p.41, and see pp.46–48).

35 On Galvani see Steigerwald (2019), pp.157–163. The publication of his experiences in the *Journal of Physicks* (1792) was very influential for several protagonists of German biology such as Treviranus or Humboldt, as she explains. On Treviranus see also Hoppe (1965) and Gambarotto (2017).

36 See Rittersbush (1972, chapter 2); entitled "Electricity: The Soul of the Universe," this chapter is devoted to speculations on electricity and its identity with the vital energy immanent in animals and plants, common in the 18th century. "The discovery of atmospheric electricity," he writes, "inspired speculation that all natural phenomena were caused by electricity" (p.25). For biological—electrical speculation, the author cites the work of Haller, Swammerdam, and Hunter, among others; some authors generalize experiments on nerves. About Ritter, Humboldt, and the use of experiments on non-mechanical forces in 19th-century German biology, see now Steigerwald (2019). See also Gaukroger (2010), chapter 7, about the inflation of force notions at the fringes of Newtonian mechanism.

37 Steigerwald (2019)'s interpretation of Kant essentially takes such a context into account.

38 The vital force, in this sense, was one of the many forces that seem to run through the physical universe, and was therefore not only open to abuse, but could even be divided into sub-species that were equally resistant to measurement and testing. On this indistinction of forces, Darnton (2006) notes: "At a time when Voltaire made Newton's theory of universal gravitation intelligible, when Franklin applied the properties of electrical energy to the invention of the lightning rod, when Montgolfier stunned Europe by lifting man into the air, Messmer's invisible fluid does not seem so miraculous. Besides, who can say that it is any less real than the phlogiston that Lavoisier is trying to banish from the universe, or the thermal energy he seems to be substituting for it, or the ether, 'animal heat', the 'interior mold', 'organic molecules' and the other fictitious powers that, like ghosts, inhabit the forgotten treatises of respectable scientists such as Bailly, Buffon, Euler, La Place and Macquer." Messmerism took off in Paris in the 1780s.

39 See also Cabanis in 1803, *Rapports*, 10ème Mémoire: "The latest experiments of the Paris medical school, those which have since been carried out in England, and especially those of the illustrious Volta on galvanism, seem to demonstrate, without reply, the perfect identity of the fluid to which this name has been given with that which produces the phenomena of electricity. I have always been very inclined, I confess, to think that electricity, modified by vital action, is the invisible agent which, constantly traversing the nervous system, carries sensitive impressions to the various centers, and from there, brings back to the motor parts, the impulse which must determine movements there" (II, p.281).

40 *Entretiens sur la métaphysique, la religion et la mort*, Xème entretien, art. IV, p.404, my emphasis
41 *Entretiens sur la métaphysique, la religion et la mort*, Entretien XI, art. VIII, p.435.
42 Bonnet is not exactly a proponent of the pre-existence of germs; for his complex position, see Schlanger (1971, p.76) and Roger (1963, pp.720–724).
43 Cherni (1995) argues that Haller did not really convert to preformationism and that he held a conception of generation quite close to Buffon's, even though he was reluctant regarding any kind of spontaneous generation.
44 *La génération, ou exposition des phénomènes relatifs à cette fonction naturelle, de leur mécanisme, de leurs causes et des effets immédiats qui en résultent*, Paris, 1774, tr. Pier (Translation of *Elementa physiologiae corporis humani*, 1766, tome 8, pp.1–426) Haller's conception of preformation is clearly ovist. Jouffroy-Gauja and Haechler (1997, pp.496 ff) have shown how Haller was able to impose his conception of generation on the cultivated world, thanks to the relay of encyclopedias then in development, during the second half of the 18th century. In 1762, Bonnet's *Considérations sur les corps organisés* provided a partial response to Wolff's *Theoria generationis* (1759) (summarized by his friend Haller), to which Wolff replied in his 1764 German version*, Theorie von der Generation*. Haller wrote an unfavorable review in the *Göttingische Anzeige*.
45 *Prima linea,* 585, my emphasis; see King (1966) for a presentation of this whole work.
46 *Elementa physiologae,* quoted by Needham (1968, p.197).
47 The last part of the *Elementa physiologae*, on embryology, from which the memoir *La génération* is translated in French, was not published until 1766 (Needham 1968, p.195).
48 From the memoir on generation; and further on: "There is an animal (the spider fly) that suddenly and for the first time seems to emerge as a perfect animal, from a caseous matter, not because it has suddenly grown, but *because its parts have taken on consistency.* This is why, although the brain is liquid, as are the muscles, we must not deny that *these parts were organic and formed*" (Needham 1968, my emphasis).
49 "It is on the basis of this force, by which all these things (generation) are accomplished in the plant body, that we attribute life to it; and on this basis I have named it the essential force of these bodies, because, precisely, a plant would cease to be a plant if this force were withdrawn from it. It is as much to be found in animals as in plants, and all that animals have in common with plants depends principally on this force" (*Theorie der Generation*, §26, p.160). Bognon-Küss (2019) clearly explained the role played by nourishing in this account, and the intertwining of nutrition and formation, as constitutive of Wolff's perspective.
50 "There is a certain force peculiar to living bodies, by which nourishing juices are distributed in all their parts (. . .) thus I discovered from observations the true constitution of vessels in plants, and deduced how they must necessarily have formed" (*Theorie von der Generation*, 37; see also §§15–21). "The speed of sap flow determines tissue formation: flowing slowly, sap produces vesicles; flowing quickly (in the same direction), it produces vessels," commented De Wit (1992, II, p.351). From here, Wolff can characterize the difference between animal and plant, as Balan (1988, p.244) summarizes: "the relationship between the two kingdoms is then defined by the opposition between a simple development for the plant kingdom, and a multiple development of autonomous systems for the animal kingdom." For another historical study of Wolff's treatise, see Aulie (1961).
51 "These vessels and vesicles, or cells, make the internal structure of a part; they make the part organic, and without them the part would cease to be organic" (*Theorie von der Generation*, §28).

52 *On the formation of the intestine canal*, 1768, then 1781 (now in Jean-Claude Dupont's French annotated edition, Brepols, 2003). The text shows that the intestine is formed from a piece detached from the ventral tissue and folded—and therefore did not grow continuously from an initial position and shape. And so: "the question is no longer, if what we do not see, thereby does not exist, but, if what we see, also exists—and this you cannot deny without making yourself an idealist" (*Theorie von der Generation*, §57, about the heart, which we see "resting surrounded by its free pericardium, before and outside the lung inside which it should develop").

53 In particular, in her book she notes that Wolff's theory lends some weight to Needham's speculations on spontaneous generation, as Wolff agrees in the German edition of *Theoria* (1764), writing "through my theory if it is correct, Needham's theories also receive at the same time a great probability" (p.31, quoted by Roe 1980, p.120). Haller's dualism and religiosity meant that he was adamant about distinguishing between matter and soul, and absolutely opposed to spontaneous generation. The possibility of the latter, rather than epigenesis itself, of which he had been a perplexed proponent prior to 1758, was unacceptable to him. Later, "as a preformationist," writes Roe, "Haller repeatedly identified Needham's views on spontaneous generation with epigenesis, because the two represented the same thing to him."

54 To a certain extent, this transformation can be paralleled by the contemporary emergence of clinical medicine, which moved from teaching medicine through books and masters, to teaching through observation of the diseased. Among others, Foucault (1963) and Ackerknecht (1967) have long ago analyzed this transformation. I have already mentioned the role of observation in vitalist medicine. However, it would be too crude to believe that, in both cases, the merits of direct observation were suddenly discovered, and a body of knowledge made up of a priori judgments based on beliefs and authoritative arguments was swept away: what changed, in a somewhat analogous way, in the emergence of clinical medicine and the theory of epigenesis, was rather the status and function of observation. In this sense, a fresh perspective is offered by Singy (2006).

55 Caspar Wolff studied with his namesake. On Christian Wolff and organic bodies, see, among others, Duchesneau (2018, chapter III) and Angleraux (2020).

56 Bonnet notes: "26. The act of generation may therefore be no more than the principle of germ development. 27. Development takes place through nutrition. Nutrition is properly nothing more than the incorporation of nourishing juices into the meshes of elementary fibers" (*Considérations sur les corps organisés*, I, p.14). Wolff's break with this point thus indicates that we are moving away from a problematic that was common to both preformationists and epigenetists in the question of generation; and indeed, between Buffon's organic molecules joined to internal molds, and Bonnet's germs dispersed throughout the organism, which only circumstances will activate or not, the difference was basically slight, a difference above all of emphasis, of metaphysical framework in which these theses were deployed. With Caspar Wolff, on the other hand, the epistemological specificity of development implies the rejection of continuous models, which dissociates his theory from the epistemological field that the earlier epigeneticists shared with the preformationists. However, for a slightly different understanding of the role of nutrition in Wolff's science, see Bognon-Küss (2019).

57 *Intestinal canal*, §110 (my emphasis).

58 Balan pointed out that there is indeed a substitution relationship between Descartes and Wolff, in the sense that "the much more flexible concept of force must be substituted for the concept of movement" if the epigenetic explanation is to be conclusive (1988, p.107).

59 Oppenheimer noted that Wolff's discovery of the germ layer refers to the general analogy he draws between animals and plants, which enabled him to think of the identity of development in one and the other: "when he demonstrated that animal organs—the intestine and probably the central nervous system—were formed by folding homogeneous tissues into tubes, he called them by a name given to leaves" (1967, 135) Similarly, the analogy between animal vessels and sap-carrying vessels in plants led him from the development of plants to that of animals (1967).

60 This text is now available in a critical edition and French translation in Schmitt (2003).

61 On this point see Oppenheimer (1967, p.141), and the essay "The non-specificity of germ-layers," Oppenheimer 1967, p.256–287 ("It hardly needs to be said that Von Baer important contribution, as far as germ layers are concerned, is the recognition that Pander's discovery for the chicken was valid for all the rest of vertebrate development" (p.259)).

62 However, Wolff's distinction can be seen as a condition for asserting the specificity of embryology in relation to mechano-hydraulic models: only later can this distinction be removed again, within embryology, and we return from organogenesis to embryogenesis.

63 The intervals least close to the canals become a little less transparent, the closest a little less non-transparent, so that "these modifications cause the difference in the malleability (*Dichtigkeit*) of the substances that constitute the interval of the vessels, inevitably to become greater and greater in these places, and to become ever more visible" (*Theorie von der Generation*, §35).

64 Quoted by Roe (1980, p.83). According to J-C. Dupont in his recent edition of *De formatione Intestinorum* (Dupont 2003), Wolff responded in this work to the challenge of presenting an epigenetic theory of organ formation that was as technically accomplished as Haller's unparalleled work on the chicken heart (*Mémoire sur la formation du coeur dans le poulet, sur l'oeil, sur la structure du jaune et sur le développement*, 1758). See Dupont (2007, pp.37–50).

65 Coleman (1979) forcefully argued that this attitude of description, in the sense of recounting a story unfolding in time, runs through all of biology as such in the 19th century, and invests pre-Darwinian theories of species transformation.

66 Maupertuis, Buffon, and Diderot all use the hypothesis of force as primitive. Wolff posits it as a necessary agent, starting with the ordering of the description. In any case, for him, the truth of his theory does not depend on the idea of this "essential force," whose name is in fact of no importance—in support of which Shirley Roe quotes these retrospective lines from the *Objecta meditationum pro theoria monstrorum*: "the cause of this slander, which, however, I endure with a serene spirit, was once supplied by the distinguished Haller, who wrote that I derived the formation of a certain force which I called "essential," as *if the whole affair rested on this force and the whole explanation of formation consisted in giving names*." (quoted p.120, my emphasis).

67 *Theorie von der Generation*, §21.

68 *Theorie von der Generation*, §22.

69 This oriented distribution of vessels" should depend on a hydraulic machine, whether it is built and laid out the way it wants! But the opposite is true, my dear friend! This hydraulic machine, this distribution and branching of the vessels, depends solely and only on the distribution (*Vertheilung*) of the sap, and this has an entirely different cause at its foundation!" (*Theorie von der Generation*, §29).

70 *Theorie von der Generation*, pp.59 ff. The difference between rational and historical knowledge is classic in the Leibnizian *Schülmetaphysik* where Wolff studied. Indeed, he feels the need to mention the link between pre-established harmony and the preformationism he has just refuted.
71 *Theorie der Generation*, §§ 12–13.
72 *Theorie der Generation*, §13.
73 For the meaning of Buffon's physics, and why it does not fit Newton's paradigm in the *Principia Mathematica,* see Hoquet (2010), which here would concur with Zammito (2018).
74 *Theorie von der Generation*, §14.
75 "Experiential Newtonianism" is the key category in Zammito (2018) of the gestation of German biology"; see for example, pp.40, 128, 149. In his reading, was indeed "far closer" to this experiential Newtonianism than Haller.
76 On the general anti-mathematism of authors such as Diderot, who were involved in thinking about vital forces in the 18th century, see Wolfe (2017), and Hoquet (2010) on Buffon.
77 Duchesneau (2018, pp.311 and 426) also doubts that C.F. Wolff's ideas of epigenesis were shared by Kant; however, as is explained below, I do not argue that Kant accepted Wolff's theory of epigenesis, but that the epistemic structure of the study of embryology set by Wolff was the target of Kant's analysis in terms of reflective judgment and teleology, as described Chapter 9. Then, Zammito (2016) also discusses the present account of Wolff and epigenesis in relation to Kant; he insists on the rather hermetic metaphysical boundary between living and nonliving in Kant, in order to argue that Wolff and the epigenesists were more liberal than Kant regarding the transitions from brute matter to life. The account proposed Chapter 9 is intended to answer such a critique by building a Wolff-Kant relation understood in terms of conceptual conditions of possibility rather than influence.
78 I agree with Duchesneau (2018) that Wolff's essential force is indeterminate while Blumenbach's *Bildungstrieb* is, by definition, oriented purposively.
79 In the remainder of this paragraph, references in brackets in the body of the text are to this work.
80 Or "effort made by a party to shorten itself," §42.
81 On crystal formation and Blumenbach, see Wilson (2018). Crystallization remained a reference for thinking of organization, since writers would admit or contradict the identity between both. Steigerwald notices about Johann Christian Reill that he "ascribed the processes of the procreation, growth, nutrition, and reproduction of organization not to a *Bildungstrieb* but to a mode of crystallization, not unlike that seen with salts, that starts with a kernel or stock and attracts new material to itself" (2019, 154).
82 On this parallel: "the term *Bildungstrieb*, like those of sensibility or irritability, explains nothing in itself, but serves to designate a force whose constant effect must be recognized in the phenomena of experience, but whose cause, like those of all universally recognized natural forces, remains for us an occult quality" (*Handbuch der Naturgeschichte*, 1797, p.18).
83 *Handbuch*. . ., §2. This intertwining of reproduction, nutrition and development, visible in the intertwining of the forces that Blumenbach analyses, is a core element of the interpretation of the role of nutrition by Bognon-Küss (2019).
84 Regarding the relationship between these two scholars, Needham (1959) noted: "Caspar Wolff was still alive at the time [when Blumenbach spoke], but made no comment on Blumenbach's ideas. He may well have thought that the differences were

not important" (p.227). This judgment is in line with the idea we are defending here, namely that Blumenbach's formative force is, in any case, part of a space of thought inaugurated by Wolffian embryology—the differences between authors then being of little importance in view of this rupture.

85 *Von des eigentümlichen und wesentlichen Kraft der Vegetabilischen sowohl auch der animalischen Substanz*, p.67.

86 *Objecta meditationum. . .*, §18.

87 Further on, he adds: "Vegetability is so closely linked with qualification (of matter) that neither unqualified vegetable matter nor qualified non-vegetable matter can exist" (§36).

Part 2

Meeting purposiveness

The idea of critical philosophy and the claims of a science of life

"The *Critique of the Power of Judgment* is Kant's most profound work, the one that would undoubtedly have given a different direction to his entire philosophy if, instead of ending with it, he could have begun with it."

Schelling, FWJ. Contributions to the History of Modern Philosophy, *Sämmliche Werke*, X, p.177.

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5 Order and life in the Appendix to the Transcendental Dialectic

My aim now is to show how the problem of contingent/necessary order, constituting the framework in which the knowledge of life is envisaged, as addressed in 1763, is transformed in the *Critique of Pure Reason*, and to wonder whether this work explicates the ontological status of the living. Then, I will clarify the meaning of the life sciences for science as understood in the *Critique of Pure Reason*, and the type of life science precisely evoked by the Appendix to the "Transcendental dialectic."

5.1 The changing nature of the problem of order

5.1.1 The systematic unity of nature

The "transcendental dialectic" of the *Critique of Pure Reason* is devoted to critically analyzing the uses of Reason, which is a "faculty of principles," hence, as recalled in Chapter 3, a faculty of rules for the rules enunciated by the understanding, as well as for practical rules. The question raised by the Appendix to the "Transcendental Dialectic" is, in a nutshell, "how can the necessary order of nature acquire meaning and grounding when the proof of God is neutralized in the Dialectic?" Remember that *The Only Possible Argument*. . . characterized a form of purposiveness as a necessary order, hence a system; such purposiveness happens when the same natural law is diversified into several laws that account for many diverse and concomitant effects.

In the Appendix, such systematicity is understood through an examination of rational theorizing; it correlates with what Kant calls the "hypothetical" use of reason. Let us imagine that, in examining a natural phenomenon, we assume that it obeys a certain law, which brings into play a certain force. The rational method then consists in finding other particular cases likely to derive from the same rule, to confirm its generality, and then investigating whether the force involved in these phenomena can be reduced in turn to a natural force already known, of which a novel manifestation would occur in the phenomenon studied. The methodology sketched in *The Only Possible Argument*. . . instantiated this

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reduction to unity, advocating the search for the necessary order beneath the contingent order, namely, the reduction to unity of the forces and laws responsible for multiple effects.

In the chapter of the Appendix to the Transcendental Dialectic devoted to the "regulative use of ideas," Kant outlines such a hypothetical method in general. He distinguishes between the "apodictic use" of reason, for which the universal is "already *in itself certain* and given" (A643/B674), and which therefore necessarily determines the particular by subsuming it under this rule, and the "hypothetical" use of reason. An example of the apodictic use would be the application of the principle of action and reaction to experience: the universal is certain, a priori given, as the *Metaphysical Foundations of Natural Science* taught us, and it suffices to recognize the particular phenomenon where it takes place. As for the hypothetical use, the particular is certain, but the universal "is taken only *problematically*, and as a mere Idea"; hence, its "universality as to this [particular] consequence is still a problem" (A643/B674). In other words, we assume a rule to explain a given phenomenon, but this is still, precisely, only a hypothesis; we must then find other particular cases that can fall under the same rule. If all the particular instances we know follow from such a rule, then "we conclude to the universality of the rule and, then, to all the cases that are not given in themselves." (A647/B675) The faculty of judging, here, does not determine: its exercise is close to what Kant would later call in the third *Critique* the reflective faculty of judging, in which the rule is sought for the case (while the apodictic use would become the determining judgment; the difference between these two judgements is addressed in Chapter 8). Here, a rule is given that is not certain, and cases are sought to validate it.

In *The Only Possible Argument*. . ., this hypothetical use would be justified by God as the principle of the agreement of possibilities, and hence of laws (see Chapter 3 and Huneman 2019b for elaboration of this point). But in the absence of an a priori God who guarantees the unity of forces and laws because He is the principle of the unity of the possible, as was the case in *The Only Possible Argument*. . . but no longer in the *Critique of Pure Reason*, how can such a method of hypothetical reasoning be legitimized? Remember that God in the first *Critique* is now only a "regulative ideal of reason," related to the disjunctive syntheses of conditions, namely the largest possible synthesis of distinct determinations. While reason can "direct the understanding toward cases that are not given, and make it coherent (*Zusammenhangend zu machen*)" (A647/B675) through this hypothetical use, the fact remains that nothing guarantees the *fruitfulness* of such a use, because we fail to see what authorizes reason to look for cases that might follow from such a hypothetical rule by warranting us that several facts indeed pertain to the same regularities and several regularities pertain to the same law. Why should there even exist cases that could corroborate a hypothesis?

Granted, the hypothetical use of reason certainly tends to increase "the systematic or rational unity of the various knowledges of the understanding" (A648/

B676). Then, systematic unity seems like a "*logical* principle" meant to govern the search for rules in nature. But this logical principle could have no reality; it might be that every time I look for cases to confirm a hypothesis, I find none. Such a principle would then be inapplicable. Yet, if I apply the logical principle involved in the hypothetical use of reason, I thereby assume that this inapplicability is not the case. In other words, I am going beyond the logical principle as a methodological rule: hence I am positing "a *transcendental* principle of reason that would make systematic unity necessary not just synthetically and logically, as a method, but also objectively" (A648/B676) There must be, a priori, an objective unity of nature (as a set of phenomena, *Erscheinungen*, not things in themselves, of course), without which the logical principle underlying the hypothetical use of reason would simply be inapplicable. This logical principle, therefore, involves a *transcendental* presupposition.[1]

The scientific methodology of *The Only Possible Argument*. . . , reinterpreted as a hypothetical use of reason, thus rests on this transcendental presupposition of the systematic unity of nature. It is based on *more than* just a subjective methodological rule, because *any methodology presupposes that some method is applicable*, and this is what our transcendental presupposition guarantees.

5.1.2 Nature and order in nature

The search for forces in nature[2] exemplifies such a transcendental presupposition. When we have several forces of different kinds at play in phenomena, we wish to reduce them to a single force. Then, the primary forces we find are "compared, so that, by revealing their unanimity, we bring them closer to a single, radical, i.e., absolute, fundamental force" (A649/B677). This approach thus embodies the presupposition of a single fundamental force, which we make just as much when we study the faculties of the soul as when we study the forces of nature, even if they are disseminated in several substances. In the end, reason postulates that all forces are homogeneous and can be reduced to a single force. This assumption is not merely problematic: if it were only a hypothesis, the failures to reduce one force to another (failures that reason has already encountered in its history) would have falsified it. But this is not the case: "without having once sought the concurrence of the various forces, and even when, after all our attempts, we have not succeeded in discovering it, we nevertheless presuppose it" (A649/B677).

Thus, the fundamental force is more than a hypothesis: it is the presupposition that makes the hypothetical use of reason possible, i.e., the methodology of hypotheses itself. If this fundamental force, as a figure of the systematic unity of nature, were not presupposed, reason "would be conducting itself contrary to its destination" (A651/B679): it would forbid itself from any search for the systematic unity of nature, in other words, for *the order of nature*. For, while the understanding, through its principles in the system of principles of understanding,

constitutes a nature, as the Transcendental Analytic has taught us, it is up to reason to constitute *the order of nature*, which the understanding in no way guarantees.

Indeed, we could suppose a universe that conforms to the three "Analogies of Experience" established in the Transcendental Analytic, i.e., a universe made up of substances that undergo change, in reciprocal action with one another, in which each event follows another according to a rule—and yet in which the multiplicity and heterogeneity of rules would prevent us from perceiving any order. Kitcher (1986) insists that the Analogies of Experience, while guaranteeing the possibility of experience by establishing the possibility of a nature, do not guarantee an experience endowed with meaning and capable of satisfying rational knowledge.[3] (In a sense, this possible catastrophic experience is as much the problem of this Appendix to the Transcendental Dialectic as it is of the later *Critique of the Power of Judgment*, and we shall see below (Chapter 8) what particular inflection the latter text gives it.) Here, Kant simply shows that reason, which guides the understanding in the search for natural rules, presupposes a systematic unity of nature, i.e., presupposes that the rules are not overly scattered, without which there would not even be a possible search for rules. The order of nature—its systematic unity—is therefore the necessary correlate of reason, without which no methodology of scientific research could be dictated by it to the understanding.

This explains why Kant speaks of "the law of reason which obliges us to seek [the unity of nature according to the principles of reason], because without it we would have no reason, without it no coherent use of the understanding, and without it no sufficient criterion of empirical truth" (A651/B679): in fact, without the hypothetical use of reason as we have defined it, we would no longer be able to test the generality of the hypothetical rules we assume govern phenomena, so we would have no way of knowing the empirical laws of nature, because the hypotheses we would make about these laws could not be invalidated or corroborated. In this sense, the order of nature, as reason must presuppose it as a systematic order in the form of a fundamental force deployed in a system, is not a para-theological supplement to foundational epistemological views on the possibility of a science of nature (those of the Analytics and the *Metaphysical Foundations*. . .): it comes under the necessary conditions of an empirical knowledge of nature. "We must," says Kant, concluding his sentence, "in consideration of this [empirical truth] presuppose the systematic unity of nature as objectively valid and necessary" (A651/B679). Kitcher (1986) argues for a fundamental role for this order, which he sees as a projection, and vindicates its essential role for knowledge itself, far from being a simple methodological addition to the Analytics seen as core epistemology, as many commentators thought. Yet, as Ginsborg (2018) argued against his interpretation, for Kant "we can conceive of the possibility that the laws of nature are not systematically organized," which means that there is some contingency

in the kind of systematicity that is the case. Hence, Kitcher seems to concede too much to the necessary status of the systematicity in itself. "If, says Ginsborg (2018, p.76), as on Kitcher's view, the laws of nature were necessarily systematic, then the principle of systematicity would in effect be prescribed to nature: something that we could know a priori and not just something that we merely have to presuppose in order for reflection to be possible." It would, in other words, conflate the constitutive principles and the regulative principles, as I will explicate now.

The difference between *nature* and the *order of nature* indeed overlaps with the difference between what Kant calls "constitutive principles of experience" and the "regulative principles of reason."[4] Through its four registers of principles (Axioms of Intuition, Anticipations of Perception, Analogies of Experience, Postulates of Empirical Thought), the understanding constitutes the possibility of the objects of experience, in other words, the *form of a nature*, while reason gives rules so that the investigation of the understanding grows systematically, revealing a *systematic nature* as its object. If nature as such were ordered, this would mean that the regulating principles of reason are even constitutive, since the order of nature they establish would be consubstantial with the form of a nature constituted by the principles of understanding.[5]

However, Kant first points out that "constitutive" and "regulative" are relative terms, since while the "mathematical principles of the understanding" (Axioms of Intuition, Anticipations of Perception) are constitutive in relation to intuition (by regulating the synthesis of representations so that an object of intuition can be represented in it), the "dynamic principles" (Analogies of Experience and Postulates of Empirical Thought), by specifying the conditions under which a sequence of intuitions enables us to bring an object into existence, do not constitute intuition itself, and are therefore only "regulative for the intuition." He then adds that these dynamic principles are "absolutely constitutive with respect to *experience*, insofar as they make a priori possible the concepts without which no experience would take place" (A664/B692), whereas the principles of reason are in no way constitutive with respect to empirical concepts. Why is this? Because "no schema of sensibility can be given that corresponds to them, and hence they can have no object *in concreto*" (A664/B692). A schema of sensibility is a rule for constructing, in intuition, through the imagination, an object that falls under a concept. For our principles of reason, such a rule does not exist, because nothing can be represented in intuition that concerns the Unconditioned, which is the ultimate object of the syntheses required by reason. Therefore, the principles of reason cannot *constitute* the possibility of an object for the Ideas of reason, and in this sense, they are only "regulative." The difference between regulative and constitutive lies in the fact that our understanding thinks under a sensible condition, forming concepts that have objective value only through their relation to intuition—in other words, it is a *discursive understanding*. Its being discursive is the reason why *constitution by understanding* and *regulation*

by reason are two distinct, and that ultimately *nature* and the *order of nature* are not equivalent.

In *The Only Possible Argument*. . ., the difference between nature itself and the order of nature had no status, because the laws of nature flowed directly from the essence of God, who is *also* the principle of their unanimity, so that the order of nature was created at the same time as the laws that constitute it. The corresponding difference between understanding and reason, essential in the first *Critique*, had no place here either. Moreover, in 1763, these laws of nature seemed to be knowable a priori, as shown by the reference to the principle of least action. The possibility of a nature disordered in its empirical rules, and leaving no room for methodology, therefore makes little sense: order comes at the beginning, posited with the a priori laws of nature insofar as they agree in God; and *at the end*, since as we have seen, even though at the outset they posit a disordered state of the world, the laws, having their source in God, feature a tendency to order themselves. This is demonstrated through the genetic epistemology that goes hand in hand with the theology of the 1763 essay (see Chapter 3).

Where there is no apparent necessary order, i.e., where there is contingency of order, this treatise resorted to "divine technique" (see Chapter 3). Now, the *Critique of Pure Reason* can no longer do so, insofar as God cannot be posited as existing (one knows that all proofs of God were dismissed therein, because they wrongly assume that reason can know the Unconditioned). In Kant's *critical* philosophy, the main difference formulated in *The Only Possible Argument*. . ., between necessary order founded in the essence of God, and contingent order founded in divine technique, has shifted to the difference between *nature* (constituted according to its laws by the legislation of the understanding) and the *order of nature* (contingent with respect to the former, and requiring an appeal to the transcendental presupposition of reason elucidated in the "Appendix to the Transcendental Dialectic"). The contingent order no longer has any status.

But the epistemology-theology alliance which governed *The Only Possible Argument*. . . and which made it possible to reduce the apparently contingent order to the necessary order—this alliance is then broken in the first *Critique*, not only by its critique of theology, but above all because the first Antinomy of Pure Reason has disqualified any genetic epistemology by rendering in principle illegitimate any speculation on the beginning of the world.[6]

The problem of order has thereby changed radically since 1763. There are no longer two types of order—one naturally necessary, the other contingent, but more often than not reducible to the former by a "genetic epistemology"—but rather a single order, no longer founded directly in nature, but supplementary to it: the systematic unity of nature. In it, there is no way of distinguishing the contingent from the necessary: the only order that could be called necessary in the strict sense, that of subordination to the a priori laws of nature, is not "the order of nature" but simply the legislation of the understanding with respect to nature; and in relation to it, "the order of nature" connecting empirical laws remains

entirely contingent. Understanding this order, then, is not a cosmo-theological inquiry, but an investigation of the *exercise of reason,* since it is founded in it and not in the understanding and its correlate, the "formal nature."[7] "Order of nature" stems from reason and only makes sense to us: *we* must presuppose systematic unity for there to be empirical truths (i.e., the empirical laws of nature).

Briefly, because nature is phenomenal (it is, as the *Prolegomena. . .* put it, "the existence of things under causal laws"), it makes no sense to distinguish between the inherently necessary order of the empirical laws of nature and a contingent order, because this would imply that we have the means to decide this difference, i.e., to show how one follows from God, which presupposes knowledge of things in themselves. Hence, in contrast to *The Only Possible Argument. . .*, the order of nature in the *Critique of Pure Reason* appears univocal.

I will now clarify this claim by scrutinizing the way reason can legitimize a systematic unity of nature, in the "Appendix to the Transcendental Dialectic." This will lead us, on the one hand, to set out the relationship between the theme of order and the problem of God after Kant's critical turn (§2), and, on the other, to understand the status of life in the context of the first *Critique* with regard to the investigation of rational operations now required by the question of order (§3).

5.1.3 Systematicity and natural kinds

How does this transcendental presupposition of one force work in practice? How does it ensure the systematic unity of nature, which, as we have seen, must be presupposed in the object itself (phenomenal nature) and not just logically, if the hypothetical use of reason is to be possible?

To work out the determination of forces on the horizon of a single force is to presuppose that the various forces at bottom will be *of the same kind*. For reason, the systematic unity of nature thus takes place as the possibility of grouping natural things under genera and subordinating these genera to one another. This is why Kant can find "hidden beneath the philosophers' principles" the transcendental presupposition of systematic unity. What are these principles? That can always reduce individuals to species, and species to genera; that each genus is divided into a multiplicity of species; that can go from one species to another by continuous transition. In this way, the possibility of a systematic representation of nature is ensured.[8]

A philosopher today acknowledges that Kant touches upon the problem we know as the "natural kinds." Of course, for a transcendental philosopher, "natural" does not mean "absolute" but "phenomenal"; and phenomena (*Erscheinungen*) are in principle framed by the understanding and our sensibility. However, even in the transcendental perspective, the question of the difference between well-founded groupings and spurious classes remains. But before asking what are the proper groupings, ontologically founded, the Kantian philosopher should

ask why such a difference makes sense. In other words, why are there some real groupings? Intuitively, of course, "kangaroos" is a more ontologically grounded group than "my left yellow sock, Batman and Federer's Ferrari Testarossa." But isn't this only a superficial appearance? After all, if all nature is *Erscheinungen*, why can we make differences between groupings, and say some are more real than others? This is a deep issue, which touches upon the claim Kant often makes, that his philosophy is an "empirical realism" as well as a "transcendental idealism"; in other words, even though it connects any possible nature to our forms of thinking or experiencing, it preserves the notion of reality and the fact that some apparent things are real and others are not. The existence of objective classes, ontologically grounded generalizations, contributes to corroborating empirical realism.

A first and natural answer to the question of the possibility of real groupings would be to appeal to the laws of nature, which are so real that they actually constitute nature (i.e., the meaning of the term "nature"). However, because of the difference between nature and the order of nature, one cannot make this argumentative step: laws cannot provide us with an ordered world, because nothing in them allows for grouping empirical laws of motion under more unanimous super-laws (or super-forces, to the extent that laws often include specifying forces.) One could surely formulate generalizations in terms of physics, but nothing more than concepts related to matter and motion could be derived; hence, no hierarchical structure such as species and genera, which constitute the grammar of natural kinds. Kant's solution consists in justifying the possibility of "natural kinds" by justifying that nature shows some systematicity, given that a form of systematicity is precisely the possibility of grouping individuals into species lumped into genera, or splitting genera into species.

Once again, Kant's approach relies on identifying beneath rules that seem merely methodological (classifying, dividing, looking for links) the transcendental presupposition without which the logical rule would have no applicability in nature (A654/B682), and ultimately no meaning. Thus, the logical principle of the subordination of kinds presupposes a transcendental principle of the homogeneity of phenomena. Similarly, the principle according to which each genus should be divided into species, species into subspecies, and so on, is not a law for classifying concepts, but presupposes a transcendental principle of specification according to which a genus of objects comprises individuals who are divided into species, subspecies, etc.

> From the sphere of the concept that designates a genus, we can as little see how far the division of it might go, as from the space that can contain matter. Hence each *genus* requires various *species*, and these, various *subspecies*, and since none takes place that does not always in turn have a sphere (extension as *conceptus communis*), then reason in all its extent demands that no species be considered in itself as the last, because, since it is always a concept, which

> simply contains within it what is common to various things, this concept is not completely determined, and consequently it could not be related directly to an individual, but would have to contain under itself other concepts, i.e. subspecies (A655/B683).

This is the *logical principle* of specification. It is based on the very nature of concepts, insofar as they cannot *directly* designate an individual, because they are made up of common characters (i.e., their comprehension), hence they are not "completely determined," as Kant says. If they could, if they completely determined an individual, they would be real essences, and we would return to Leibniz, because the understanding could know the complete notion of an individual (i.e., all its predicates, necessary as well as contingent, spatio-temporally situated) and ultimately its existence.[9] Hence, there would be no cut-off between concept and existence, hence between understanding and intuition. The last concept would be "felt."

However, "it is easy to see that this logical law would also be meaningless and without application, if there were not at its foundation a transcendental *law* of *specification*," a law that "prescribes to the understanding to seek, for every species that presents itself to us, subspecies, and for every difference the smallest differences" (A656/B684). The very possibility of conceptualizing by genus rests on this presupposition of specific diversification: without it, concepts could group nothing together, for "if there were no *inferior* concepts, there would be no *superior* ones" (A656/B684). In this sense, reason requires that the matter to be determined—namely, the comprehension of the concept—lend itself to division into species, subspecies, etc., and so on *ad infinitum*. Yet this infinity is not given[10] but, as that of a regression in the series of the conditions, it is produced by the very act of determining sub-sub-sub-sub-. . .-species. Such a specification is mandatory because, without it, the understanding could not know any particular: it has no intuitions, and therefore knows nothing about individuals. Faced with the intuition of an individual, the understanding can only propose a concept that will be too broad (it will ultimately encompass other individuals); it must therefore refine this concept, which will display a division into species, only one of which contains the individual in question, and subdivisions. Each new determination of the individual yields a fresh division of the species into subspecies, and a reduction in the extension of the concept to which the individual belongs.

We have a discursive understanding, which does not know individuals, but determines intuitions by concepts. This requires that between the genus and the individual, the extension of the genus can be divided into an infinite series of increasingly minute differences, at the end of which we would ideally arrive at a concept of extension one, which would be equal to the individual itself.[11] This requirement is no mere logical rule, again, because it rests on the very structure of our power of knowing; it is more than a rule of subsumption valid for the logical use of the understanding alone.

Nor can it be said that the law of specification is empirical, and simply reflects human experience of the great diversity of nature around us. For if this were the case, we would not understand why we seek diversity even when the senses seem to detect only similarity, as is the case in scientific activity. Thus, an a priori principle is at play here.

Finally, the principle of genus homogeneity and the law of specification have complementary meanings because they express the opposite "interests" of reason. The former expresses reason's requirement from the point of view of the extension of concepts: to be able to obtain concepts of ever wider extension; the latter, from the point of view of comprehension: to reach concepts that are more and more determined. "The understanding, in the first case, thinks many things *under* its concepts, in the second case, it thinks more *in* each of them" (A654/B682). This is why these two principles are presented in the same terms as conditions for the exercise of the understanding. In pragmatic terms, in current talk about science, privileging one or the other would yield what we often call the lumpers' style and the splitters' style of inquiry.

Hence, "we must," writes Kant, "in consideration of it [=empirical truth] presuppose the systematic unity of nature as objectively valid and necessary" (A654/B682), and we have seen how indeed the possibility of empirical truth requires the transcendental presupposition of the systematic unity of nature. In other words, following the same inspiration, Kant links considerations of genera to the possibility of the explanation of things. The principle of homogeneity excludes a diversity between individuals so large that no comparison would be possible, which means that, insofar as the empirical concept results from a triple act of comparing characters/abstracting of common characters/reflecting,[12] no concept would be forgeable.[13]

At the same time, the act of comparing only makes sense if we expect variety in things. A single genus, not constituted by the collection of its species, would not even have a name. In it, we would think of nothing definite. "We have an understanding only under the presupposition of diversity in nature" (A657/B687). In other words, the logical principles of genus homogeneity and specification presuppose the corresponding transcendental principles, because otherwise there would not even be an understanding capable of applying these logical laws (more precisely, of forming concepts to which it could then apply them).

Consequently, Kant can write that reason "prepares the field for the understanding" (A657/B687): without its transcendental presuppositions, the understanding would certainly have its categories and the principles it forms to make experience possible, it would constitute a formal nature, but it would have no matter to think about in nature. A nature without order would certainly be a nature, susceptible to the (partly)[14] a priori physics set out in the *Metaphysical Foundations. . .*, but it would not allow for any empirical knowledge. In a way, this "preparation" is analogous to the relationship between understanding and

intuition, which can, through original synthetic apperception, unfold a field of possible intuitive objects accessible to intuition.

Thus, the logical "principles of philosophers" as "school rules" presuppose transcendental principles from which a systematic knowledge of nature, and hence an empirical science, is possible for the understanding. "Reason prepares the field for the understanding: 1. by a principle of *homogeneity* (*Gleichartigkeit*) of the diverse under higher kinds, 2. by a principle of *variety* (*Varietät*) of the homogeneous under lower kinds"—and Kant continues: "in order to complete systematic unity, it adds 3. A law of *affinity (Affinität)* of all concepts, which orders a continuous passage from each species to each other through the gradual increase of diversity. We may call these principles: the principles of *homogeneity*, *specification* and *continuity*" (A657/B687). The third is the union of the first two, just as in the table of categories the third one always resulted from the union of the first two. For if we follow the first two principles, "all diversities are related to one another, because all together derive from a single supreme genus through all the degrees of expanded determination" (A658/B686).[15]

But then the status of these three maxims of reason becomes problematic. They are transcendental presuppositions hidden beneath logical-methodological rules.[16] They therefore have, "although they contain only pure ideas for the conduct of the empirical use of reason (which reason can only follow asymptotically, i.e., simply by approaching them, without ever reaching them), (. . .) *an objective though indeterminate validity*, and serve as a rule for possible experience" (A663/B691, my emphasis). But to say that the maxims of reason, based on "reason's interest in the completeness of possible knowledge of the object"[17] (A666/B694), have "*objective validity*," is this not to attribute an objective reality to the Ideas of reason? Doesn't this go against everything that Transcendental dialectic teaches? Is the nuance conferred by the word "indeterminate" in this sentence enough to neutralize such an objection?

We face a surprising situation here. The transcendental principles of reason are there to broaden and systematize the empirical use of the understanding. Without transcendental principles, the understanding would only be able to deal with some of the given, to legislate on it according to its principles, but not to go any further, especially to make assertions about what it cannot yet see, and finally to *find laws*. Kant recounts the discovery of planetary orbits and the force of attraction, to show that astronomers successively used the principles of specification, affinity (orbits are not circles, they are assumed to be elliptical, i.e., a figure from which the circle is continuously derived) and homogeneity (to posit the force of attraction). This reasoning clearly shows that the creative process of science is based on the three principles of reason.[18] Without them, the understanding would be unable to make any discoveries, because it would not be able to go much further than the naturally given constituted according to its synthetic principles for example, it would probably not have been able to go from the table of planetary positions, a non-circular table obtained by Tycho-Brahé, to the

supposition of an elliptical orbit. A contemporary philosopher of science would notice that this account of the explanation of the revolutions in the solar systems easily translates into the current account according to which the best model of a data set achieves a trade-off between simplicity (here, homogeneity according to the first Kantian rational principle) and inclusion of data (here, diversity according to the second Kantian rational principle).

Kant is thinking of such an extension of knowledge when he writes: "if we want, beyond the objects that are before our eyes, to see at the same time those that are far behind us, that is, if, in our case, we want to push the understanding above any given experience (part of the whole possible experience), *consequently if we want to take it to the greatest and most eccentric extension*." (A645/B673, my emphasis). So, "if we want" this, we must posit the transcendental maxims of reason. They thus allow the systematic extension of the use of the understanding.

But "if we want to see behind the objects before our eyes . . .," writes Kant, then a necessary illusion results, analogous to the optical illusion provided by a mirror. But how? Reason makes converge the "lines of direction of all the rules of understanding" at a "point which, although it is only an Idea (*focus imaginarius*), i.e., from which the concepts of understanding do not actually proceed, insofar as it is quite outside the boundaries of possible experience, yet which by this allows us to constitute for it the greatest unity combined with the greatest extension" (A644/B672). The illusion then consists in the fact that "all these lines seem to start from an object that lies outside the field of possible experience," in the same way that the reflection of a thing seems to stand beyond the mirror.[19] So, as soon as we want to extend our experience, "to see beyond the objects that are before our eyes," this mechanism of illusion comes into play: "this illusion (for which we can ensure that it does not deceive) is inevitably necessary" (A644/B672).[20] Thus, if we want to systematically extend knowledge, we employ the principles of reason, so that appears the image of an object beyond experience, which is the very object of the Ideas of reason.[21] The solidarity between the transcendental principles of reason set out in this first part of the Appendix to the Transcendental Dialectic, and the Ideas of reason, is revealed here: to employ the former to ensure the systematic extension of knowledge, is to make the content of an Idea appear as something objective, as a *Gegenstand*, an object facing us.

Hence, the objectivity of transcendental principles of reason. But how can this illusion not deceive? How can reason both make an object appear in front of it and, at the same time, not endow it with effective reality, which would be to endorse the transcendental illusion? This "mirror question" is answered in Part 2 of the "Appendix to the Transcendental Dialectic," "Purpose of Natural Dialectics." By examining it, I will finally be able to answer the double question that interests us here: how can critical thought guarantee the order of nature that God in *The Only Possible Argument*. . . founded, and by the same token, what status is granted to life, which this latter text thought of under the category of contingent order and divine technique?

5.1.4 Object-within-idea and order

The Kantian first answer to the mirror question can be summed up in a few words: we must distinguish between a thing "given to my reason as *an object (*Gegenstand*) absolutely*," or given as an "*object in the idea*" (A670/B698). In the first case, an object is determined by concepts: a force, a substance, etc. In the second, "it is effectively only a *schema*, to which no object is given directly, not even hypothetically, but which serves to represent to us other objects in their systematic unity, by means of the relation to this Idea, consequently *indirectly*." (A670/B698, my emphasis) In other words, what is posited is not the actual existence of the object, but only something in relation to the systematicity of the objects of experience (hence, indirectly). The object is in the Idea, in the sense that the Idea anticipates the systematicity of the objects of experience, and the object is posited with this systematicity itself. You cannot think of systematic extension without also thinking of the object, just as you cannot look into a mirror without seeing your reflection *behind* the mirror (and not in it).

Two points need to be emphasized to understand the status of the object-within-idea:

- The role of the schema in understanding *indirect* object relationships (a).
- The importance of the "relative" position of the object-within-idea (b).

(a) First of all, concepts have an objective reality only because they necessarily relate to the objects of intuition, as the Transcendental Deduction showed, and conversely, the latter are only thinkable under such concepts. But then, concepts can only relate to objects through the schemas formed by the imagination, i.e., the rules for constructing a concept in intuition, so that concepts can effectively subsume the object of intuition. Now, if "understanding constitutes an object for reason, in the same way that sensibility constitutes an object for understanding" (A664/B692), the fact remains that reason finds no schema in intuition for the systematic unity of all the concepts of understanding, a schema that could determine the unity demanded by reason, in the same way that the schema of intuition makes it possible to determine the concepts of understanding in relation to objects.

Nevertheless, there is a *rule* for constructing systematic unity in the understanding: this rule is "the idea of a maximum of the linking and division of the understanding's knowledge in a single principle" (A665/B693).[22] This rule obviously echoes the principle of reaching the highest possible synthesis, which drives rational activity.

More generally, the rational Idea is in itself the "concept of a maximum": "When we name an idea, we say *a great deal* in relation to the object (*Objekt)* (as the object (*Gegenstand)* of pure understanding), but we say *very little* in relation to the subject (i.e., in relation to its effectivity under empirical conditions),

because the idea, as the concept of a maximum, can never be given congruently" (A327/B384). Once again, this notion of maximum crucially relates to Leibniz's idea that God is always maximizing (e.g., the quantity of reality in the world that he actualizes among all possible worlds), and that our reason is of the same nature as God's reason since it is always computing extrema. Nowadays, theoreticians of rational choice would agree to this latter claim; and philosophers of science's idea that a model for the data is an optimal trade-off between simplicity and the richness of data, as emphasized above, also connects to this Leibnizian-Kantian idea of reason as *maximization*. What Kant did in his critical turn, parting ways with Leibniz, consisted in conserving this assimilation of reason and maximization operations, but rejecting Leibniz's idea that this is homologous to God's reason, since for Kant our discursive understanding is different in nature from any intuitive understanding, because the separation between concepts and intuitions that defines the discursivity of understanding is, in principle, the finitude of our thought.

Concerning in particular the question of the "object-in-the-Idea," with this rule of the "maximum of the linking and division of the understanding's knowledge in a single principle," despite everything, we have "the analogue of a schema."[23] "The idea of reason is the analogue of a schema of sensibility," but since applying concepts of the understanding to the schema, i.e., systematizing them, does not provide knowledge of the object, the ideas of reason have objective reality only *indirectly*.[24]

In this sense, the objects of ideas, analogues of a schema, can be themselves thought of as analogues of actual things: "they are not to be admitted in themselves, but their reality is valid only as that of a schema of the regulative principle of the systematic unity of all cognitions of nature, consequently they should be *grounded only as analogues of real things*, and not as themselves actual" (A674/B702, my emphasis). This analogy clarifies the uniquely relative status that Kant recognizes for the object-in-idea, as we shall now see.

Indeed, Kant thus achieves for the Ideas of reason the analogue of the "transcendental deduction of the pure concepts of the understanding," i.e., the explication of their proper kind of objective reality, even though such Ideas, as impossible to relate to experience, have no objective reality in the proper sense.[25]

Such a deduction proceeds by a double movement, in which the position of the object-in-the-Idea intervenes only secondarily. First of all, the Idea of God, the Idea of the soul, and the Idea of the world are merely ways of proceeding in the unification of knowledge. The Idea invites us, in the three domains of internal experience, of the series of conditions of phenomena, and of the whole of possible experience, to act *as if* psychic acts and states were the changing phenomena of a simple soul-substance, *as if* the series of conditions were infinite while leaving room outside it for intelligible causes, and *as if* finally the whole of phenomena were an absolute unity which at the same time requires at its foundation a reason subsisting by itself from which precisely phenomena are derived.

The "*as if*" marks the regulative status of such ideas. Thus, the phenomena of the soul do not actually derive from a thinking substance, but "derive from one another according to the Idea of a simple being," and the order of the world does not derive from a supreme intelligence, but we ourselves derive from "the Idea of a supremely wise cause" the rule for linking causes and effects in the world (A673/B701). Yet, the Idea of the world does not itself provide a rule, because it gives rise to antinomies.

(b) However, Kant goes even further: "nothing prevents us from admitting these Ideas as objective and hypostatic," except the Idea of the world, because of its antinomies. Insofar as, being without contradiction, we can think them, and insofar as, on the other hand, they cannot be determined by categories, we cannot therefore deny the existence[26] of their objects—and then we can indeed admit such objects. But what we have here is an object whose nature cannot be determined; it can only be conceived *in relation to* the set of phenomena whose knowledge it enables us to systematically grasp. The supposition of the object-in-the-Idea is therefore not the absolute supposition of an object, but its "*suppositio relativa*" (A676/B704)—Allison speaks of a position as "intentional" rather than as extra-mental existence.[27] And this relative supposition *goes hand in hand*, ultimately, with the very use of the Idea as a regulative principle.[28]

We therefore assume an object, but one whose nature is indeterminate, a "something" whose relation to the totality of phenomena is all we know; this "something," the object of the Idea, we cannot speak of according to categories, since it is outside the realm of possible experience. But we do think of its relationship to the whole of phenomena, which is "analogous to that which phenomena have with one another" (A674/B702)—that is, a *relationship of condition to conditioned*. In this sense, we can use the same *language* to describe the relation of this indeterminate something to experience as we use to describe the relations among phenomena: causality, substance-accident relations and so on. The same language—provided that we firmly hold that it no longer determines objects, but only an object in *relation to something else*, an "object" in a relationship.[29] The objective reality of the Ideas is therefore analogical, in the sense that we can only speak of their reality analogically, and "analogical" then goes hand in hand with "relative."[30] This conception takes over from the doctrine of God as the essential foundation of the necessary order in *The Only Possible Argument*. . . .

The object-in-the-Idea thus described by analogy is thereby the support of a rule for systematizing the use of reason—*or*, *again,* it is the rule itself. This is why Kant can say, as we have seen, that the Idea is the analogue of a schema, and, elsewhere, that its object is the analogue of real things—or again, further on, that the object, this "transcendental thing," is "simply the schema of the regulative principle by which reason extends, as far as it is within it, systematic unity over all experience." (A682/B710) For the object-in-the-Idea is inseparable from the *analogical language* that expresses it; absolutely indeterminate in nature, it is

even reduced to this language. Yet such *language* ("God causes the world," etc.) is precisely *the very rule* that enables knowledge to be stated systematically: all phenomena as ordered in God, states of mind as manifestations of the same soul. The Idea is the *principle* of unity (cosmological, psychological, theological), the object is the *schema*, i.e., the rule, i.e., the legitimate language for expressing experience according to this unity. In this sense, we can reject Bennett's critical interpretation that the Ideas of Reason "shed no new light on antinomies" and are ultimately useless in the Dialectic.[31] The transcendental quasi-deduction of the Ideas was the *justification for a language*, a language that speaks not of objects, but of our very knowledge of objects. An "indirect" language, then, as Kant insisted, which turns out to be an analogical language.

5.2 Purpose and life

5.2.1 The purposiveness proper to life?

The systematic unity of knowledge according to the Ideas of reason appeared to be a particular language: that of *finality*. "The highest formal unity, which rests solely on the concepts of reason, is *final* unity" (A686/B714). Here we find the same approach as in *The Only Possible Argument*. . ., but inverted: in that work, the multiple finalities of nature were basically an order; here, order leads back to finality. However, this finality is enriched by the achievements of *The Only Possible Argument*. . ., i.e., the deletion of the intentional character of finality, since purposiveness as a system lost all technical-intentional meaning. Purposiveness *is* now systematic order. As we can now see, finality as a technique and contingent order have disappeared.

Purposiveness is no longer something to marvel at in reality: it is the *language of reason tackling nature*, the language by which reason establishes its correlate, the order of nature.[32] One sees the absurdity, at this level, of a question about the *reality* of finality in nature, since it would be a question about the reality of a language. This is why, conversely, no counter-example, i.e., no discovery of a merely mechanical link where a teleological link (*nexus finalis*) was expected, can undermine the language of finality (A687/B715).

If the category of contingent order has disappeared, if all that remains is the purposiveness language, whereas *The Only Possible Argument*. . . thought of life in terms of divine technique, what status can this "technique" receive in terms of theoretical reason according to the first *Critique*? What happens to the problem on which we left Kant in 1763, namely the hesitation as to the very status of the living? In particular, what about the pages in the "Goal of Natural Dialectics" where Kant refers to the use of finality in physiology and anatomy? Let us explicate it.

Insofar as the systematic unity prescribed by pure reason is purposiveness, "the speculative interest of reason makes it necessary to consider every order in the world

as arising from the intention of a supreme being" (A686/B714). But once again, the "as if" should remind us that there is no objective intention at all in this order of nature; on the contrary, it is simply a metaphorical language for talking about nature. If systematicity itself is the subject of a transcendental presupposition—in other words, it is objectively presupposed in nature as phenomena—then divine intention is just the scheme we ourselves use to establish this presupposition. We presuppose a supreme creative intelligence "only in the Idea," says Kant; but through it, "new views" are offered to reason, insofar as it can "bind the things of the world according to teleological laws" (A687/B615).

The first example Kant gives of teleology is geography: here, teleological language allows us to make discoveries. In particular, he says in a note, that if the advantages of the Earth's sphericity are known, then those of its flattening at the poles, if admitted in advance, allow us to discover that this alone prevents earthquakes and mountainous projections from displacing the Earth's axis. Then Kant adds, in implicit reference to the genetic hypothesis of the *Universal History and Theory of the Heaven*: "And yet this wise disposition is unhesitatingly explained by the equilibrium of the once fluid earth mass." (A687/B615) The very approach taken in the 1763 treatise is recalled here: the apparently useful benefit results from the continued effect of mechanical laws. In no way does Kant rehabilitate a divine intention at the bottom of things: intention is simply a language that enables us to identify facts requiring a physical explanation. In other words, to see the Earth as the result of a divine intention is to ask how its very form can be useful to itself, or how, insofar as it is the way it is, it can persevere in its being. To see the polar flattening as the result of an intention, then, is to seek in what way this flattening contributes to the Earth's stability.[33] And from there, according to the genetic epistemology described previously, this contribution can be explained mechanically.

This case represents an important shift in the very concept of finality, from the moment Kant reintroduces it in the context of this Appendix—once its merely regulative use has been specified—because here, the final disposition in question is a disposition of the Earth *toward itself*. In terms of *Critique of the Power of Judgment*, there is no (immediate) question of relative finality in the purposive language of reason toward nature (namely the "for what?" or "for whom?"). And the same laws that have contributed to the Earth's formation have given it the orderly shape that preserves it from the accidents that geology can inflict. Here, then, Kant remembers a fundamental lesson from *The Only Possible Argument*. . ., namely, that teleological dispositions do not necessarily derive from any causality other than that of the laws of physics, as was the case with the benevolent tropical winds. This is why, once again, the discovery of mechanical links where there is a teleological benefit—that is, where we might expect *nexus finalis*—in no way contradicts the language of finality. "This counterexample cannot reach the law in its universal and teleological intention in general" (A688/B716).

Such a geological example announces the second one, namely, *anatomy*. Just as reason presupposed a purpose for the Earth, so anatomical reason presupposes a purpose for every part of the organism. "Physiology (of physicians) also extends its very limited knowledge of the purposes of the members of an organic body by a principle, given simply by pure reason, and so far-reaching that it admits, quite boldly and at the same time in the agreement of all the understandings, that *everything in animals has its utility and a good intention*" (A688/B716, my emphasis). Purpose, here, is the language by which the physiologist can *expand and systematize* her knowledge of the animal: expand, since it makes it possible to speak of *functions*—and thus to investigate the processes by which organs perform functions; systematize, since all these processes can then be united with one another insofar as they *contribute* to the existence and preservation of the whole animal.

But purposiveness in no way characterizes the animal as such. Once again, it is a language that reason uses to discover and unify phenomena; it cannot be concentrated in a particular object. At this level, a "natural purpose" such as the *Critique of the Power of Judgment* will attempt to formulate is still unthinkable. The physiologist is only a slightly expanded version of the geologist, in terms of the use of purposiveness. Insofar as it is ordered, the whole of nature, including living things, is amenable to a teleological reading that both synthesizes it and uncovers new laws. Purposiveness as a language unifies the two former 1763 faces of finality, system/necessary order, and technique/contingent order, at the cost of depriving them of any objectivity. The *Critique of Pure Reason* instates a stance today adopted by many biologists and philosophers, according to whom purposiveness is a useful way of talking about things, but this utility does not involve anything special concerning life. From 1763 to 1781, Kant followed a deflationary trajectory about purposiveness, eventually subscribing to a pragmatist and anti-realist thesis about purposiveness; the last stage of his thinking would then consist in recovering a more objective meaning of purposiveness, as I will show in Part 3.

Delivered in 1783–84, the *Lectures on the Philosophy of Religion* confirm this observation. Where finality is concerned, a passage[34] echoes several phrases from the text of the Appendix we are reading here, concerning the regulative character of the teleological vision, so that we can indeed attribute to this text a close proximity to the *Critique of Pure Reason*. In it, Kant writes: "The entire structure of the human eye, for example, shows the wise way of arriving at the goal of vision." The "exemplary" character of the eye is to be emphasized: the eye-object is not a natural purpose, but an example where it is easy to apply the rational attitude toward nature, that of the presupposition of purposiveness. It becomes manifest as the author continues:

> But our reason absolutely cannot decide whether in a certain thing it is the end itself that is encountered or, merely, the effect of still higher ends that

> constitute the whole of all ends. For the presupposition that *everything in the world has its utility and its good intention,* would go much further, if it were constitutive, than our previous observations could justify. But as a purely regulative principle it is entirely appropriate to the enlargement of our understanding and can, therefore, always be useful to reason and never detrimental to it.
>
> (*Vorlesungen über Rationaltheologie*, "Philosophische Religionslehre nach Politz," Ak. XXVIII, 2, p.2)

The underlined words are taken in their entirety from *Critique of Pure Reason*, except that Kant has substituted "in the world" for "in the animal": it is difficult to show more clearly that finality in 1781 in no way characterizes the status of the living. The living is not *essentially* to be considered teleologically; it is *exemplarily* teleological.

It should then be noted that this purposiveness, which is not *essentially* connected to life, is characterized by the predominance of the notion of *utility* within it. It is no coincidence that the example taken is precisely physiology, i.e., a discourse in which finality appears as the relation of a means (the organ) to a determined end (the function), so that, on the one hand, this conception could very well fit in with the Galenic and classical vision of the organism as a set of *organons*,[35] and, on the other, there is an immediate tendency to relate this finality to an intention, the physiological function being precisely this intention. This means that the passage quoted on finality in physiology is not yet in tune with the epistemological transformations I have been analyzing, through which the concept of organism took on its new operative significance for the life sciences. Finally, the understanding of purposiveness as utility effectively precludes the idea of any difference—ontological or even epistemological—between the utility of some of the Earth's dispositions and those of animal parts.

However, this text is interesting in another respect. The Kantian argument points to the impossibility of deciding on the purpose encountered: namely, is it a purpose itself, or the effect of another end? From the point of view of constitutive teleology, i.e., positing the purpose within the object, this question would be a real problem. But since teleology is merely regulative, Kant points out, hence the end is not posited in the object (i.e., the object is not objectively posited as the fruit of an intention), so it is irrelevant to decide the alternative, the essential point being the heuristic and systematizing role of the teleological presupposition.

Nevertheless, the choice between purposiveness and effect of a higher end was precisely a question addressed by *The Only Possible Argument*. . ., a question which often leads to rejecting finality-intention in favor of finality-system. That such a question is entirely neutralized here by the regulative conception of teleology indicates that the intentional-technical dimension of purposiveness, despite the vocabulary, is totally neglected in C*ritique of Pure Reason*.

5.2.2 Kantian purposiveness in 1763 and 1781: the case of the living

Here we see the difference between the first *Critique* and *The Only Possible Argument*. . . . While in the oldest text, the status of the living world wavered between the contingent order (and thus a certain specificity in relation to inorganic nature) and the necessary order (and thus immersion in inorganic nature), now the difference between the living and the inorganic seems totally blurred. Or, to be more precise, purposiveness cannot serve as a philosophical criterion for marking this difference, precisely because the type of finality that rigorously allowed us to think of it in 1763 (i.e., finality as technique) is neutralized here.

This may be hard to accept, since the very text of *Critique of Pure Reason* speaks of divine intentions. What I mean here is that, for Kant, divine intention is merely language, and in no way *explains* anything, or gives us anything to know or even to think about the object under consideration. ("Or even to think about," because what is thought about in finality, an idea authorized by the analogical status of discourse, is precisely the object in the Idea, i.e., God, and not the natural object that we relate to God as to its cause). Remember: in *The Only Possible Argument*. . ., Kant precisely criticized the abusive use of technical-divine purposiveness as an explanation, but left open the possibility of its use in a few rare cases, including some of the living. Now, we can freely speak of "divine intention," because we know that it has no status in any objective knowledge.

But how can we *both* reject the hyperphysical assumptions of a "lazy reason" in the face of order and finality: namely, imagining a purpose for each event, as Voltaire caricatured Leibniz's *Theodicy—and* "consider all order in the world as if it resulted from the intention of a supreme reason"? To answer this question, a clue is given in the Appendix to the Transcendental Dialectic, precisely when Kant shows how to avoid the sophisms of "lazy reason." For him, the intention or goal must always remain presupposed at *a certain level of generality*, a level too general for explanations to be deployed, for when we enter into particularities, then we must explain naturally:

> We can avoid this error if we do not only consider, from the point of view of ends, a few parts of nature, such as the division of the continent, its structure, the constitution and disposition of mountains, or even the organization in the vegetable and animal kingdoms, but we make this idea of a systematic unity of nature, in connection with the idea of a supreme intelligence, *completely universal*. For then we put at the foundation a purposiveness according to the universal laws of nature, to which no particular arrangement is an exception, although it only lets itself be known more or less by us, and we have a regulative principle of the systematic unity of a teleological connection, which we do not determine in advance, and in the meantime, we must pursue the physical-mechanical connection according to universal laws.
>
> (A691/B719)

This text follows a major inspiration from 1763, namely, that purposiveness is finality according to universal laws. As I said earlier, particular purposiveness, "contingent order" according to *The Only Possible Argument*. . .—which conceived of this category but did not unconditionally assert that anything would in reality correspond to it—has now been eliminated. In this sense, purposiveness in 1781 is reconciled with physical-mechanical laws, and *transcendental methodology* (of the use of hypothetical reasoning about nature) with the *goal of natural dialectics (*about the Idea of God). In *The Critique of Pure Reason*, Kant does indeed lean toward the reunion of the living and the nonliving as outlined at the end of *The Only Possible Argument*. . . . For the *Critique* also points out, once again, that the purposiveness thus understood, precisely in order to be acceptable within the criticist framework, must be much more general than "the animal and vegetable kingdom." At the same time, this is not a mechanistic solution, in which both living and inorganic beings would be ontologically of the same kind, all explainable by physics.

Why not? Precisely because not only can the presupposition of finality and the transcendental methodology of hypotheses be reconciled, but *they are basically the same thing*. You only have to look at the entire Appendix to understand this. If we are to avoid hyperphysical hypotheses, and in particular not to appeal to special dispositions or forces outside the scope of physics, this is, as I have amply shown, because the systematic unity of nature prescribed by reason translates into the presupposition of *a single fundamental force* in nature, indeterminate, never objectively posited, but whose reality consists precisely in prohibiting the multiplication of objectively different forces. Now, *the systematic unity of nature* unfolds in presuppositions that are not, as we have seen, merely subjective and methodological theses, but *transcendental principles* endowed with a certain objective reality. Ultimately, these principles imply the *position of the Object-in-the-Idea*, which is expressed in the language of purposiveness, and hence the analogous use of the term "intelligence" in the above-quoted phrase "idea of a systematic unity of nature, in connection with the idea of a supreme intelligence."[36] Teleological language about nature in general, and the search for uniquely physical and non-hyperphysical explanations, are thus united, not only because in the text quoted the latter comes in the expectation of a hypothetical elucidation of actual teleological links, but also and above all because they are in fact *the two faces of* the systematic presupposition of unity in nature. This also explains why the two forms of explanation known as "mechanism" and "teleology," whose Antinomy will be formulated and resolved in the third *Critique*, are not yet to be found in this first *Critique*.

Such unity is precisely what is at stake in the antepenultimate paragraph of the "Goal of Natural Dialectics":

> It must be equivalent (*einerlei sein*) for you to say, wherever you perceive it [the systematic and final unity of nature]: God designed it wisely, or nature

> wisely arranged it (*geordnet)*. Because the greater systematic and purposive unity, which your reason demands to use as the regulating principle at the ground of any investigation of nature, was precisely what allowed us to set at the ground the idea of a supreme intelligence as the schema of the regulative principle, and now, the more purposiveness you find, according to this principle, in nature, the more confirmation you have of the legitimacy of your idea. (A699/B727, my emphasis)

Natural arrangements—i.e., naturally produced, *physical* arrangements—or divine will, these are now *two* equivalent *ways of speaking*, for divine intelligence is the schema of systematic unity, which at the same time can be seen as an ordering of nature through the interplay of its immanent laws. God's technique and natural systems, distinguished by *The Only Possible Argument*. . ., are now merging.

Deus sive natura?—If you like, and we have seen how theologically close the OPA was to Spinozism. But Spinoza's position has now been reversed, as evidenced by the presence of *Weislich* in the two equivalent statements. God and nature are not two equal ways of naming the unique necessary process, but *two equivalent ways of applying the presupposition of systematic unity*. While the Spinozist formula refers both to the suppression of all transcendence and the relegation of purposiveness to the level of imaginary beings, the Kantian formula also refers to the ideality of finality, but a rational ideality and, in this sense, possessing the reality attributable to an "object-within-the-Idea." To put it another way: in the first *Critique*, the *order* of nature and God are synonymous, reminding us that order is always natural, as a result of natural laws and to be explained by physical hypotheses, as the *Critique's* Methodology puts it.

Kant can therefore go on to emphasize the reciprocal implication of the consideration of divine purposes in general and the *Naturforschung*.[37] He eventually distinguished several levels: that of *nature itself*, where laws govern events, so that we may find here rules to explain particular phenomena; that of *systematic unity*, i.e., the order of nature, never given in extenso, but present as a task of reason, and expressible in the language of purpose; that of *intelligence* or wisdom pursuing goals, an analogical vocabulary that allows us to speak *generally* of the order of nature and to pinpoint particular enigmas that must then be explained naturally—flattening of the earth at the poles, vision on the retina, etc. These three levels are not the same thing. In other words, precisely because a purpose explains *nothing at all*, we can consider nature in a teleological light, without fear of lapsing into *hyperphysics*: such is the conception of purposiveness in the *Critique of Pure Reason*.

5.2.3 The unsolved problem

An investigation of the status of life before *Critique of the Power of Judgment* could end here. No criteria for life are given in the first *Critique*; the science of life

is entirely immersed in the science of nature, with which it shares transcendental presuppositions and methodology. But then, from this point of view, the *Critique of Pure Reason* represents no advance on *The Only Possible Argument*. . . . In particular, the question of generation does not seem to make any progress, and remains in the same aporias as those of Buffon and Maupertuis, whom Kant took up again, rather taking their side in this quarrel. If, as we have seen, Caspar Wolff alone enables us to overcome these aporias, how can Kant reorganize his doctrine so that Wolffian embryology becomes thinkable?

If I take as my point of reference the initial analysis of order in *The Only Possible Argument*. . ., I can conclude that, insofar as Kant wants to rethink the status of the living and escape the aporias that his doctrine of purposiveness in *Critique of Pure Reason* has in some way solidified (specific status of the living, problem of generation), he would have to rehabilitate the type of finality that he had underrated in 1763 and that the *Critique of Pure Reason* had finally eliminated, namely contingent order or technical purposiveness.

However, in order to understand where the requirement to reconsider the status of the living through the concepts of organized being and natural purpose came from in the *Critique of the Power of Judgment*, one needs to take other elements into account. In 1775, Kant published *On the difference between human races*, an essay whose argumentation essentially incorporates considerations on the living being. It seems to stand outside the problematic of the first *Critique*. I must now retrace the thread of those questions. In the next chapter, these Kantian considerations will be discussed in the light of the profound transformations of the concept of species at the end of the 18th century, which will appear as the third positive condition for the constitution of the concept of organism (after animal economies and vital forces, Chapters 2 and 4). However, the framework of these considerations highlights shortcomings in the results of the *Critique of Pure Reason*, which would lead Kant to revisit his critical concepts.

5.2.3.1 Architectonics[38]

A new notion will serve as a common thread for understanding these unsettled aspects of the first *Critique*: architectonics. "By *architectonics*, I mean the art of systems" (A832/B860). The "system" is, in turn, "the unity of diverse knowledge under one Idea" (A832/B860)—so far, nothing new compared to the Appendix to the Transcendental Dialectic, apart from the word. But to clarify architectonics, Kant further contrasts architectonics and technique, depending on whether the Idea coordinates the ends rationally or accidentally (i.e., empirically).

> The Idea, in order to be executed, needs a *schema*, i.e., a manifoldness and order of parts essentially determined a priori from the principle of the purpose. The schema that is not projected according to an Idea, i.e., according to a purpose, that is central to reason, but empirically, according to aims that arise contingently (the totality of which cannot be known in advance) yields a

> *technical* unity, whereas that which has its origin solely in the consequence of an Idea (where reason prescribes purposes a priori, and does not expect them empirically), founds an *architectonic* unity. What we call a science, whose schema must a priori contain the outline (*monogramma*) and division of the whole into members, in accordance with the Idea, cannot arise technically, through the resemblance of the manifold or the contingent use of cognition *in concreto* for any arbitrary external ends, but architectonically, through the affinity (*Verwandtschaft*) and derivation of a single supreme, internal end, which above all makes the whole possible.
>
> (A833/B861)

The *monogramma* was already the way Kant characterized the scheme in the Transcendental analytic: intuition and concepts intertwined in a figure of time, in the same way that two initials are in embroidery. The scheme, as a rule of presentation, sketches out in intuition the form in which a concept can acquire an empirical representation. Since the Appendix to the Transcendental Dialectic, we have been entitled to speak of the scheme of an Idea of reason; and it appeared as a partition, not of space as a pure form of intuition, but of objective knowledge itself. The schema of an Idea thus outlines a division of the tasks of knowledge in a domain to be known. In this way, knowledge is architectonic: an architectural diagram is drawn up in advance. The scheme has the same relationship to the system of knowledge as the map of a palace has to the palace; and the architectonic idea then plays the role of the idea of the palace (i.e., the concept indicating its function, the number of rooms, their attributions, etc.).

But this example is not entirely accurate, apart from its triviality, because unlike a palace, a system is always incomplete: The Idea merely prescribes, and the schema outlines the form in which it is to be realized, in its very incompleteness. The Idea determines the places to be occupied by the different parts of knowledge, and the relationships they will have with one another. The term "member" is required here by Kant's thinking: not the juxtaposition of parts, but the articulation of members, in the sense that members are defined not so much by themselves as by the relationships they sustain with one another and with the Whole.

Speaking of the Idea of reason, the Appendix to the Transcendental Dialectic immediately indicates this aspect of the Idea: it determines the parts of a Whole, as members—and thus the Whole becomes a system. The systematics of reason presupposes an idea of reason, that "of the form of a Whole of knowledge which precedes the determined knowledge of the parts and contains the conditions for determining for each part its place and its relation to the others." (A645) Thus, the Idea maintains a close relationship with the living, in the sense that in an organism each member has its place determined by the whole, as the users of the concept of animal economy knew.[39] This comes indeed very close to the *Critique*

of the Power of Judgment, in which the Idea of the whole determines its parts. Thus, in the first *Critique*, the Idea of reason has an organic character.

We could even read in these texts a decisive milestone toward the thought of German idealism, which would make the identity of reason and life a guiding theme. In its highest degree, there is the Hegelian reversal, marked by the conception of Life as the first moment of the Idea, named as the "immediate Idea," which means that, contrary to the conceptions developed in the 17th and 18th centuries, life is more rational and more knowable for reason, than are the mechanical and chemical natures known in Newtonian science*, because life realizes rationality in itself*.[40]

Nevertheless, it could be argued that there is nothing more banal than comparing a science to a living thing. We can go as far back as Plato's *Phaedrus*, speaking of the good and beautiful discourse: "every discourse must be constituted like a living thing (δειν παντα λογον ωσπερ ζωον συνεσταναι), it must have a body of its own, lacking neither head nor feet, and have a middle and ends, written in such a way as to establish a just proportion between them and with the whole." (264c). However, this reference allows us, on the contrary, to underline the difference. For Kant, speaking of the system of knowledge refers explicitly to the animal body, but from a perspective that, on the contrary, takes up the terms in which the living began to appear as an organism in the 18th century.

> The whole is then articulated [*gegliedert*] (*articulatio*) and not disordered (*coacervatio*); it may, in truth, grow from within (*per intus susceptionem*), but not from without (*per appositionem*), like an animal body, whose growth adds no members, but rather, without change in proportions, makes each stronger and more suited to its purposes.
>
> (A833/B861)

The difference from Plato's comparison is the dimension of growth, insofar as it has a singular modality for the animal, namely, the mode of intussusception. We have seen how Buffon or Bourguet distinguished the intussusceptional growth of living beings from growth through the juxtaposition of minerals. In Plato's sentence, a right and true discourse resembled an animal because of its form; here, the knowledge system resembles an animal because of its mode of growth. The latter presupposes that the proportions essential to the animal are already sketched out—and this is the scheme—while the form itself is not present, but rather is constituted by a growth that would respect the outline of the scheme.

Above all, this text should not be understood as an application of a preformist model to the system of science. On the contrary, it invites us to re-examine the Kantian rejection of preformationism and to understand a new aspect of the solidarity of this rejection with all Kantian positions. In what sense?[41]

If Kant were a preformationist, i.e., if the analogy with the animal body referred to a genesis of the system of knowledge whose correspondent would be

a preformationist genesis of the animal body, we would not have at the outset a mere schema that simply sketches out the major divisions of knowledge, but the very form, in miniature, of all knowledge. The Idea would contain within itself all the knowledge, and the investigation of nature would simply consist in developing what is enveloped within it. If the Idea needs a schema, this means that it does not in itself include the content of knowledge, but requires a sketch outlining its application to nature. If the system of science were already pre-formed in the Idea, we wouldn't need the schema, because ultimately there would be no solution of continuity between the sensible and the intelligible, since in the intelligible Idea the system of the science of sensible nature would be included, so that the progressive clarification of the sensible would reveal the Idea. It would reactivate a Leibnizian notion of the sensible as a confused version of the intelligible.

There is thus a solidarity between the Kantian refusal to identify the ideal and the sensible (against Leibniz but also Hume), and the rejection of preformationism announced in *The Only Possible Argument. . .*, and which we find again in this analogy between animal and system of knowledge. Admittedly, in the *Critique of Pure Reason* (1781), as in 1763, Kant, as we have seen, cannot propose a satisfactory alternative to preformationism. Nevertheless, in its 1787 second edition (§27), when he speaks of an epigenesis of the concepts of the understanding, we find a more elaborate instance of this unity between the theory of knowledge and the search for an epigenetic conception.[42]

Later on, the cardinal notion of the "primitive germ" demonstrates how the epigenetic motif comes to the fore as soon as we start thinking about architectonic:

> unfortunate that it is only after a long period of rhapsodizing about an Idea hidden within us, and even after a long period of technical collation, that we can finally look at the Idea in a clear light and architectonically project a whole according to the ends of reason. Systems seem, like worms, to be formed by *generatio equivoca,* from the simple assemblage of concepts brought together, first truncated, then complete over time, although they all equally had their schema, as a primitive germ (*ursprünglichen Keim*), in reason simply developing. In this way, each is not only articulated for itself according to an Idea, but is also finally united with others as members of a whole in a system of human knowledge (. . .).
>
> (A834/B862)

Historically, knowledge develops through contingent assembly, a series of chance encounters; "*generatio equivoca*" means a sort of epigenesis that brings about living things from inanimate matter (opposed to "*generatio univoca*," which remains within the domain of life).[43]

But below this appearance of chancy epigenesis of knowledge, says Kant, a "germ" drives this development, which enables us to recognize the developing knowledge as a system, and to coordinate it with other systems in the general

system of human knowledge. This germ is the outline traced by the schema of the Idea, which in a way commands the development of reason, because it indicates broad outlines, without, however, determining forms and details. Insofar as it is a schema, the primitive germ does not present divisions and articulations of knowledge, but rather a rule for tracing these divisions, a rule that will apply at the appropriate moment in the development of reason, and that remains invisible at the beginning.

Thus, Kant sketches here a kind of epigenetic theory in which the rational form of the result, insofar as it cannot be the result of chance, must at the same time refer to a pre-established outline, even though, through the Kantian refusal of preformationism, there can be no blueprint in the true sense. On this "epistemological" side of Kant's analogy between the animal and the architectonics of knowledge, then, this text presents us with the rudiments of a conception which would avoid the aporias of pure epigenesis, without assuming a preformationist blueprint, thanks to its notion of the "primitive germ" (*Keime*).[44] This notion of *Keime* lies at the heart of Kant's writings on race—the latest being published the same year as the second edition of the first *Critique*—, which I will consider in the next chapter in parallel with the transformation of the notion of species at the end of the 18th century, and which Kant will attempt to think through in his last *Critique*.[45]

5.2.3.2 Architectonics and technology, genesis and development

The *Critique of Pure Reason* thus engages the enigma of the originality of the living being in the thought of architectonics. Indeed, appealing to the analogy of a growing organism in order to express the architectonic dimension of reason raises an insoluble philosophical problem within the *Critique* itself: even though at the transcendental level of the principles of knowledge nothing distinguishes an animal from the whole of nature, how can the former provide *an example of* architectonics?

This indicates the inadequacies of the doctrine of purposiveness in the *Critique of Pure Reason* with regard to the issue of architectonics and the living. Kant wrote in his notebooks: "Technical: according to similarities; architectonic: according to kinship under a common stem." (*Reflexion 2703*) Here, the community of architectonics and biological language is once again asserted. Concepts involved in architectonics have a "kinship": the term *Verwandtschaften* was already used by Kant when he said that a science is only possible architectonically, not technically. The architectonic approach brings concepts together according to their affinities, which is always a reference to a common stem.

The model of intussusception can be applied to architectonics just because concepts are therein related as kin: each member grows by developing what comes from the germs it contains within, and not by external additions, since

any addition would add elements from another strain. This description of the architectonics of reason by reference to the developing animal implies shifts in the range of concepts dealing with the metaphysical problem of order.

Indeed, the language of technology is quite separate from that of the living, since the latter (relatedness and strain) qualifies architectonics. We recognize here a point made in the Kantian critique of the Leibnizian organism, echoing the vitalist moment in living thought., However, this technique is clearly not the divine technique according to *The Only Possible Argument. . .*, which purportedly described the living. As we have seen, this technique was disqualified in the first *Critique*. What remains now is a technique that is *opposed to* architectonics: or rather, the lesser rationality that Kant attributes to technique here reflects the fact that the primacy of systematics over technique in the *Only Possible Argument. . .* has been brought to its term in *Critique of Pure Reason*, a term that is the disqualification of divine technique (i.e., of the contingent order) as a purposiveness. And if the third *Critique* has to rethink this "divine technique" in order to grant a specific status to the living, it is clear that it would have to rethink it *in relation to the architectonics* conceived here, and even think in *solidarity* with architectonics.

The texts on architectonics thus highlight the internal difficulty of the *Critique of Pure Reason*: on the one hand, there is a specificity of the living, since it provides us with the model for thinking about the architectonics of reason (against an anarchic growth of knowledge); on the other, this *Critique* has hardened the position of the *Only Possible Argument. . .* about the epistemic superiority of system over technique, a "technique" that possibly constituted the originality of life. In the *Critique,* the systematicity proper to reason, modeled on the growth of animals, is conceived of in such a way that architectonics, which is in its essence systematic, comes to be opposed to technique, which in 1763 characterized life in its own right. The Kantian thought, therefore, requires us to revisit the notions of order, purposiveness, technique, and system, in light of the question of the originality of the living (at least epistemologically).

5.2.3.3 Architectonics, history of nature, and problems of the living world

In any case, the architectonics thus conceived is inseparable from its own development. To oppose architectonics and technique as Kant did in his *Reflexion* 2703, distinguishing the search for kinship from the perception of similarity, can only evoke the status of natural history as set out in his first writings on races. In his 1775 essay on "The difference between human races," Kant asserted for the first time the legitimacy of an approach to nature he calls "history of nature" (*Geschichte der Natur*), and contrasted it with "natural description," (*Naturbeschreibung*) corresponding to traditional natural history (*Naturgeschichte*), which is precisely insufficient to consider the different living species and their relations. "The description that has as its object the state of nature in our time

is far from sufficient to indicate the *raison d'être* of the diversity of derivations. We must, however fervent we may be—and certainly with good reason—about reckless opinions, attempt a *history of nature*: this is a separate science, capable of progressing little by little from the stage of opinions to that of knowledge." The recklessness evoked here refers, of course, to the hypothetical nature of such a science, insofar as it seeks to reconstruct a past that is by definition different from the present state, and therefore contains only traces on the basis of which the historian of nature must reconstruct a sort of scenario.[46]

Naturbeschreibung is scholastic and artificial: precisely, proceeding by similarities of encounters, always in search of an arbitrary criterion of classification (since the criteria of natural history are not a function of their role for the animal, but of the ease they give *us* in classifying), it is akin to a *technique* in the sense of *Reflexion 2703*. History of nature, on the other hand, would show the "derivations that have resulted (since the Earth's revolutions) from the primitive force of the original genus"[47]—expressions that will become clearer later, but in which, throughout the consideration of the primitive and of the original genus, we can already recognize the notions of stem and kinship that characterize architectonics.

The scholasticism denounced here regarding natural history is that of Linnaean classification; it is no more than a technique for memory, it is artificial because it does not follow the productive relations between species.[48] It multiplies artificially, just as the technical order sought by theologians splinters nature into myriads of final dispositions, as shown in the *Only Possible Argument*. . . . On the contrary, recourse to genesis reduces multiplicity to unity, just as purposiveness as a system, coupled with genetic epistemology, reduced in 1763 the apparent plurality of technical finality to a single root. The epistemic primacy of the architectonic over the technical entails *the primacy of the history of nature over the description of nature*, in other words, over usual natural history. In the next chapter, I will show how this project still refers to Buffon's "physics of the living" and how Kant's own theory of species will borrow certain concepts from it.

But while Buffon and Maupertuis were still present in the background of *The Only Possible Argument*. . ., things have changed for Kant since 1781: the genetic epistemology we had traced meets the obstacle of the First Antinomy of Reason (about the world as a series of causes). No speculation on the origin of nature is possible: hence, the project of explaining order and the present state by going back to the origin of the effect of laws no longer makes sense within a science of phenomena.[49] Of course, this does not affect the architectonic project as such, which has never been that of a history of nature from its origins. The notions of derivation and kinship it uses designate no objectivity. Their legitimacy is regulative, and was made explicit when, in the Transcendental dialectic, Kant expounded and justified the law of affinity, and, beyond that, our right to make use of the language of derivation from the transcendental Ideal (§1.4).

Yet, if the project of a history of nature proposed in "Human Races" bears to natural history the same relation that architectonics bears to technique, then this project must retain its legitimacy. For the architectonic dimension of knowledge is grounded in rationality, whereas traditional natural history, as a mere technique—such as Linnaeus's nomenclature, which Buffon regarded as a tool for recognition and memory—cannot on its own satisfy this architectonic demand. In a word, architectonics is not the history of nature, but the very fact that architectonics—and not technique—satisfies the interest of reason means that we must seek an alternative to ordinary, purely technical natural history. Insofar as living nature presents *actual* relations of derivation and kinship, this alternative would have to connect the problematic of derivation present in architectonics to the actual derivations in kinship. In other words, the emphasis on architectonics raises a question: after the critical dismissal of the history of the origins of nature examined in *The Only Possible Argument*. . ., how are we to think about the project of a history of nature whose locus is prescribed by the architectonic structure of human knowledge? I now turn to Kant's writings on races and species, where this project is developed, in connection with the shift in notions of species that occurred in the same period and constituted, as I will argue, another condition for the organism concept.

Notes

1 "In fact," writes Kant, "we cannot see how a logical principle of the rational unity of rules could find a place if a transcendental principle were not presupposed, by which such systematic unity, as inherent in the objects themselves, would be admitted a priori as necessary." (A650/B678) Concerning the inference from the logical to the transcendental principle, see Massimi (2018).
2 Unlike the Cambridge edition, I translate *Kraft* by "force," since it makes more sense in relation to the problems of various forces in nature, Newtonian physics, etc., that are the background of the *Critique*. It loses the connection with "*Urteilskraft*" translated as "power of judgement," for sure; but each choice of translation has costs and benefits.
3 Buchdahl (1965) believes that the very lawfulness of nature—in the sense that it cannot be subject to scientific investigation without presenting empirical laws—rests on the rational presupposition of an order of nature. Kitcher (1986) developed this idea.
4 On the regulative function, see Allison (2003, pp.422–447). Ameriks (2018, 46) explains that "constitutive principles" means that "they are each determining principles that our intellect cannot do without if it is to have theoretical knowledge at all." For a bibliographical review of the interpretation of regulative and constitutive in the perspective of teleological judgment, see my introduction to Huneman (2007a).
5 I take it that the difference between the form of a nature and the order of nature is what Guyer exposes in terms of necessary or sufficient conditions for empirical truth. "While the understanding, through general and transcendental logic, supplies certain necessary conditions of empirical truth, thus of the truth of empirical laws of nature and the objective validity of the concepts that express them, in the form of the basic laws of logic and the basic categories for concepts of objects, only reason, through its requirement of systematic unity, can specify what is necessary for sufficient

conditions of empirical truth, or the truth of empirical laws of nature." (Guyer 2018, p.57).

6 For a comment on such demonstration see Allison (2003), Grier (2001), Guyer (1987).

7 Hermann Cohen refers to transcendental deduction (B165) to link nature as a set of phenomena and formal nature through the synthesis of the imagination: "Thus nature, as a set of phenomena, becomes, through the medium of the faculty of imagination, nature as the 'original foundation of its necessary conformity to law.' This conformity of nature to law is 'nature in general'. Thus, the 'nature of phenomena' is linked to the 'nature of laws' by the synthesis achieved by the faculty of imagination" (1989, p.65).

8 On systematicity and its role in scientific knowledge from this perspective, see Kitcher (1986), and for a different view, Ginsborg (2018) and Zuckert (2018).

9 By the "principle of complete determination," which stipulates that an existing individual is an individual determined according to all determinables. Consideration of this principle forms the basis of the chapter on the Transcendental Ideal in the Dialectic of Pure Reason.

10 The law of specification does not "require of the things that can become our objects a *real* infinity with regard to diversities" (A656/B684).

11 "The understanding knows everything only through concepts: consequently, as far as it goes in division, it never knows by simple intuition, but always by means of *inferior* concepts. The knowledge of phenomena in their complete determination (which is only possible by the understanding) requires an incessantly continuous specification of its concepts, and a constant progression towards differences that still remain, and which have been disregarded in the concept of species, and even more so in that of genus" (A658/B686).

12 *Logic,* §6. Long commentary on this act in Longuenesse (1995, ch.5, p137ff).

13 "If there were such a great diversity between the phenomena that present themselves to us—I am not saying as to form (for in this they can resemble each other [e.g., being in space and time, subject to causal relations, etc.]), but as to content, i.e., according to the diversity of existing beings, that the most penetrating human understanding could not, by comparing one with another, find the slightest resemblance between them (a case we can well imagine), then the logical law of genera would no longer find a place, and there would no longer even be a concept of genus or universal concept, and consequently no longer any understanding, since the latter only deals with such concepts" (A653/B681).

14 For the concept of motion it presupposes is, as we said, a posteriori.

15 On the theme of affinity in Kant, which unites the registers of chemistry and natural history, but is modified by the Transcendental analytic in the form of "transcendental affinity" between phenomena as my representations, see Lequan (2005).

16 Buchdahl (1969, p.512) formulates their status as follows: they are not methodological, but "principles presupposed by the development" of any methodology. Allison (2003, pp.422–442) links the Kantian problem of systematicity with the general problem of induction.

17 More precisely, each is based on a particular interest: the principle of homogeneity refers to the speculative interest of reason, which seeks unity; the principle of specification refers to the interest in diversity. These two principles can therefore clash in the person of scientists with a more unifying, "speculative" tendency, and others with a more "empirical" one (a bit like continental science and Anglo-Saxon science as Pierre Duhem described them in *La théorie physique, son objet, sa structure*) the *lumpers* and the *splitters*. Empirical conflict results from the transposition into different personalities of multiple interests that coexist in reason itself. The principles

form a system, with motivating interestes complementing one another to constitute the systematicity that reason requires, namely "the idea of the maximum division and linking of the knowledge of the understanding in a single principle." (A665/B690) A single interest—systematic unity—thus determines several: homogeneity, diversity. Transcendentally, they are not in conflict; empirically applied, by people who will each favor one of the interests of reason, they may be. The word "maxim," used rather than "principle," refers to this diversity of interests: used alone, a maxim, even if legitimate, does not delegitimize the others (cf. A667/B695). The error of reasoners in conflict is to believe that their maxims are objective: then they would actually be in conflict. However, since they are based solely "on an interest of reason," they are compatible, because they do not imply any contradiction in the object.

18 On the fundamental role of the principles of reason in scientificity itself, see Kitcher (1986).

19 The motif of specularity used to describe reason's approach is irresistibly reminiscent of what Hegel would later say about reason in the science of nature (essentially biological) in the fifth chapter of the *Phenomenology of Spirit*: reason wants to find itself in nature. In a way, Kant's mirror identity foreshadows the specularity of Hegel's scientific rationality. But where Kant insists on the optics of illusion, Hegel emphasizes the dimension of reflection-identity; see also Hegel (1977) for an analysis of the language in which this dimension is expressed.

20 On the principle of necessary illusion, see Grier (2001, pp.263–301.) On Kant's general of metaphysics in relation to ontology see Ameriks (1992).

21 As Buchdahl writes, "it is as if Kant were saying that transcendental illusion must be incurred by us necessarily, as rational beings, while at the same time inviting us always to remain aware of the logical nature of this illusion, in order to prevent us from endowing the object of the idea with properties that would inevitably render it problematic." (1969, 549). Lebrun (1970) explains how the theory of the *focus imaginarius* structures what Kant calls a "territory of knowledge." To some extent Zuckert (2018) provides also an analysis of this notion, solving the paradox that something proved non-existing plays a major role in the inquiry about what exists. She writes: "as representations of unknowable objects, and as nearly empty, (. . .) the ideas are useful for scientific investigation on a Kantian view. Specifically, I shall suggest that the ideas function as "optimistic placeholders" (p.89), meaning, by "optimistic," that the idea of the soul offers a "the projection of a stable, existent substance, a thing," while "the idea of the world-whole appears (. . .) but as an impulse, a 'push,' to find further causes, further (earlier, farther) states of affairs," and the idea of God provides "a projected unifying rational ground" (even though, she nuances, "each idea can be seen to function in all three ways (if perhaps with more emphasis on one or another of them)" (p.96)). My interpretation, based on the notions of indirectness and scheme, partly concurs with hers.

22 Kant uses this idea of a maximum when formulating man's essential ends, to give one of the first formulations of the principle of duties, in the *Lectures on Ethics* taught between 1775 and 1781: " The conditions under which alone the *greatest use of freedom* is possible, and under which it can be self-consistent, are the essential ends of mankind. With these, freedom must agree. The *principium* of all duties is thus the conformity of the use of freedom with the essential ends of mankind." (Ak. XXVII, p.347, my emphasis) The "maximum" is thus a general schema of the functioning of reason according to Kant. The text presenting the Ideas in the sense of the Transcendental Dialectic, with reference to Plato's *Republic*, uses the same conception to define the Idea: "A constitution of *the greatest human freedom* according to laws which would ensure that *the freedom of each could subsist with that of others* (and not of the greatest possible happiness, for this would flow from itself) is at least a

necessary idea, which must serve as a basis not only for the broad outlines of a civil constitution, but also for all laws (. . .)" (A316/B373).

23 For MacFarland, the regulative idea as analogous to a schema means that he draws "a parallel between the role of an idea in bringing a body of knowledge to systematic unity, and the role of a schema in bringing sensible intuitions to the unity of categories. Schemes provide the rules of procedure when the diversity of sensible intuition is unified under the categories, and, analogously, ideas provide the rules of procedure for bringing the ordinary knowledge of the understanding to the systematic unity that is required for scientific making" (1990, p.27). Recently Watkins (2019) summarized Kant's view as follows: "our cognition is limited to whatever is given in space and time, which is always conditioned, and for that reason our (theoretical) cognition necessarily falls short of what reason demands, namely cognition of what is unconditioned."

24 "Since every principle that provides the understanding with the complete unity of its priori use, also applies, albeit only indirectly, to the objects of experience, then the principles of pure reason also have a reality in relation to the latter, not only to determine something in it, but only to indicate the procedure by which the empirical and determinate use of the understanding in experience can be completely in accord with itself, by this being brought, with the principle of complete unity, to coherence, *as far as possible*, and thus derived from it." (A665/B693)

25 Allison pointed out that the same Idea, which, taken absolutely, is illusion, becomes a guide for reason when it relates to understanding (Allison 2003, p.433).

26 Since existence is a category of the understanding, it only makes sense for phenomena, and cannot be used in a discourse about objects of thought that are not likely to present themselves to the intuition.

27 Allison (2003, p.438).

28 "Reason cannot think of this systematic unity otherwise than by at the same time giving its Idea an object, which however cannot be given by any experience; for experience never gives an example of achieved systematic unity." (A681/B709)

29 Consequently, Kant can write of the Idea of God: "if an Idea (. . .) lies at the foundation of the greatest empirical use of my reason, which in itself can never be adequately presented in experience, although it is inescapably necessary to bring empirical unity to the highest possible degree, then I will not only be authorized, but even necessitated (*genötigt*) to realize this Idea, that is, to suppose it to have an actual object, but only as something in general, which I certainly do not know in itself, and to which I give, only as the foundation of this systematic unity and in relation to it, properties which are analogous to the concepts of the understanding in its empirical use. I will therefore conceive, by analogy with the realities of the world, substances, causality, necessity, a being that possesses all these in the highest degree of perfection" (A677/B705).

30 Martin clarifies Kant's position in the tradition: "it is indisputable that no break in the continuity of Greek and medieval currents of thought on this problem, up to and including Kant; for all of them, defining essence remains possible, but for Kant it is by analogy *alone*" (1963, p.185). Thinking of God without knowing him, by applying categories (causality, substance, etc.) in an empty way (without schema), is ultimately an "analogical passage" (1963, p.222).

31 Bennett (1974 §90, p.288). On the contrary, Allison (2003, pp.430–442ff), attempts to justify the necessity of the Ideas in the very conception of systematicity.

32 Bennett (1974) points out that the proposition "God exists" is linked by Kant to two regulative maxims, that of a teleology of nature, and that of a supreme unity by which all laws can fit into a genus (§86, p.273). Nevertheless, he remains puzzled when Kant

tries to unite teleology and systematicity, a link that seems artificial to him (p.274)—this point becomes clearer, however, if we link the Dialectic to the question of finality as a system in *The Only Possible Argument. . .*, and if, as I do, we see in Kant's sentences a new elaboration of this question according to which finality appears as language. I agree here with Allison (2003), regarding the topical relevance of the notion of systematicity in Kant's transcendental philosophy.

33 The example is perhaps not insignificant, since the figure of the Earth gave rise to a controversy in which Maupertuis played an essential part (since he went to measure the meridian at the North Pole with Clairaut, etc.), and this very question occupied part of his *Essai de Cosmologie* "In recent times, it was suspected that the Earth was not perfectly spherical. Some experiments led Newton and Huyghens to think that it must be higher at the equator than at the poles, and be a flattened spheroid. Current measurements of different degrees of France seemed to give it the opposite shape, that of an elongated spheroid. These measurements, taken by very skilled observers, seemed to destroy the flattened figure, which was only proven by indirect experiments and reasoning. Such was the uncertainty, when the greatest King France ever had ordered the most magnificent enterprise ever formed for the sciences." (*Essai,* pp.66–67).

34 *Vorlesungen über Rationaltheologie*, "Philosophische Religionslehre nach Politz," Ak. XXVIII, 2, 2.

35 One of Galen's reference works is entitled *Usefulness of the parts of the human body*, as we know.

36 Allison similarly interprets these texts: seeing phenomena as a systematic unity and seeing as ultimately arranged are not "two distinct mental acts" (2003, p.441).

37 "But since the principle one thinks of has no other purpose than to seek the greatest possible necessary unity of nature, then insofar as we attain this we will have the Idea of a supreme being to acknowledge, but we cannot, without contradicting ourselves, neglect the universal laws of nature, insofar as the Idea was only put at the ground with the aim of these laws, and thus consider this finality of nature as contingent and hyperphysical in its origin, because we were not justified in assuming above nature a being endowed with the qualities here thought of, but only in laying at the ground the idea thereof, to consider, phenomena as systematically connected to one another, according to the analogy of causal determination" (A699/B727).

38 Here, I acknowledge that Mensch (2013) addressed the same problem of the presence of organicism throughout Kant's critical philosophy, and does provide often similar analyses or at least identify the same points of emergence of the biological vocabulary in the First *Critique*. Given that this has been written independently and after the first French version of the present book, I do not want to propose an extended discussion of her theses, which would be too long, and suggest to read the two works successively.

39 On this point, MacFarland interprets as follows: "if the only laws we can legitimately use to explain the world are mechanical laws, the final structure of knowledge will itself be final (*purposive*) or organic." (1970, p.42). Nevertheless, when he then indicates that mechanical explanations function as "means" for a higher possible explanation, it seems to us that he is encroaching on the *Critique of the Power of Judgment* the position taken in the first *Critique*, whereas the synonymy we have established between mechanical explanation and teleological language on nature rules out this interpretation of the relationship of the two discourses in terms of means and ends.

40 On this point, see Stéphane Schmitt's afterword to his translation of Schelling's *Weltseele* (2007). I reconstituted the relation between Kant's CPJ, *Naturphilosophie* and life in Huneman (2011, 2006a)

41 Since the publication of this book, besides Sloan (2002), Jennifer Mensch published her book on Kant, organization and epigenetics (Mensch 2013) which confers a great conceptual role to this question of an epigenetics of reason. I will not discuss it here, because it would be too long; Mensch mostly argues that Kant's idea of epigenesis makes sense of what he sees as the history of reason, and therefore commits to a variety of organicism that she analyses, and that pervades criticism. Our perspectives are rather complementary than competing. We both concur in granting a major significance to the notion of epigenesis as a conceptual scheme uniting biology and epistemology in transcendental philosophy. On this epigenesis of reason see also Piché (1999).

42 On this point, see Sloan (2002), Genova (1974), Ingensiep (1994).

43 The *Critique of the Power of Judgment* dedicates a long development (§81) to the generation problem, using these terms in a detailed manner, but I cannot address it before the whole conceptual apparatus of the third *Critique* is explained. My account of this is given in Chapter 10.

44 On these aporias, see Zammito (2007); these questions are addressed from a distinct perspective, Chapter 9.

45 On this question, see Genova (1974) and Ingensiep (1994). According to the latter, the correlation between the theory of epigenesis and the theory of the systematicity of reason is not an ontological identity but a structural correlation, an interesting analogy for exposition. These structural similarities are an "intuitive illustration" and "can in no way be constructed as a requirement constraining an ontological connection between philosophical and biological positions." (385) But regarding the epigenesis of concepts, the correlation between philosophical and biological is even tighter. Our aim here is more to justify the structural correlation, and to show that its reasons raise questions in the Kantian problematic; see Mensch (2013) for a position different than Ingensiep's.

46 The history of nature proceeds on the basis of explanatory requirements: given the impossibilities we now find for such and such a process, things must initially have been in such and such a state for this process—from which alone the present state can be derived—to have taken place. A good example can be found in the *Universal History of Nature and Theory of Heaven*: "If we posit (as we cannot help recognizing) that the analogies mentioned above [between the directions and planes of the orbits of the planets and satellites and between their respective velocities] establish with the greatest certainty that the harmonious motions relating to each other in an orderly manner, and the orbits of the heavenly bodies, indicate the existence of a natural cause at their origin, this cause cannot however be the same matter which today fills all celestial space. It must therefore be the same matter that filled these spaces and whose motion was the cause of the current paths of the celestial bodies, after it had gathered on these spheres and thus cleared the space we now see empty; or, what follows immediately from this, it must be the very materials of which the planets, comets and the Sun itself are made up, which in the beginning were dispersed in the space of the planetary system, and which, in this state, engaged in movements which they retained when they came together in distinct masses and all formed the substance of the matter of the world formerly dispersed." (340)

47 "We usually take the terms "description of nature" and "history of nature" to mean the same thing. But it is clear that knowledge of the things of nature, in their present state, is never enough to satisfy the desire to know *what they were before*, and through what series of changes they passed to arrive at their present state. The *History of Nature*, which is still almost entirely lacking, would teach us the revolutions of the earth,

together with those of terrestrial creatures (plants and animals), and the derivations that have resulted from the primitive force of the original genus."

48 On the history of nature according to Kant, see Sloan (1989, 1995, 2006), and Fisher (2007).

49 This statement calls for a caveat. In his 1785 essay *On the Volcanoes of the Moon*, Kant reiterated his cosmological hypothesis, even though it was thought to have been discredited. It is simply a matter of saying that we do not reconstruct the origin of the universe, but present a series of events that make what we want to explain intelligible from the present state. "It is true that [the original ordering of the world] must close our researches when it comes to nature as a whole, but since no epoch of nature can be presented simply as the first in the sensible world, we are obliged for each of these epochs to search among universal causes as far back as possible, and to follow their sequence according to known laws as long as it remains coherent." (Ak. VIII, p.74–76) The term "epoch of nature" undoubtedly alludes to Buffon. The genetic epistemology, here, is revised according to the idea (exposed in the solution of the Second Antinomy) that the rational synthesis is always intended, i.e., that it is always an indefinite backward regression.

6 The problem of species and variations in the transformation of natural history

Kant's encounter with the teleological question in biology

In 1775, Kant wrote his essay *On the Different Human Races.* He aimed to show that humankind is one species differentiated into races, rather than several distinct species. The key idea consisted in determining precisely the concepts of species and races. This question would preoccupy Kant steadily, as he devoted in 1777 a second essay to the issue of *The Determination of the Concept of the Human Race*. His considerations were based on the reorganization of the concept of species that began in the middle of the century, and whose main architects included Buffon, who counted as Kant's main inspiration in these texts. Such reorganization is the third prerequisite for the constitution of a concept of organism, in the sense that it will free living organisms from Linnaeus-style natural history, and make them the focus of a new approach that, combining the transformations seen above under the headings of animal economy and epigenesis (with vital forces), would present itself as *biology*.

Historians of science have been discussing for decades the nature of the change affecting biology in the late 18th century. I recalled Foucault's radical thesis about the nonexistence of biology before 1800; Gaukroger (2010) proposed a much more continuist reading, akin to what is proposed here, and in which many inflections slightly changed the theoretical landscape in the life sciences, insisting on the shift from mechanicism, that I saw as the heart of the *mathesis*, toward sensibility as an organizing principle for scientific explanations. We encountered the discovery of sensibility and its role in natural philosophy in Chapter 2, by reading Haller and then the vitalists. Independently, Zammito (2018) assessed the role of sensibility in German biology and proposed a history in which the creative power of nature as well as its internal historicity became the object of many different investigations by German natural philosophers influenced by the vitalists and also by Buffon, and developing various viewpoints which ultimately led to modern biology.

While historians disagree about the details—and I will expose my disagreements—, we concur in the idea that several continuous lines of scientific change, instantiated by discussions, controversies and transmissions, constituted independently conceptual shifts that would, together taken, made possible another

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approach to life. The classical triad "natural history, physiology, anatomy" in which the *mathesis* conferred its epistemic situation to "life," has been progressively replaced by a coherent interrogation about the functioning and development of organisms structured around embryology, physiology, comparative anatomy, and history of nature. While the changes analyzed in Chapters 2 and 4 concerned the two former terms, the last term was mostly affected by Buffon's work and the surrounding discussions about the concept of species and varieties. Buffon's achievements also included two histories of the Earth, one as a volume of his *Histoire Naturelle* and one in his latest work, called the *Époques de la nature*.[1] My present examination of Kant, Buffon, and their contemporaries on species and its conservation will argue that here lies another major condition of the concept of organism.

Comparative anatomy would develop thoroughly with Félix Vicq d'Azyr, George Cuvier, and Etienne Geoffroy Saint Hilaire, shortly after Kant's critical turn, and I will address it in Chapter 10 after the examination of the organism according to the third *Critique*, because, as the texts attest it, Cuvier was already familiar with this concept. But it suffices to say here that this comparative anatomy took on board many conceptual elements brought about by the conceptions addressed in this chapter.

I will therefore begin by examining what is at stake in Buffon's thinking about the concept of biological species.

6.1 Buffon and the species

6.1.1 Biological species

Buffon was a prominent naturalist in the first part of the 18th century; as I said, his *Histoire Naturelle* was a major selling success among literate people. Yet, he was starkly critical of the "prince of taxonomists," namely Linnaeus. He rejected the Swedish naturalist's claim to a classificatory system, which he considered artificial, for the main reason that the genus is for him an abstraction and does not exist in nature. Buffon was a hard-boiled nominalist. For him, the genus is merely a convenience used by humans to classify, but it is too imprecise when we actually look at nature, composed of individuals and not genera. Nature is above all profusion and variety: "it is this great number of neighboring species that has given Naturalists the idea of genus: an idea that can only be used in this sense, when we only see objects roughly, but which vanishes as soon as we apply it to reality and come to consider Nature in detail."[2] And he added further: "Particular names have only come about as a result of the comparison we have made of each species of things: we have increased the number of these names as we have studied nature more and known it better (. . .) Ignorance made genera, Science has made and will make proper names."[3]

If the individual is real and the genus artificial, what then about the species? This natural history concept, unlike others, proves its grounding in reality and thus makes natural history into a science that grasps reality, instead of an art that provides a practical picture of it.[4] For this reason, the criterion of *resemblance,* traditionally used to construct a species, and which distinguishes the categories of *genus, species and variety* as increasing degrees of resemblance, will no longer suffice: a species must be an entity closed in on itself over time. "It is neither the number nor the collection of similar individuals that makes a species, but the constant succession and uninterrupted renewal of these individuals that constitutes it."[5] Hence, the criterion of the species, which Buffon took from the pre-Linnean naturalist John Ray, consists in the possibility of *generating fertile hybrids.* From this point on, "the comparison of the number or resemblance of individuals is only an accessory idea": "the donkey resembles the horse more than the barbet resembles the greyhound, and yet the barbet and the greyhound are but one species, since together they produce individuals that can themselves produce others, whereas the horse and the donkey are certainly of different species since between them they produce vitiated and infertile individuals."[6]

Buffon's definition acquires its full significance as marking a shift in the meaning of the word "history" in natural history. The species becomes a concept that indicates its instantiation by being realized over duration in time. Such an epistemic shift concerning the species recalls what Caspar Wolff do with the notion of vital force. A species is no longer merely a box in a table, but an actual relationship among individuals, attested by a product (the fertile hybrid), and thus perpetuated over time. From this point on, the question of the difference between species arises on a completely different level: the possibility of deriving species from one another acquires a meaning that it lacked so long as the species designated a collection of individuals themselves defined by a sets of signs of recognition. Thus, it is not surprising to find in Buffon's writings a theory of the production of species by degeneration through time. Granted, this theory is highly complex, full of hesitations and backward moves: a mention in 1749 (on the subject of human races), the *Histoire des quadrupèdes* (1753–1766) including its chapter on the "donkey" and its famous denial in the face of the transmutation of species ("*Mais non, il est certain, par la révélation. . . .*") (1753), the section on the "Animaux des deux continents" (1761), the chapter "De la dégénération des animaux" (1766), and the *Epoques de la nature* (1778*)*).[7]

The species is thus embedded within the individual itself, at the level of its reproductive power, a notion which reminds us of the theory of the interior mold.[8] It is attested as filiation: a double break with the Linnaean species, attested at first glance and concerning the visible, representable surface of the individual.[9] This gives us both a natural criterion of species community, putting an end to the disputes over the degree of resemblance between two conspecific individuals, which the Linnaean definition of the species inevitably implied[10]—and the

possibility of solving some questions by experiments, such as the degree of relatedness of two species, or the increase in the number of species.[11]

6.1.2 Complications

Nevertheless, Buffon was to further refine his concept of species. If dogs, wolves, and foxes do not crossbreed, it is not so much because of their physiology as because of the way they live and where they live: in an artificial situation, i.e., by domesticating a female wolf, it was possible to crossbreed her with a dog. This means that the way of life, the place—in short, what we would call the ethological characteristics—contribute to the definition of the species: we must define the species "as much by climate and naturalness [= morals] as by figure and conformation."[12] These considerations are based in particular on comparisons of the faunas of the Old and New Worlds: the parameters of resemblance and dissimilarity, as well as those of inter-fertility, become insufficient to identify species, and we need to consider what we would now call ethological barriers. A species is therefore both a kinship and a territory combined with habits.[13]

In his *Histoire naturelle des oiseaux*, Buffon uses the term "bundle (*faisceau)*" to describe this new representation of relationships between species:

> Nature, deployed in all its extent, presents us with an immense tableau, in which all orders of beings are each represented by a chain that supports a continuous succession of objects close enough, similar enough that their differences are difficult to grasp. This chain *is not a simple thread that extends only in length*, it is a broad weft or rather *a bundle,* which, from interval to interval, throws branches aside to reunite with bundles of another order; and it is especially at the two ends that these bundles bend, branch out to reach others.
>
> (HN (A), IX, "Animals common to both continents," p.31 (1761), my emphasis)

The multiplicity of models representing the order of species ultimately indicates that the multiplicity of criteria invoked in the redefinition of the species cannot give rise to a single representation of the order of species, but entails the need to choose the representation we wish to use, according to the dimensions most relevant to the specific problem we wish to address.

Climate—already central in Montesquieu's *Esprit des lois* (III, p.14–17), inspired here by William Arbuthnot[14]—proves to be the fundamental factor in the diversification of species, alongside human action in domestication. For example, the black man is a white man "degenerated" by the action of the sun. Varieties, or races, are thus born from the species by degeneration, due to the movement of individuals or changes in climate. Since the climate can have varied, over a period significantly longer than the traditional and biblical six thousand years, the Buffonian concept of species implies the interweaving of a history of the

living and a history of the Earth.[15] Until the *Époques de la nature* (1779), Buffon would emphasize the orientation of this history, first with the motif of degeneration and then, in this work which challenges it, with that of terrestrial cooling. This latter notion is another version of the tendency of animals to degenerate, which pervades the *Histoire Naturelle*: like this tendency, it is indicated by the reduction in size of animals that are nevertheless similar in form, as shown by the difference between the remains of mammoths found in Siberia and today's elephants;[16] like this tendency, and in a more obvious way, it also refers to variations in climate. Degeneration in Buffonian thought, far from being the expression of an ideology or temperament, constitutes a principle of intelligibility: orienting a table like the table of dogs, having a principle for classifying and naming species that are at once inter-fertile but without fertile hybrids (horse, mule, etc.), all this becomes easy if species can be oriented along a line of degeneration; and the history of varieties within species can then, through the theory of cooling, be linked to the history of the Earth, so that the very naming of species takes into account the environment in which they live as a dated environment, a moment in the history of the Earth.

To this extent, Buffon introduces the *role of the environment* in the definition of the animal: it is no longer just a form, a structure, it is also a way of life which, in order to be defined, must encompass the characteristics of the place in which it lives.[17]

Buffon's double reformulation of the concept of species (generational criterion/role of the environment) is the horizon on which the last condition of intelligibility of the concept of organism can appear, namely its double reference to a proper environment and a diachronic chain of transmitted properties.[18] Kant's essays on races are paradigmatic of such a double reference.

6.2 The Kantian theory of human races

Kant's own theory was arguably developed in dialogue with the physiologist and anthropologist Johann Friedrich Blumenbach. In 1775, Blumenbach wrote an essay on the variety of human races, *De generis humani variatione nativa*. He was equally attentive to morphological questions—continuing to describe the species by its form—and to the living conditions and geographical habitat of the various races.[19] His naturalistic practice led him to place ever greater emphasis on the examination of geographical regions, lifestyles, and relationships between species, in a movement that continued Buffon's. Thus, in the sixth edition of the *Handbuch der Naturgeschichte*,[20] he mentions the mating periods of birds (Section 5, §66), their places of residence (§61), their diets (§63), and the forms of nests (§76). The determination of *orders* is based, after Linnaeus (albeit with modifications), on the conformation of beaks and feet, which condition the manner of feeding and living, i.e., "the total habit" (§79). For the determination of *genera,* in order to classify animals, the author indicates the places in the

world where they are found, and, as an introduction to each order, he indicates what individuals eat. As for the classification of mammals, it is no longer based on appearances but proceeds "by looking more at the *total habit of* mammals" (§54), which yields a more natural system than Linnaeus or Ray (whose system, based on teeth, yielded bizarre groupings like certain species of pig classified in different genera (§53)). As the organs of movement strike the eye and "generally respond to this total habit," we classify according to such organs (quadrupeds, bimanes, fissipeds, etc.). The fissiped orders of the same general habit, including very different animals, are divided according to teeth into rodents, carnivores, and edentates (Similarly, the palmipeds are grouped into these three divisions—beaver, otters, and platypus—forming a transition to cetaceans) (§53).

Concerning the human species, Blumenbach argued in a manner close to Buffon's that, starting from a specific unity, human races diversified through degradation due to climate.[21] His *Institutions of Physiology* proposed a theory of the skin according to which the Malpighi network "gives different individuals their own particular color. In all, the leather is white, as is the epidermis. Only the Moors have a slightly yellowish epidermis," he adds, "but the reticular body is almost as diversely colored as there are men of different ages and climates. It is not even the sickly state that modifies it [and here he refers to his 1775 *De generis humani. . .*]."[22] This action of climate and conditions upon the network, and hence on skin color, gives rise to the various races: "From these modifications of color arise the five principal varieties that are observed in the human species."[23] The section "Man" of the *Handbuch der Naturgeschichte* distinguishes five races: Caucasian, Mongolian, Ethiopian, American, and Malayan. Each is described and illustrated by an engraving of one of its illustrious representatives, named and described by Blumenbach. These five races are nonetheless linked to the first, the Caucasian, as to their strain, or mid point. He notes:

> All physiological reasons must make us regard the Caucasian race as the stock of the others, or at least as the middle race between the five main races; the two extreme races into which it has degenerated are, on the one hand, the Mongolian race and, on the other, the Ethiopian; the other two form the transition from the middle race to the extremes; the American leads to the Mongolian, and the Malay to the Ethiopian [(1)].

But Blumenbach does believe that the Caucasian race is the stock rather than merely a middle point for us, in a table, since in footnote (1), he derives the others from it by climatic and geographical factors:

> People scattered in different parts of the world have, according to the stronger or longer influence of different climates and other causes of degeneration, experienced different effects. Either they have moved further away from

> the primitive figure of the average race, or they have come closer to it. The Yacutes, for example, the Cossacks, the Eskimos and other peoples of the Mongolian race living under the poles are strikingly degenerated from the beauty of the average race, while on the contrary the American race (although further from the Caucasus, but living in a more temperate climate) is closer to it. Only in the northernmost part of America, i.e., the Tierra del Fuego, does this race fall back into the conformation of the Mongolian race. The same is true of the Ethiopian race; under the scorching skies of Africa, it has passed to the other extreme in the gradation of varieties of the human species, while in the new Holland and the new Hebrides, where the air is much milder, it passes to the Malayan race. I do not need, I think, to mention the influence that the mixture of different races that meet in their emigration can also have.
>
> (*Handbuch der Naturgeschichte*, 6th ed., sect. 4, order 1, Bimanes, genus 1, "man.")

Finally, the doctrine of *Bildungstrieb* in Blumenbachian epigenesis clarifies the mechanism of race creation. Blumenbach notes that this impulse can deviate "from its proper and determined direction" when "disturbed or modified by extraneous circumstances," resulting in monsters, hermaphrodites, mongrels, races, and varieties (§11). Thus, "races and varieties are deviations which insensible degeneration has brought about in the specific original conformation of particular species of organized bodies" (§15). A race is characterized by a "character which degeneration has brought about" and which "necessarily and inevitably becomes hereditary by propagation." The main causes of degeneration are climate and food, and, in animals, way of life (§16). Cold, for example, stops growth and whitens the skin, as seen among the peoples and animals of the North (§18).

Between 1775, the date of Blumenbach's and Kant's two respective texts on human races, and 1790, the date of *Critique of the Power of Judgment*, the two authors read one another carefully and influenced each other's theories. My aim here is to highlight how Kant's work converged with Blumenbach's on several points prior to the *Critique of the Power of Judgment*.[24]

Kant's *Von den verschiedenen Rassen der Menschen* was published in 1775, but was reprinted two years later in J.J. Engel's collection *Philosophie für die Welt.* It should be seen as "the only significant *publication of* Kant as a popular *philosopher* in the 1770s."[25] Kant's preoccupation with proving the unity of the human species is undoubtedly correlated with the need for a concept of the human species to provide a phenomenal substratum for the idea of humanity enshrined in practical reason. It would be somehow unacceptable to reason if morality demanded the uniqueness of humanity, while theory endorsed the plurality of human species, as proponents of human polygenism like Voltaire did at the time. In particular, Henry Home's (Lord Kames) publication in 1776 of his work on the difference of human races revived this passionate debate.[26]

Before turning to Kant's texts, we may be surprised by one thing: species is a central notion in the Appendix to the "Transcendental Dialectic," since it is the object of the three principles of the ordering of nature that reason presupposes. But the writings on race, on the one hand, and the Appendix to the "Transcendental Dialectic," on the other, seem strangely independent: yet another indication that the problematization of *Critique of Pure Reason* would have to be revised if it is to take into account the singularity of the organism, which comes to the fore precisely at the moment when we must respond to a moral demand: to prove the unity of the human species.

6.2.1 Species definition

All this is, of course, retrospective. Kant's first question in 1775 is to clarify the status of the diversity of human races. Here, Kant immediately takes Buffon's side: the criterion of inter-fertility to define the species, a break with classical natural history, which is treated as scholasticism. "In the animal kingdom, the natural division between genera and species is based on the common law of generation, and the unity of the genus is nothing other than the unity of the reproductive force, which is completely valid for a certain diversity of animals." Hence the Buffonian rule: "that animals which produce fertile offspring with each other (however different in form they may be) belong to one and the same physical genus," must be considered the definition of a natural genus of animals in general, unlike all scholastic genera" (Ak. II, p.429). In this sense, under the terms "scholastic" versus "natural" divisions, Kant extends the distinction between the technical and the architectonic, as discussed in the previous chapter. He writes: "Scholastic division proceeds by *classes*, it divides animals according to *resemblances*, natural division proceeds by *strains*, it divides animals according to *kinships* (*verwandtschäften*) with regard to their generation" (Ak. II, p.429). Hence, the opposition of resemblance on the one hand, and strain on the other. "The former constitutes a scholastic system for memory, the latter a natural system for the understanding: the former only intends to arrange creatures under headings, the latter to bring them under laws" (Ak. II, p.429). As the antithesis between memory and understanding indicates, Kant is repeating Buffon's criticism of Linnaean classification as an abstract artifice, a pure mnemonic system that reveals nothing about nature. Here, however, the criticism is based not so much on the prodigality of nature versus the dryness of technique, as on the lack of an unambiguous rule for determining species membership. While Buffon contrasted the continuous chain of beings with the artificial separations of naturalists, Kant sees in Linnaean classification the absence of prior conceptual reflection, and thus does not have to commit to nominalism. "In the system of nature," says Kant in his *Physical Geography* lectures, "we are not concerned with the place of origin of forms, but with their resemblance. This is why the systems of nature that have been proposed up to now could more appropriately be called *aggregates of* nature; for [genuine] system presupposes the idea of the whole, from

which the diversity of things is derived. Strictly speaking, we still have no *Systema naturae*. In the so-called systems of this kind that we have, things are merely assembled and aligned one after the other" (Ak. IX, p.160). Kant clearly indicates here that Linnaean systematics is on the side of aggregation, and excludes architectonics, which is indeed implied on the side of natural history, since the first sentence opposes systematizing aggregation to the consideration of the origin of things.

Linnaeus's supporters and John Ray's followers, in the 18th century, represented two schools of taxonomy, labeled the methodists and the systematists. They could clash over the criteria for a classification that accurately represents nature, but Kant points out that classifiers in general, whatever their school, have not previously delineated what they mean by "species" and the empirical signs that allow us to determine that we are dealing with a species.[27] In so doing, Kant avoids the problems of Buffon, who, criticizing classification in the name of the continuity of the chain of beings, had to gradually revise his conception of species and the relationships between species, because the linearity of the chain model is not suited to the actual, always multiple relationships of the animal groups he was studying.

This lack of reflection produces dangerous consequences when it comes to humanity, because then everyone is busy applying the concept of "race," wondering whether races are or are not different species, while the concept of race itself is undefined. Adickes shows how different the ways of counting human races were at the time, in addition to the major naturalists' views. For these differences between naturalists, Adickes (1924, II, pp.445–449) cites Ludwig (*Grundriss der Naturgeschichte der Menschenspezies* 1796), Linnaeus, John Hunter (*Disputatione inauguralisquaedam de hominum varietatibus et harum causis exponens* 1775), Leibniz, Zimmerman, who posited the original origin of mankind in Central Asia, Buffon and, on the contrary, Henry Home, who, in his *Sketches of a History of Man* (1774), denied the original unity of the human race and ruled out the possibility that climate and external causes could have caused races to vary: hence local creations in the manner of Linnaeus's account. It is easy to see how Kant regarded this as a major flaw in the science of man, and sought its remedy in a proper definition of the very concept of race.[28]

Kant wrote his second opuscule on races, *Determination of the Concept of the Human Race,* in response to those who had not understood the level of his questioning in the previous essay, and who confused empirical with conceptual issues. This is why he states at the outset: "my intention is only to determine with exactitude the concept of human *race*, if there are any in the human species; the explanation of the origin of those that are actually present and which are held to be susceptible of such a denomination is an ancillary work, of which one can think what one likes" (Ak. VIII, p.91).

Linnaeus was wrong, not so much for an excess of system as for a lack of systematics, or even architectonics. Hence, finally, Kant's reference to

"understanding," as opposed to "memory," to which the usual classification is addressed: there is understanding in "natural classification," because concepts have been used; whereas "scholastic classification" remains at the level of associations of the imagination and their conservation in memory, insofar as it remains at the level of groupings of individuals, which are lumped according to arbitrary criteria and can always be grouped differently according to the criterion chosen.

But then, one point remains obscure in Kant's distinction: scholastic division arranges under headings, while natural division brings under laws—which laws? Here again, we might find an echo of the Buffonian project:[29] to replace natural history with a "physics of living nature," on the Newtonian model, i.e., with the use of forces and laws. What do these laws relate to, if not the *reproduction* of the living, insofar as inter-fertility defines the central concept of this "natural division" of the sexes?

Just as there are two approaches to organic nature, so there are two concepts of genus, which Kant calls *nominal genus* and *real genus:* the first defined by external form, the second by the inter-fertility of individuals, i.e., ultimately by the provenance from a common strain. "For animals, whose diversity is so great that so many creations would be necessary for them, may well belong to a *nominal genus* (to classify them according to certain resemblances) but never to a *real genus*, insofar as for the latter we require at least the possibility of the provenance of a single couple" (*Determination*, Ak. VIII, p.102). If classification under real genera consists in arranging under laws, then it is clear that these laws are the laws of descent. This implies, once again, that the architectonic requirement represented by natural classification intersects with a certain kind of historical consideration. "Finding the latter [real genera] is genuinely the task of *Naturgeschichte* [in the sense: history of nature], while the description of nature *[Beschreibung der Natur]* can be content with the former [nominal genera]" (*Determination*, Ak. VIII, p.102). What do we mean by this history? In other words, what precisely is the status of the "laws" used in Kantian biological classification? Let us focus on this issue.

6.2.2 History, law, species, and races

From the very definition of species, it follows that there is only one human species, since all humans can reproduce among themselves. The unity of the human race is "the unity of the force of reproduction, universally valid" (*Races,* Ak. II, p.430), and which refers to a common strain for all humans: men "all belong to a single strain, from which, independently of their diversity, they descended, or at least could have descended" (*Races,* Ak. II, p.430). Admittedly, there is no proof of this common strain, but the inter-fertility of humans makes it thinkable—"*could have descended from*," he says—and thereby makes relatively onerous

the (untestable) hypothesis of multiple creations, as well as contrary to the requirements of the hypothetical use of reason.

There is a methodological lesson here. The choice of a rational maxim of judgment (here, common strain) always determines the relevant facts, since otherwise, on the simple level of empiricism, we always find certain facts to oppose others (Ak. VIII, p.96).[30] Thus, Kant is not making any empirical history of the human species; he is articulating a rational theory of human differentiation, a theory that implies historicity at the level of its concepts, but he is not offering any empirical history. To this extent, we understand how architectonic concerns and historicity, apparently contradictory insofar as history evokes the disparate nature of contingent facts, never cease to resemble each other in Kantian thought.[31]

Human races are therefore not species.[32] But then, what are they? And above all—since we're talking about a history of nature here—where do they come from? Kant then proposes to clarify the sub-species concepts used to bring living individuals together by relating them to the theme of transmission: races, variations (*Abartungen*), degenerations (*Ausartungen*), filiations (*Nachartungen*), variants (*Spielarten*), varieties (*Varietäten*), lineage (*Schlag*).[33]

When the various forms resulting from a strain are heritable, they are *variations*; hereditary characters that conform to the strain are *filiations*; they are called *degenerations* if they no longer conform to it, so that the animals are unable to reproduce "the original organization of the strain." *Races* are variations that are preserved despite transplants, and which, when crossed with other variations, always give rise to half-breeds. Blacks and Whites, for example, are two distinct races; blondes and brunettes, on the other hand, are variations of the white race, insofar as they do not always give rise to a half-breed, but may only produce blondes (or only brunettes). When, finally, the nature of the soil and the food give rise to certain hereditary characteristics in living beings—according to a process explained below—which, however, are extinguished by transplantation, we speak of *lineages*.

According to Kant, the criterion of race is therefore *inheritance*; and what attests to the infallible hereditary transmission of a character is *interbreeding*, because we then see that, in interbreeding with a being bearing a different character, the focal character is preserved, since it mixes with the other.[34] Conversely, the trait that signals a race is the trait that gives rise to interbreeding during crossbreeding: for example, skin color, a relatively insignificant trait, constitutes the criterion for human races.[35] Applying the race criterion, we find that there are only four human races.

With these concepts, Kant distances himself from the Buffonian theory of degeneration due to the effect of climate or transformation through domestication, and from its revival by Blumenbach in 1775 in the text on the varieties of the human race, even though Blumenbach's *Handbuch der Naturgeschichte* distinguished race and variety by the same criterion, namely the hereditary aspect of the transmission of a character.[36] For how is it that these four colors are, of all

those that are transmitted, "the *only ones* that are *infallibly* maintained" (*Determination*, Ak. VIII, p.98)? Other colors exist, due to interbreeding, or, in certain lineages, to the effect of sun and climate, but only the four colors, typical of the four human races, are thus constant. On the contrary, if color were only the effect of climate, as Buffon maintains,[37] it is clear that all skin colors would have the same status in terms of transmission.

Certainly, in the case of characters that appear in the animal kingdom and are subsequently hereditary, such as the shortening of the tail of English horses, Kant could hypothesize an action of external conditions on the reproductive force of animals. This satisfies the rational maxim of economizing as far as possible on innate primitive dispositions. The theory of climate and races as degenerations would also like to fulfill this maxim, but it is limited (*eingeschränkt*) according to Kant by an opposite maxim: "in the whole of organic nature, through all the changes of individual creatures, species are preserved unchanged" (VIII, p.97). In other words, a theory that sees the cause of races in external influences, however economical it may be at the level of hypotheses, must be backed up by a theory that appeals to *primitive dispositions*—without which the conservation of the four skin colors (and only four) would be incomprehensible. But Kant's sentence goes further: it is the *very conservation of species in general* that will appeal to such a theory, because without it, if nothing in the reproductive force of a species were preserved from the effect of external influences to which we would grant a full transformative power in organic nature, then the species themselves would not be conserved. This would happen because at some point the offspring of a certain strain would carry a content of its reproductive force entirely different from that of the original strain from which it originated. "External things," writes Kant as early as *Races*, "may well be occasional causes, but not efficient causes, of that which is necessarily transmitted and propagated" (*Races,* Ak. II, p.435).

This last principle lies at the heart of Kant's theory of race and transmission. That which is necessarily transmitted and propagated must from the outset have been present in the reproductive force of the original stock, even if it was not manifest—developed—in the specimens of the stock itself, or its first descendants. If a hereditary modification appears that is necessarily transmitted, we can perhaps find an external cause in the climate, but this cause has merely awakened a potentiality that was latent in the strain (and thus in the reproductive force of the individual, which repeats that of the strain) and that, because it was in the strain, can now necessarily be transmitted in the absence of this cause (*Races*, Ak. II, p.435). This is why external influences are only occasional causes of hereditary changes.

Kant calls germs (*Keime*) and dispositions (*Anlagen*) the potentialities found in the reproductive power of the strain. The development of an organic body takes place according to some of its germs and dispositions, which are transmitted to it by its strain and thus belong to its species.[38] The performances of individuals

of the various species are therefore "preformed" (*Races*, Ak. II, p.435) (*vorgebildet*) in the force of generation: without this, again, if the force of generation itself were susceptible to external influences, species would not conserve themselves, and in the end, there would be no order of nature. Sloan (2002) has distinguished between the use of "germs" and "dispositions," the latter arising later, in order to express a more radical rejection of the preformist thesis, and a greater emphasis on the epigenetic process under environmental influence.[39] The actualization of dispositions is indeed susceptible to mechanistic explanation.

Let us emphasize this: when Kant opposed the Buffonian theory of degeneration, or more simply any theory of the arising of variations through the direct influence of the environment on the force of generation, he was arguing for the conservation of the species not as a fact but as a *maxim*, opposed in this case to the maxim of the economy of principles that inspires the rival theory. The conservation of species is therefore the very requirement of reason, assumed later in the Appendix to the "Transcendental Dialectic," and it even appears as another formulation of the principle of homogeneity. In other words, if this maxim of reason is to be respected, we must subscribe to the theory of *Keime* and *Anlage* set out in the essays on human races.

But Kant is not *radically* opposed to Buffon, because the organism and its specificity are still conceived of in relation to the environment. While food affects the preservation of life, air, and sunlight concern the "source" of life, hence they affect the "first principles of its animal constitution and movement" (*Races*, Ak. II, p.436), and in this sense can awaken previously silent germs and dispositions. Thus, they can contribute to the formation of a race, since the germ, once awakened, is transmitted hereditarily, whereas modifications that do not directly concern the reproductive force are transmitted but extinguished upon an event of migration.[40]

The Kantian theory thus meets two requirements: (1) to respect the maxim of species conservation—the core of *the order of* nature—and (2) to allow for the action of the environment on the organism, which again implies, as Buffon saw, a certain *historicity*, in the sense that the animal must acquire characters in its relationship with its environment, rather than presenting them from all eternity. In this context, the use of the word "preformed," *vorgebildet*, in relation to dispositions, should not obliterate the gap between Kantian and preformationist theories. Kant would never reverse his 1763 condemnation of preformationism. Because the essence of preformationism is that the whole animal is in the egg, but here, germs are not enough to define the animal, or to drive its development, since there is an irreversible recruitment of germs according to climate and environment. All the germs present in a reproductive force, even if they are transmitted, do not develop: the germ is therefore not the originally present form of the individual to come, it would rather be the form of *possible* individuals, or more precisely, of several possible variations of the same species: contrary to Malebranchist preformationism, what is preformed is not individual, but specific.[41]

Kant then isolated the force of generation from external influences, though not totally, since a germ once awakened by the environment is transmitted in active form, so air and sun acted once on the force of generation.[42] This conclusion drew the consequences of two premises: (1) species is defined by inter-fertility, so the determination of a species lies in the support of heredity, which Kant calls the reproductive force, and (2) species are conserved (this is a rational maxim). Consequently, this reproductive force must endure, relatively unchanged, through successive generations and therefore be relatively preserved from external causal influences.

This gives rise to a Kantian paradox: history accounts for the relationships between varieties, and more fundamentally, reason demands a historically-based classification according to architectonics—and *at the same time*, because each species develops its *own* germs in history, there can be no evolution of species.[43] In this sense, the Kantian position on descent is broadly similar to Buffon's: species stability, intraspecific transformations giving rise to variations.[44] Ultimately, this results from Kant's adoption of the Buffonian criterion of species.

6.2.3 Teleology

6.2.3.1 Adaptation

Such Kantian theory then realizes a tendency already present in *The Only Possible Argument*, when that text evoked the dispositions, *Anlage*, in living nature, according to the general idea that the final performances of nature are not to be explained by particular technical decrees of God: "Even in the construction of an animal it is to be presumed that a single *disposition* will have a fruitful aptitude for many useful effects, for which at the outset we would have found various particular configurations (*Anstalten*) necessary" (II, 6, §3, Ak. II, p.126). The "disposition" is indeed the framework within which a physical explanation can be deployed; but this concept, once now developed, no longer signifies the presumption of explaining living things on the basis of the necessary order according to *The Only Possible Argument*. . ., i.e., the universal laws of nature. On the contrary, it signifies the limit that a clear understanding of the phenomenon of adaptation would impose on a physics of the living that would proceed in the manner of Buffon or Blumenbach, understanding the emergence of human varieties by the direct action of the environment according to a physical causality, i.e., ultimately according to the universal order of nature.

Through the role of climate and environment as occasional causes of germ development, the Kantian thought is indeed a thought of *adaptation*.[45] While Buffon or Blumenbach think of a direct causal relation from the environment to the species, Kant begins to think that adaptation somehow stems from something intrinsic to the "reproductive power" or the strain. Modern ideas of adaptation are indeed divided between the notion of individual plasticity—a human being

running marathons will adapt by decreasing her pulse, etc.—and the notion of species adaptation, which, for us post-Darwinians, results from natural selection: the antelopes and the cheetahs are adapted to savannah's environment, and adapted to each other since their running speed approximately match. The relation between these two adaptations—the former one currently being thought of as adaptive plasticity (e.g., West-Eberhard 2003) is a major riddle for orthodox evolutionary biology since the 1920s (Loison 2025). Introducing the role of the stem (germs/disposition) in his account of the species-environment relation opens the way for an idea of the distinction between these two levels of adaptedness (strain/individual), which is constitutive of the modern concept of adaptation.

For Kant, indeed, the organism conforms to its environment, because in contact with that environment it develops the germs best suited to maintain itself there. Here again, Kant's thinking both reflects and distances itself from the transformations taking place in the field of natural history. The adaptation of species to their environment is a *topos* of classical natural history, in which it concurs admirably with natural theology: God has created species suited to the environments in which He has placed them, and nature preserves the proportions between species and their geographical distributions through a wisdom expressed in their interactions—a principle known as 'natural economy.' I already exposed in Chapter 2 the complementarity between the economy of nature, the balance of nature, animal economy, and natural theology. As a consequence, admiration for the teleological performance of organisms extends to wonder at the infinite wisdom of God, who has provided everything for them.[46]

But if species are historical entities located in the "history of nature" that reason intends to uncover, then their adaptation can no longer be an initial fact, but must appear as a *result*, namely, that of the relationship between organism and environment. This was also the case with Buffon: far from actual transformism, he allowed for variations in species within the limits defined by the circumscription of the species, variations that refer precisely to the action of climate or domestication. Indeed, domestication induces greater conformity between the animal and its environment. But this does not mean that the species *adapts* to its environment, as the process here is one of the order of physical causality of one substance on another, illustrated by the change in skin color under the effect of the sun. In *Histoire Naturelle*, it is not the species that adapts, but rather its environment, or humans, that shape it within certain limits.

In turn, recall that today, for evolutionary biologists, adaptation results from natural selection, which implies a response to selection, starting from the genotype of the organisms. Crucial controversies exist nowadays about adaptation in current evolutionary biology, but they concern the extent to which the organism is implied in its adaptation: contenders of the classical evolutionary biology ascribe a stronger causal role to organisms (and not genotypes), sometimes by arguing that the cause of adaptation is the way the individual organism adapts

itself to its environment, through its phenotypic plasticity (West-Eberhardt 2003; Walsh 2015; Sultan 2017).

But Buffon's view conceived organisms as totally passive and modeled through the physical action of the environment. In contrast, the Darwinian view begins by recognizing that the environment alone does not create varieties of species—it has to act upon heritable matter. Thus, the modern idea of adaptation is not conceivable along the lines of Buffon's thought, because it requires some involvement of the organism in its adaptation, as Kant started to conceive. Whether the organism leads its adaptation, as do challengers of the Modern Synthesis think, or gets adapted through the responses of the heritable traits, as is established by Ronald Fisher, Sewall Wright and the founders of the Modern Synthesis, this controversy requires in any case that adaptation arises as a causal interplay between something of the environment and something of the species (the organism? the genes?), and such a causal interplay, which defines the modern idea of adapted organisms, emerges as conceivable through the conceptual process I am delineating here.

To this extent, Buffon's *Époques de la Nature*, despite their apparent neglect of the theory of degeneration, reveal the truth of the naturalist's conceptions of adaptation: if species are relatively adapted to their climate, it is not that they change in the direction of better conformity. Rather, they do not change at all, but, driven by cooling, they migrate from their previous habitat to a place where the climate would correspond to what they had previously known. This underlines the impossibility for Buffonian thought to envisage a process of adaptation that starts with the animal itself or its species.

In this sense, Kant proposed such a perspective—implicitly presupposed in the modern conceptual history of adaptation—, replacing the direct action of external causes in *Histoire Naturelle* with the theory of germs and the occasional causes of their development. Species, according to Kant, *adapt* to their climate; indeed, this is what produces a "race." They adapt because, in contact with their environment, they develop the germs fitted to it. This reveals the first teleological dimension of this theory: simple physical causality could not explain why, among all its germs, an animal, in contact with a cold climate, activates the germ that develops in it the best dispositions to resist cold temperatures. There is an irreducible dimension of finality here. Yet unlike in classical natural history, this finality is no longer located in the hands of God and fixed at the moment of Creation; it has become immanent to the organism itself and diffused across the history of the Earth and the migrations of living beings. This transformation requires a historical conception of organic nature and an entanglement with a deep history of the Earth—an unimaginably long temporal scale that Buffon was among the first to envision.[47]

And precisely, the totality of germs and dispositions present in the generative force of a species' stock is relative to adaptation. This is what Kant intends to show, by establishing it for—apparently—the most insignificant of these germs,

that which concerns skin color, and which made it possible to classify human races. In *The Determination*. . ., he established a link between the black color of the skin, the black color of the phlogiston-laden blood, and the high proportion of phlogiston in the air in regions inhabited by black people. This suggests that their skin is such because it can "*dephlogistize*" blood in greater quantities than the skin of other races, a useful thing for these men, given the hot and therefore highly phlogistic-ladden regions where they live.[48] Thus, skin color is actually an adaptive trait for Blacks, which Kant establishes by analogy for other races.[49] In so doing, he exposes a link between the *concept of race,* which is based on hereditary transmission, so that skin becomes the sole criterion of race, and the *germ theory*, which actually is a theory of adaptation. For these two conceptions can only be reconciled if it has been proven that skin color itself plays an adaptive role.[50] Thus, the theme of *generation,* which must be understood in terms of germs and dispositions, and requires us to overcome the opposition between preformationism and epigenetism, is superimposed by Kant on the theory of *heredity*, which concerns the problem of the ancestral continuity of living forms and their stability. From the point of view of heredity, preformationism and Buffonian epigeneticism share the same notion of a hereditarily reproduced type, as Lopez-Beltràm (2002, p.75) pointed out. To understand individual reproduction, both Buffon and Blumenbach had to draw upon the medical tradition, and the distinction attested in the *Encyclopédie* between "natural things" (animal economy, organs) and "non-natural" ("les *non-naturels*") influences (waters, air, places), as well as between solid or humoral influences, which affect particular individuals. Only this second dimension accounts for the variation of the particular, and therefore the modification of the type in individual reproduction, as Buffon mobilizes it in the theory of degeneration. Kantian theory, on the other hand, synthesizes *heredity*—the specific and unchanged species form—and *individual reproduction*, by pinpointing the effect of "unnatural" circumstantial factors on the generation of individuals: the latter no longer being thought of without the former, since any individual causal event has actual effects through activation of inherited germs/dispositions present in the strain.

To sum up, Buffon's theories of species and reproduction sketched a first link between the species (as a causal notion) and the environment (as affecting the species to form varieties). This link is reflected in Kant's theorizing on the notions of race and species, in a way that made explicit *adaptation*, as an organismal property induced by something inherited present in the organism—namely, "germs and dispositions." While "organism" appeared, by Leibniz and Stahl, as a peculiar way of combining parts in a whole, whose particularity required for Leibniz a metaphysical decree of God turning "relations" into "substances" (see Chapter 1 on *vinculum substnatiale*), this combination now involves a specific relation of this whole to its history, as well as its environment—a relation that involves a particular *fit*. Kant's essays on race altogether reflect on this shift and bring about its explicit formulation.

6.2.3.2 Native strain

As a result, germs and dispositions are adaptive possibilities for organisms. Having the germ of black skin within him, a human could adapt to the climates of Africa, and was able to do so when he migrated there. In this sense, the germ theory is consistent with the idea of a unique creation of the human species and its dissemination throughout the world. Better still, it requires it, thus reinforcing the idea of the uniqueness of the human strain.[51] For while Kant first wrote that the criterion of inter-fertility implies that all men *can* come from a single stock, so that the discipline of reason invites us to think of them as indeed coming from a single stock, the germ theory, on the other hand, implies that all men *must* come from a single stock. Why is this? Because the existence of half-breeds, i.e., the infallibility of the mixture of skin colors when two different races cross, implies that the primitive germs of skin colors can harmonize, which would not be understandable if each germ were to belong to a special strain.[52] Such an argument noticeably parallels the reasoning that traced back from a diversity of empirical laws in nature to an a priori principle of their unity in the domain of possibilities, which constituted the key argument of *The Only Possible Argument*. . .; Kant here repeats it regarding the question of the unity of the human species, and of a species *generaliter*.

Thus, there was a primitive human strain, which contained within it all the germs to cope with all the planet's climates. It spread to different parts of the world, and each time gave birth to different human lineages, each one activating a particular germ adapted to the surrounding climate, and which gave rise to the various human races. This brings us to a second teleological dimension of Kantian thought: not only is the relationship between climate and the activated germ teleological, but even prior than that, the presence of germs is teleological. Before *adapting* to its climate and environment, the species—and above all the human species—is *pre-adapted* to all possible climates. In the sentence quoted just now, I omitted precisely this: "(dispositions) by which (the primitive stock) was suited to the gradual populating of the different regions of the globe"—the primitive stock is, in fact, *pre-adapted* to all environments.[53] Kant set himself obviously apart from Blumenbach, since while for both of them humans are destined to inhabit all climates,[54] for Blumenbach the fact of inhabiting certain climates affects the formative force (*Bildungstrieb*) and determines varieties by producing hereditary variations, whereas for Kant the original stock possesses the germs of adaptations to all climates, so that each of them—and therefore each skin color in particular—will be hereditary.

The idea of a primitive human stock is common to all those who, at the time, held to the unity of the human race, Blumenbach and Buffon in particular.[55] But Kant disagrees on one precise point: the color of the original stock (*Stammgattung*) cannot be found, because all races have separated from it by developing one of the germs of skin color. The original race, insofar as it predates, as it

were, the development of the skin color germs, cannot have an assignable skin color (*Determination*, Ak. VIII, 106); and since the germs, once awakened, are hereditarily transmitted infallibly, then neither can we, by crossbreeding, erase them and recreate experimentally the original race.[56] For Buffon, the original race was Caucasian, since it was precisely the action of climate and food that had created the other skin colors. Blumenbach, as we have seen, shared this conception of the original race in his 1779 *Handbuch der Naturgeschichte*, and before that in his 1775 Latin dissertation on *The variety of human races*.[57] But Kant writes: "the character of the Whites themselves is only the development of one of the original dispositions which we find in this stock alongside the other dispositions [i.e., those of other skin colors]" (*Determination*, Ak. VIII). This is why Blumenbach thinks that variations in skin color are continuous, that one passes imperceptibly from one to another,[58] since they are due to the continuous action of the climate on the same rather white strain, whereas for Kant, these differences in color between varieties are discrete since they are differences in germ activation. Thus, the status of the primitive strain in Kant's view is ultimately similar to that of the social contract according to his opuscule *Theory and Practice* or his *Metaphysics of Morals*: it never took place empirically, but it is an Idea that should be placed at the origin of considerations about the State to decide on the legitimacy or otherwise of empirically enacted laws. Such a primitive strain, too, is like an Idea of reason, whose empirical existence is not attested, but which should be assumed at the origin of existing races.[59]

Since Buffon's idea of the transformation of Caucasians into Blacks by the effect of climate implied that it was possible, through prolonged exposure to the European climate, to whiten a Black person, then the history of organisms told in *Natural History* was not irreversible. By keeping the primitive stock of races irremediably beyond the reach of present-day history, Kant was thinking in terms of an irreversible history of organisms, within the framework of a theory of pre-adaptation. On this point, and insofar as irreversibility is essential to historicity, he goes further than Buffon toward attributing historicity to organic nature. In this sense, he appears close to Caspar Wolff, since Wolffian epigenesis seemed to us to be distinguished from the epigenesis of Maupertuis or Buffon precisely by the inscription of an irreversible direction into the history of organisms, implemented by the *vis essentialis* (Chapter 4).

The human stock, therefore, has no precise empirical form: it designates the invisible foundation of the reproductive power by which the human species maintains itself, propagates, and adapts to its living conditions. Kant would thus subscribe to Wolff's last theory, which defined the species without reference to visible form, by indicating a "qualified matter" coextensive with reproductive power, whose affections by living conditions produce variations. The only difference is that for Wolff, here in line with Buffon, these variations imply effective, rather than occasional, environmental causality.

The doctrine of the original stock and dispositions then has two interdependent teleological dimensions: *adaptation*, presupposed in the position of dispositions that fit future organisms to their environment, and the purpose inherent in development itself, which could be called the *norm of development*, and which manifests itself in the fact that the embryogenesis of the individual aims to develop in her the dispositions that define her variety. These two axes of finality that structure biological theories will require a critical transcendental analysis.

6.3 Race theory, germ theory, and the question of generation

6.3.1 Kant, Blumenbach, and Wolff

It is time to consider the relationship between this Kantian theory and epigenesis according to Wolff and Blumenbach. Between 1775 and 1790, Kant's biological considerations were actually built on a constant exchange with those of Blumenbach. This was a reciprocal action, since, as Timothy Lenoir has amply demonstrated, Blumenbach's thinking was considerably modified by his reading of Kant, as can be seen in the various editions of *Über das Bildungstrieb* (1781, 1789), of the *Handbuch der Naturgeschichte* (1779, 1785,. . .), which took into account the propositions of the Essays on races and finally the *Critique of the Power of Judgment*. In paragraph 15 of the 6th edition of the *Handbuch der Naturgeschichte*, Blumenbach refers to races, adding in a note that the distinction between races and varieties, based on the strict hereditary dimension of the distinctive character of a race, had been established in Kant's 1788 article—even though the theory of race production that Blumenbach defends is not exactly Kant's, as we have seen. Initially, in 1775, Blumenbach followed Haller's preformationist ovist line, but Kölreuter's experiments with nicotine, which showed a return of hybrids to pure forms, i.e., to the paternal stock, prompted him to doubt the ovist thesis of an absence of paternal role in generation.

The existence of half-breeds poses the same problem. In Kant's germ theory, Blumenbach found a framework for thinking about Wolff's epigenesis, overcoming his reservations about Wolff's formulation. In *Über das Bildungstrieb*, he proposed a theory of epigenesis, whose proximity to—and difference from—Wolfe's we have already examined. Kant must have carefully read this 1781 text, which he discusses again in the third *Critique* and in the letter accompanying the sending of this work to Blumenbach, but which he already mentions in the following terms in the *Use of Teleological Principles in Philosophy* (1787): "This penetrating man does not grant the *Bildungstrieb*, the drive towards formation—*by which he has brought such light into the theory of generation*—to unorganized matter, but only to the members of organized beings" (Ak. VIII, p.180, my emphasis, the context is a note citing Blumenbach's refutation of the chain of beings).

Indeed, Blumenbach writes of the vital force that it is peculiar to organized bodies: "but the idea of organized bodies, an idea which necessarily carries with

it that of a purpose, of a goal, absolutely destroys all purely mechanical explanations of the formation of organized bodies by means of what the ancients called a plastic force, a force similar to that which takes place in the mineral kingdom."[60] And he adds:

> I call this trend *formative* (*nisus formativus*); it differs from all *formative forces* (such as that which produces crystallizations in the mineral kingdom) in that, since organized bodies and their parts are destined for so many different functions, it can give the seminal substance susceptible to various organizations forms just as varied as these functions; only these forms are always modified in accordance with a purpose (*zweckmässig*); thus this force (by the union of purely mechanical principles with those which are susceptible to modification in accordance with a purpose (*zweckmässig*)) first brings about successive formation at conception; it then preserves this organized being throughout its life by means of nutrition, and when this body has by chance made some losses, it repairs them as far as possible by reproduction.
>
> (*Institutions of Physiology*, §9)[61]

According to Blumenbach, the vital force is above all a formative trend, *Bildungstrieb*, related to a specific, organic seminal substance, and cannot take place outside these substances. While its nature is unknown to us, it is nevertheless possible to study its laws, as in the vitalist tradition we have examined. Thus the term "formative trend" explains nothing by itself, just as the names of all the other kinds of vital forces do; it only designates that particular force which unites in itself the mechanical principle with that susceptible of modification "in accordance with a purpose (*zweckmässig*)". It means a force whose constant effect is shown to us by experience, but whose cause, just as much as the causes of all the other generally recognized forces of nature, remains for us an "occult quality" (*Institutions of Physiology*) whose effects we must track by our observations and reduce to general laws. Importantly, in this last edition of the *Institutions*, Blumenbach characterizes such laws with a term borrowed from Kant: *zweckmässig*—crucial in the third C*ritique,* as I will show later.

Regarding the relationship between Blumenbach and Kant, and how Blumenbach, despite his written assertions, did not follow Kantian epistemology in his notion of *Bildungstrieb*, Robert Richards (2000) set matters right. Against Larson (1979), he established that Kant's fruitful misinterpretations already began with Blumenbach. But Kantian distinctions (regulative/constitutive, in particular) were undoubtedly too metaphysical to be seriously taken up or discussed by German biologists of the time. Kant's project is, above all, metaphysical, as Zammito (1992) insists, who sees in it a defense of certain metaphysical boundaries between man and animal or between inanimate matter and organisms. This difference contributes to the argument proposed by Zammito (2018), who claims that Kant's biological views were ultimately orthogonal to the advances in

German biology. Even if this characterization of Kant's metaphysical project is not exactly mine, I take up this diagnosis of a difference between the projects of Kant and his readers. (This point will be developed and discussed in Chapter 9.)

Yet, as I saw with *The Only Possible Argument*. . ., the Kantian thematization of the organic was hindered by the theory of generation. It might as well be said, then, that Kant, with his own citation of Blumenbach, is indicating here, if not a debt, at least a significant community of thought with the naturalist. Not a debt—since the essay on the *Bildungstrieb* comes after the first essay on the *Races*—but a singular proximity: Blumenbach would have felt the same dissatisfaction as Kant with the state of the theory of generation around 1760, i.e., a choice between the Malebranchist preformationism renewed by Haller and then Bonnet, and the physical epigenesist theories of Buffon and Maupertuis, whose hypotheses seemed so extraordinary. Kant definitively condemned the former, and for a long time found it difficult to accept the latter; Blumenbach rejected the latter, but ended up no longer adhering to the former (see Lenoir 1981; Richards 2000; Zammito 2018 on this trajectory). Both are following the same path, simply in reverse. Getting out of this dilemma is the main task in understanding generation, and this is why Kant values Blumenbach's importance so highly, even if, in a sense, and as I have shown, epigenesis according to Blumenbach would probably not have been possible without Caspar Wolff. I argued above that the Wolffian conception provided a way out of the dilemma in which Kant found himself trapped in 1763. Epigenesis, according to Wolff, spares preformationism while not subscribing to the fanciful theories of Buffon and Maupertuis, because, as we have shown, the field of questions and concepts is uncoupled from the Newtonian nomothetic framework in which the latter operated.

Preformationism is a hyperphysical theory because it never ceases to involve God in nature, and the existence of races is hardly comprehensible in its case, since it would require special creations for the ancestors of each race, and so races would merge with species. Linnaeus himself conceived of them as cross-breeds, but this problem of hybrids is precisely one of the major difficulties of preformationist thinking.[62] Blumenbach invoked hybrids as an insoluble empirical problem for preformationism, and demonstrated with them that preformation is "hyperphysical apparatus and multiplication of physical forces" (*Handbuch der Naturgeschichte,* §7). Thus, "bastards" imply that ovism posits a formative force and an excitatory force in the sperm (*Handbuch der Naturgeschichte*, §7); but the disappearance of the maternal form after a certain time implies that the formative force would have outweighed the excitatory force, which is contrary to the principle of ovism, in which the sperm is simply endowed with an excitatory power. Preformation is thus both "opposed to all the laws of the philosophical study of nature" and also to experience (*Handbuch der Naturgeschichte*, §7), which is precisely Kant's own 1763 assessment of this conception, blaming both the excess

of principles and the deviation from the empirically given. Epigenesis, according to Maupertuis or Buffon, remains physical, but has the disadvantage of making unknown forces, of which we have no experience, act according to laws. Moreover, in Buffon's case, epigenesis is consistent with a theory of species that, by positing only efficient causes of variation, ends up, as we have seen, contradicting the rational maxim of species conservation. The dilemma between preformationism and epigenesis thus intersects with the question of the status of races. Kant indeed becomes able to enunciate a determination of race only by breaking out of the dilemma that blocked him in 1763, namely, by producing a theory of generation (the *Keime* and *Anlage),* but which then presupposed an extant way out of such a dilemma, that is, Wolffian epigenesis (like Blumenbach presupposes). This structural relationship is indicated by the convergence between Kantian germ theory and the latest Wolffian theory of qualified matter and species (Chapter 4).

Rejecting the alternative between preformationism and mechanistic epigenesis is the intention that Kant attributed to his former student Johann Wilfried Herder in *Ideas for another history of humankind (*Part 1) in his review of this 1781 book, but it is also his own. Herder actually believed that the notion of *Bildung*, perhaps developed in common with Goethe (see Chapter 10), made it possible to overcome the alternative in question. "We are not speaking correctly when we speak of germs that only develop, or of an epigenesis in which members grow out of one another. *Bildung* (genesis) is the action of inner forces, for which nature has prepared a mass, which they build (*zubilden*), and in which they must make themselves visible."[63] On these conceptions, Kant writes:

> [Herder] calls *genetic* the force that produces the climatic varieties between humans. Let us therefore present our collaborator's [Kant's] conception of this expression, in the sense in which the author uses it. On the one hand, he rejects the evolutionary system [=preformationism],[64] but on the other, he also rejects the purely mechanical influence exerted by external causes, regarding them as inadmissible explanations. He, on the other hand, accepts a vital principle capable of modifying *itself* from within according to the various external circumstances and in a manner consistent with them, as the cause of these climatic varieties. Our contributor [=Kant] fully endorses this view, albeit with one reservation: if the cause that organizes *from within* were limited by nature to a certain number and degree of varieties in the conformation of its creature (once these had been established, it would lose all freedom in new circumstances to fabricate another type), we could call this: natural function of plastic nature germs, or original dispositions as well, without for that matter considering the preceding variations as mechanics and buds potentially inserted at the very first beginning and which would only have unfolded according to chancy opportunities (hypothesis of the evolutionary system);[65] but we could see in them the simple, otherwise inexplicable limitations of a

> formative power (*bildende Vermögen*) acting upon itself; limitations which for our part we can neither explain nor make intelligible.
>
> (Ak. VIII, p.62)[66]

Herder sides with Kant, in my quotation above, regarding the double rejection of preformationism ("mere development") and epigenesis; he appeals to a *Bildung* force, like Kant and Blumenbach. Yet, he does not limit this power so that, under all external circumstances, an organism could not take all possible forms. This point constituted the precise target of Kant's critique, and the occasion for the transcendental philosopher to show his deep disagreement with his soon-to-be-famous student—this is the "reservation" to his "full endorsement" of the Herderian view.

Herder rightly departs from preformationism; he also rejects, as Kant praised him, the Buffonian view that makes the environment the sole creator of varieties of organisms. As Kant himself argued, the adaptive change comes from within the organism—Herder spoke of a plastic genetic force, which echoes both the old notions of plasticity as creative power[67] and the recent inflation in hypothesized forces by developmentalists after Wolff (see Chapter 4).

For Kant, the plastic force, namely "the cause that organizes, *from within*" is "limited by nature to a certain number and degree of varieties in the conformation of its creature." This is exactly the *Keime* and *Anlage* that appear in the same sentence. Kant argues that this view of self-limited force is not classical preformationism (which "inserts buds and mechanisms" at the beginning of life). Thus, Herder's critiques do not concern it. These dispositions and germs are, says Kant, the limitations of the "formative power" that Herder and Kant saw at the origins of varieties. And such limitations are "inexplicable" namely, one cannot derive them from the mechanisms of nature. This enigma will be at the heart of the third *Critique* (Chapter 9). For the moment, we understand that the existence of distinct species shows that the "formative power" has some limitations; the science of nature cannot explain to us why this is the case, but the requisites of reason regarding the availability of species differences have already justified it.

Adaptive variations can only take place within the limits of the type of a species defined by self-limitations of the "formative power," because it only develops the germs of this type. Without this, Herder's thesis contains a pre-Darwinian peril that Kant has noticed: the peril of a vision of the totality of species as descended from a single species. His review pointed out that Herder's *Ideas* sketch the image of a common origin of all species, an image before which reason "shudders," precisely because it contravenes the rational maxim of the conservation of species, which is a principle of the order of nature. "Only an affinity (*Verwandtschaft*) between species, whether one species arose from the other and all from a single original genus, or whether they all arose from a single producing womb, would lead to *Ideas*—but these are so monstrous (*ungeheuer*) that reason shudders before them" (Ak. VIII, p.54). Here, the German word *Verwandschäfte*,

which means at the same time affinities (like in chemistry, and recall Geothe's *Wahlverwandtschäfte*, the "elective affinities") and biological kinship, induces a precious ambiguity: the law of affinity justified in the "Transcendental Dialectic" was not about biology, but here, the *Verwandtschäfte* can appear as kinship, hence relations of descent.

For Kant, in a nutshell, Herder forgot that the maxim of affinity is only regulative, and that if it were not, it would clash with the other two maxims, speciation and homogeneity, which require that nature be distributed into species and that these are preserved, since they enable nature to be ordered. The Appendix to the "Transcendental Dialectic" already saw that these maxims could conflict when taken constitutively and not as a style of research (namely splitters vs. lumpers). Thus, Herder here would sacrifice the possibility of dividing into species to the requirement of establishing affinities. Kinship would become real, and no longer regulative, or rather—in words familiar to this Kant's student—empirical and no longer transcendental in the sense of a condition of possibility, which means conditioning the order of nature (Appendix to the "Transcendental Dialectic"), and then an architectonics that is not a technique (see Chapter 5, §2).

Of course, in the domain of the living, "kinship" in the transcendental sense of the "law of affinity" as a principle of the order of nature finds itself faced with derivations and *real* kinships. But this does not mean that it should immediately be *identified* with real kinship, as Herder does. Because, as Kant says, by reading at the constitutive level what is merely regulative, he leads us back to the classical illusions of reason.[68]

Zammito (2018) praises Herder for having the right insights here. Kant, mostly concerned with metaphysical limitations between domains and epistemic boundaries, would prevent his readers from inquiring about the causes of the multiplicity of species. After all, Kant's emotional reaction against Herder's transformism strikes us as archaic, since we know that all species descend from former species. Kant would have warned us against Darwin[69]!

Epistemologically, Herder here anticipates what Kant's followers would do later on, namely, confusing regulative and constitutive, and seeing as constitutive those germs, or this self-limiting force, that Kant, from the *Critique of Pure Reason* to the third *Critique*, would strive to prove merely regulative. According to this reading, thus, the disagreements in the interpretation of Kant, and the position of Zammito or Richards, who credit Kant's late readers such as Ritter, Kielmeyer or even Blumenbach, with having freed biology from Kantian metaphysical limitations, were prefigured in Herder's text.[70]

As to transformism, I would point out the difference in levels of historical processes. In terms of statements, Herder seems clearly closer to Darwin than Kant, since he argues in favor of transformism, while Kant denies it. However, in terms of concepts and compatibilities between conceptual schemes, things may differ, because the concepts of adaptation, development, and organism that Kant reflected and then transmitted to later scientists include conditions for thinking

evolution as Darwin did—as I will argue later on (Chapter 10), developing consequences of the present analysis of the concept of adaptation (§2.3.1 above).

6.3.2 Summing up

Thus, let us recapitulate Kant's view on the history of life. If the history of nature explained everything, whether through the direct effect of external causes (Buffon, Blumenbach) or the unlimited spontaneity of an internal principle in organisms (Herder), then once again the maxim of species conservation would have been denied. Thus, something must resist history, while at the same time, historicity is a principle of intelligibility for the things of nature. Here comes into play the theory of germs: only within certain limits, defined by *Keime/Anlage*, can the empirical history of climate variations and migrations account for the kinship between species.[71] Kant speaks of the self-limitation of the "formative power": it limits itself in the same way that the rational requirement to divide the living into species limits the other rational requirement to unfold architectonics historically (Chapter 5). The theory of germs and dispositions thus plays the limiting role: it limits the historicity of animals and plants in such a way that not everything in them is reducible to the contingency of the vagaries of empirical history, which means that knowledge of their empirical history cannot exhaustively account for what they are.[72]

However, beyond Herder, the insistence on the transcendental dimension of history, i.e., on the regulating character of the germ theory, is a response to a problem internal to Kantian theory. If a strain, such as the human strain, includes latent germs, then this strain itself could be understood as a germ within a larger strain, such as the ape's. The monstrous possibility of species descending from one another, that Kant detected in Herder's theory, is therefore always present in the form of a possible nesting of strains. We therefore need to limit the nesting of germs in strains, we need this "self-limitation" that Kant refers to, achieved by the germs present in the "germs/dispositions" pair forming the strain of the species.[73] If we confuse the historicity requirement of architectonics with empirical history, then this monstrous possibility remains open, and would be represented by the conception that Kant attributes to Herder in order to criticize it.

The idea of a transcendental history does not assert an actual inclusion of strains into one another—an empirically unprovable assertion—, it simply indicates that the possibility of knowledge requires historical relations between varieties, without, however, specifying the level at which empirical historical correlations cease, so that we move on to independent strains. It leaves this question unanswered, whereas the Herderian temptation dissolves it by reducing the transcendental requirement to empirical history.

The paradox of Kantian race theory—namely, the demand for historical derivation at the basis of classification*, coupled with* the refusal to derive strains, and therefore species—is solved by the subtle distinction between empirical

and transcendental history, by the refusal to determine empirically the threshold between independent strains and latent germs internal to a strain. The idea of a transcendental history of nature reconciles the architectonic *requirement* of historicity with the refusal of a *general* empirical historical derivation of species. The delicate status of this history is undoubtedly to be later found in Von Baer's major embryological work, the *Entwicklungsgeschichte der Thiere* (1828). He actually held together a diversity of four major organic types combined with a hierarchization of these types, and his followers would have to painfully maintain both the derivation of types and an actual species fixism.[74]

Like Buffon and Herder, those who enclose the history of nature within the search for empirical consequences between phenomena must appeal to forces whose meaning no longer refers at all to possible experience: inner molds in the case of one, and "formative power" in the case of the other. There comes a point when their physicalism turns precisely into hyperphysics, the very thing that the zealots of natural explanation were eager to denounce in preformationism. We have reached the "most extreme frontier" of the principle that everything in nature must be explained naturally "when we have recourse to the last of all the principles of explanation that can still be guaranteed by *experience*. Where these are lacking, and one must begin to imagine for oneself forces of matter obeying unknown laws that are susceptible of no proof, one has already departed from the science of nature, although one still calls natural things "causes" but ascribes to them forces whose existence is proved by nothing, and whose very possibility can hardly concur with reason" (Ak. VIII, p.179). At this point, we must abandon the naturalistic explanation, without, however, seeking any other explanation. We must simply set a limit to the explanation, in itself inexplicable, which is the set of germs/dispositions.[75]

Empirical history, or its reconstitution by analogy with present-day forces, must come up against an origin that is removed from the empirical, but which nevertheless confers on an intelligible framework (otherwise we fall into the illusions of Herder or Buffon, contravening the principle of the conservation of species).[76] This origin as germs or dispositions has a *pre-adaptive* character since they fit the species to any *possible* environment. This is why the transcendental history of nature is necessarily *teleological*, and all the more teleological that, beyond the existence of germs, the mystery of their *activation* is teleological: why would nature activate the fittest germ when a species is transplanted to another environment? Here, the effect, namely, the adaptation to the new environment, appears as the cause of the selection of this germ rather than others, which is clearly a teleological process.

The text on Herder, however unjustified it may be with regard to the Herderian *Ideas*,[77] had identified a problem internal to Kantian theory, the problem of the self-limitation of germs, which is about the rules of properly using teleology; hence the need to write about the *Use of teleological principles*, and later, to elaborate the third *Critique* as an investigation of teleological judgment.

6.3.3 Teleological laws according to The Use

To the question asked above: "What laws will the history of nature use?," we can now answer: "teleological laws of generation." But on this point, is the short 1787 paper entitled *The Use of Teleological Principles* satisfactory? The origin of the original in the theory of the living—that is, germs and dispositions—is not a matter of physics, but of metaphysics (*Determination*, Ak. VIII, 179). If we want to think about it, we have to look for a fundamental force, outside the world, that could account for it.

"A fundamental force, by which an organization would be realized, must be thought of as a cause acting according to *purposes*, and in such a way that these purposes must be laid at the foundation of the possibility of the effect. But we know such forces, *according to their principle of determination*, only in ourselves, i.e., in our understanding and our will, as the cause of the possibility of certain products totally constituted according to ends, i.e., *works of art*" (*Determination*, Ak. VIII, 181, my emphasis). The model of artefacts thus comes into play once again in thinking about living nature. In the Appendix to the "Transcendental Dialectic," remember, purposiveness had become mere language. Here, it is something more: we need the model of *the work of art* to conceive of it. In *The Only Possible Argument. . .* purposiveness as technique was set aside by purposiveness as system, and the Appendix to the "Transcendental Dialectic" concluded this process by an indifferentiation of the very status of the living. The technical paradigm now returns with the concept of purposiveness and teleology when it comes to thinking about the living itself in the perspective of a history of nature, and against the background of the architectonic requirement of reason. However, since the Second Antinomy, we also know that technicality alone is insufficient to define the living organism, for a machine, even rendered infinite, does not match with the living organism, contrary to Leibniz's idea.

In this sense, if we really want to reconcile the critical project initiated by the *Critique of Pure Reason* with the investigation into the status of living nature, we must revisit the question of technical purposiveness. For there is no doubt that Kant found the text of the *Use. . .* insufficient, otherwise he would not have written *Critique of the Power of Judgment*. Or rather, the two texts stand on different levels. The *Use* legitimizes what the theory of germs did, namely, its right to use teleology; the *Critique* inquires into the concept of purposiveness itself, which defines teleology.

Certainly, the germ-development model and the transcendental history of species seem to provide the beginnings of an answer to the question raised by my reading of *Critique of Pure Reason*: what meaning can be given to the affinity between the architectonic requirement and the animal model? For here, the notions of strain and affinity, which constituted architectonics, take on a new meaning, both deprived of the abstract character they had in Linnaean classifications, and filled with a new historical and teleological significance. The idea

of the epigenetic character of reason, which the Architectonics implemented in the *Critique of Pure Reason*, refers back to Kant's theory of races. The exemplary value of animality for understanding the system of knowledge, seen in the "Methodology of pure reason," ultimately rests on the need to think of the animal species in terms of germs and dispositions fit for possible environments. In this sense, both the architectonics of knowledge and the animal or species require a history to develop their germs and dispositions, a history that can be understood as a teleology. Reason and life are intrinsically teleological.

Under these conditions, clarifying the status of animality requires us to revisit teleology and its technical paradigm: no longer *the use of* teleology, but its *meaning*. This also means revisiting the thought of classification presented in the Appendix to the "Transcendental Dialectic." While in the essays on *Races* Kant is already close to Wolffian epigenesis and Blumenbach, in the first *Critique* we still saw him torn between his condemnation of preformationism and his reluctance toward Buffon's and Maupertuis's reckless theories on generation. He had not yet taken the measure of his meeting with Wolff and epigenesis in *On different human races,* an encounter whose significance is further explored in the other opuscules discussed in this chapter. But then this encounter would ultimately have to affect the theory of species and genera offered in the Appendix to the "Transcendental Dialectic," which granted no privilege to living nature and ultimately resulted in a general theory of classification.

A singular articulation has emerged between Kantian speculation and the transformations in the way his fellow scientists thought about the living. To sum up: in the Second Antinomy, Kant appeared to echo the reaction against mechanicism common to Leibniz's and Stahl's vision of the living, reinterpreted in the context of his theory of reason as a faculty for unending syntheses. The conception of vital forces was taken into account, first with his partial support for Maupertuis and Buffon's theories of generation, and later with his approval given to a theory of epigenesis close to Wolff's in the essays on races. In Wolff's case, such a theory made use of a *vis essentialis* of essentially methodological status, whereas in Blumenbach it required a *Bildungstrieb*, to which I will return later. For Kant, generation implied a fundamental teleological force in interaction with occasional causes that stimulate it. Accordingly, Buffonian reflections on the biological species, leading to considerations about environment, history, and climate, were reinvested and transformed in the 1775–77 theory of races and adaptation.

6.4 Conclusion: toward the problem of the third *Critique*

Considering living nature immediately raises the question of the relationship between the operations of nature and those of man, insofar as they represent the two forms of purposiveness: natural finality and the ends of freedom, the latter being seen as the only model for the former, as indicated the sentence of the *Use*

quoted above. Is there harmony between these forms? This is the question that critical thought must develop once it has distinguished the domain of concepts of nature from that of concepts of freedom: for if they are absolutely disjointed, the actions prescribed by the categorical imperative, which governs our moral life (according to the *Critique of Practical Reason*) no longer make any sense. Nature should be such that it is not hermetic to moral action.[78]

Thus, questioning the articulation of nature and morality, as the *Critique of the Power of Judgment* would undertake, necessarily involves interrogating the germ theory at the heart of this dual concept of the human species, in order to clarify the meaning of the teleological presupposition of reason. Reason, like life, is teleological because it must be expressed in the language of the germ theory, as I pointed out in reading the Transcendental Methodology. Hence, as an interrogation of the concept of purposiveness and an investigation of the discourse that reason can hold on life, this *Critique* will also be an investigation of the necessities by which reason must appear to itself in the same way as life.

With this in mind, before embarking on such a reading of *Critique of the Power of Judgment*, I must first turn to Kant's texts in which life is conceived in its relation to reason, as the property of humans and animals. Scattered throughout Kant's texts indeed exists a discourse on life other than that which begins in the opuscules examined here and is then scrutinized in the third *Critique*. Its naturalistic and physiological references are not exactly the same. And this other discourse is not necessarily compatible with the present one, as I will investigate in the next chapter.

Notes

1 See Roger (1989, 1992) and Hoquet (2007) for an analysis.
2 And also: "Nature does not know our definitions; it has never arranged its works by heap, nor beings by genus; on the contrary, its march always goes by degrees and its plan is nuanced by everything and extends in all directions" (HN (A), 14, *Nomenclature des singes*, p.3).
3 HN, VII, "Le rat," 1758, p.278.
4 With Sloan and Lyon (1981, p.27), this insistence on physical reality as opposed to abstraction can be seen as what lends stylistic unity to Buffon's thought and its various components: content-based empiricism, Newtonian natural philosophy, probabilistic epistemology, Leibnizism. . .
5 HN IV, 1753, "Les animaux domestiques," chapter "L'âne (donkey)", p.143.
6 HN IV, 1753, "Les animaux domestiques," chapter "L'âne (donkey)", ibid.
7 It is not the place here to discuss the supposed Buffonian "transformism," on which studies abound, among others Roger, "Buffon et le transformisme," in Roger (1995); Roger (1963, pp.572–580); Roger (1992, pp.523, 548); Foucault (1966); Jacob (1970).
8 "By establishing the criterion of inter-fertility for the recognition of individuals of the same species, Buffon associated the concept of *inner mould* with that of species" (Farber 1972, 265).

9 What happens with the Buffonian definition of the species corresponds to Jussieu's work in the field of plant taxonomy: by choosing characters that indicate internal analogies, namely, identities of functioning, in the plants they allow to be grouped, Jussieu anchors the plant species in an invisible organic functioning. Foucault (1966, chapter 5) analyzed this transformation. Atran (1982) related this operation, which he studies after an examination of Buffon, to the emergence of biology: "now that taxonomy was based on an *understanding of the* underlying *biological processes*, the study of these processes would soon emerge as the main object of a *new science*," namely, biology (p.137).

10 "We can always draw a line between two species, that is, between two successions of individuals who reproduce and cannot mix, just as we can also unite in a single species two successions of individuals who reproduce by mixing: this point is the most fixed we have in Natural History; all the other resemblances and all the other differences that could be grasped in the comparison of beings would be neither so constant, nor so real, nor so certain" (HN IV, "L'âne," p.144). Hence the rejection of categories other than species, all of which are artificial: "and we will make no more use of families, genera, orders and classes than nature makes use of them."

11 "How else can we know how closely related animals of different species are, other than through the results of a thousand and one attempts to unite them? Is the donkey closer to the horse than to the zebra? Is the wolf closer to the dog than the fox or jackal? How close to man are the great apes, which so perfectly resemble him in body conformation? Were all animal species once what they are today? Did their numbers not increase or rather decrease?" (*Supplément*, t.III, 1776, "La parenté d'espèce" (Species kinship)).

12 HN (A), IX, "Animals common to both continents," p.31 (1761).

13 Barsanti (1992) reconstituted Buffon's approach to representing relationships between species. The linear model of ladder, adopted at the outset, was deemed insufficient, so Buffon added the model of the map, i.e., the geographical network: "each species can no longer be conceived as an intermediary between two other species, since it possesses affinities with many different groups to which it is linked by 'particular relationships'." However, Hoquet (2003) offered a penetrating critique of Barsanti's argument. In 1766, Buffon felt the need for a three-dimensional representation to synthesize these relationships. When, in his *Elenchus zoophytorum* of 1766, Pallas drew a tree in place of the ladder of beings, to indicate the difference between mineral and animal, Buffon took up this model to be able to represent his theory of degeneration: the map marks the ecological dimension of species but cannot represent the dimension of time, while the tree synthesizes the directionality of the ladder, easy to interpret temporally, and the geographical ramification of the map.

14 On this author's medical doctrine, see Hannaway (1993, pp.292ff).

15 In this sense, the coupling of a history of the Earth with a natural history makes Buffon's natural history a "research program" distinct from that presented by Linnaeus's natural history; and no doubt in this competition between contemporary programs, Buffon prevailed: this is how Sloan (1989) presents Buffon's critique of Linnaeus. He points to the role of the Cambridge Platonists, Cudworth and More, with their desire to attribute plastic force to nature, in liberating the history of the Earth from its Cartesian mechanistic framework, and thus enabling Buffon's theories (p.302).

16 *Époques de la nature,* 1, p.27. On the mammoth, which enabled Buffon in 1761 to write "one will be surprised at the promptitude with which the species had, and the facility they have, in taking new forms," see HN (A) IX, "Animals common to both continents," p.34.

17 "At Montbard," wrote Roger (1992, p.285), "Buffon set up a menagerie where he kept foreign animals "to observe their habits before dissecting them."
18 See also Farber (1972, p.284) "The species, then, was no longer a static category. It was a succession of genetically related beings that differentiated over time. Buffon indicated that, since the environment was the cause of its changing expression, the concept of species was inextricably associated with earth history, zoogeology and zoogeography."
19 On Blumenbach's notion of races, see Eigen (2005), and McLaughlin (1982).
20 References in brackets in the body of the text go to this work for the remainder of this paragraph.
21 Fabbri Bertoletti (1994) analyzes Blumenbach's doctrine of the human species in relation to the embryological theory of the formative tendency.
22 *Institutions of Physiology*, section 14, §174.
23 *Institutions of Physiology*, ibid.
24 Kant's treatment of Blumenbach therein will be discussed below.
25 Zammito (1992, p.303); on the category of "popular philosophy"; see also Puech (1990).
26 For the anthropological context of these Kantian theories, see Lagier (2004).
27 Kant's interest is in the empirical criterion of species, not in classification itself. In his *Physical Geography*, Kant is much less rigorous when it comes to classifying animals. The first four parts, concerning quadrupeds and large land animals, follow a Linnaean classification (hoof criterion, etc.). After that, things get sloppier: Kant obviously selects the weirdest animals, and makes a separate entry for "other remarkable fish," which includes octopus and flying fish. As for invertebrates, they are classified as "useful" and "harmful," even though progress in biology, first by Lamarck and then by Cuvier after Réaumur, insisted on the distinction made in this group. (On Lamarck, see Burckhardt 1977; Corsi 1988). The families for trees and birds are also clearly pre-Linnaean, and only mention species that are interesting or bizarre to man.

    This comes from a geography course, and it is clear that this discipline favored beings with which listeners would have little familiarity—hence Kant's choices, which insist on what is likely to arouse curiosity (the "edible grasshoppers," (IX 350), the chameleons (352), the pelican (354) and "the tree that gives water to drink" and "the tree that gives bread to men" (356, 358)). At the same time, this is an echo of Buffon's approach, which begins natural history with the animals familiar to man. Kant's reassertion of man's central place is justified both by moral philosophy and by the defective nature of all existing classifications, their lack of species criteria, so that we might as well begin with common sense, with what is similar to us.

    Finally, the description of the animals themselves, including especially the vertebrates (where less emphasis is placed on the exotic), devotes considerable space to their habits (lions eat mostly men, not women, IX 336) and their habitats. While the last point is expected in a geography course, these two features indicate different concerns from the Linnaean systematics that Kant partially uses, and refer, if not to Aristotle's *History of Animals*—a work to which the Kantian text is often reminiscent—then at least, and above all, to Buffon's insistence on ethology.
28 On the biological underpinnings of this theory, see Cohen (2006).
29 *Physical Geography* offers an example: setting out the idea of a history of nature, Kant writes: "If we were to examine, for example, how the different breeds of dog have arisen from the same stock, and what transformations they have undergone through all the ages under the effect of different countries, climates, reproduction,

etc., we would have a natural history of dogs, and we could produce one for each distinct part of nature, for example for plants, etc." (Ak. IX 162). The paragraph devoted to the canine species in the naturalistic part of the text then refers to a specific dog breed, which is the sheepdog, and the "degeneration of domesticated dogs returned to the wild" (IX 333). However, the degeneration of animals is addressed by Buffon (HN XIV 317), and he himself makes a historically oriented classification of the dog species (HN V); thus, it seems that this little example of "nature history" in the Kantian sense refers back to Buffon.

30 It is this same rational evaluation of the maxims of judgment that enables Kant to reject Woodward's history of the earth—even though in this matter, because it concerns a bygone past, there are no facts that can be used as touchstones for decision (*Physical Geography*, §77, Ak. IX, 303).

31 The Kantian history of nature, in the age of the *Races*, is thus not a search for past events, "for example the first origin of plants and animals," but is content to "seek the connection of present dispositions of natural things with their causes in former times, according to causal laws, which we do not forge but derive from the forces of nature as it now presents itself to us, and which we follow back as far as analogy allows us" (*Gebrauch*, Ak. VIII, p.162). This "as far back" respects, of course, the impossibility of speculating on the origins of the world and of beings in the world, as shown by the "Transcendental Dialectic."

32 Or genus. The two terms, species and genus, are synonymous in the history of nature insofar as they both refer to the community of strain (*Determination*, Ak. VIII, p.100 note).

33 On these distinctions, see Lagier (2004).

34 "If differently constituted human beings are placed in circumstances favorable to their interbreeding, then if the generation is mixed there is a strong presumption that they may belong to different races; but if this product of their interbreeding is each time mixed, then this presumption becomes certainty" (*Determination*, Ak. VIII, p.100). McLaughlin (2007) shows that the notion of heredity in an anthropological rather than medical context is largely indebted to these texts by Kant.

35 "There are so many characters within the human species, some of them important, some of them hereditary within families, and yet there is not one which, within a human class characterized by skin color, is necessarily transmitted. On the other hand, this last character, however insignificant it may seem, is universally and *infallibly* transmitted, both within this class and by interbreeding with one of the other three" (McLaughlin 2007).

36 A race is distinguished by a "character which degeneration has given rise to" and which "necessarily and inevitably becomes hereditary by propagation," unlike a character peculiar to a variety, such as blond hair (§15). Blumenbach adds that it is sometimes difficult to distinguish between species and race, in characters that have been hereditary for a very long time. But we shall see that this is not the case for Kant, for the character that defines a race does not become hereditary "by propagation," it is hereditary from the outset, because it is an adaptive character.

37 "Man, white in Europe, black in Africa, yellow in Asia and red in America, is but the same man tinted with the color of the climate. (. . .) the influence of climate is the strongest" (HN (A) 9, "Le lion," p.35).

38 "The principles of determinate development, which lie in the nature of an organic body (animal or vegetable), are called *germs* when this development concerns particular parts, and if it concerns the magnitude or relation of the parts to one another, I call them *natural dispositions*." (*Races*, Ak. II, p.434) On *Keime* and *Anlage* see Zumbach, (1984 ch.4, p.109); Lenoir (1982, chapter.1); Sloan (2002).

39 Germs refer to the first preformationists, Leibniz and Malebranche, and dispositions, to the second, such as Haller and Bonnet.

40 This is why Black persons transplanted to Europe would conserve their skin color, contrary to Buffon's belief: while the mere climate in which they live has awakened the germ of the black color, the fact remains that it is now necessarily transmitted to all offspring, regardless of living conditions, insofar as it is an active germ in the reproductive power of individuals of the black race. More generally, for Kant, Buffon's theory of degeneration should be qualified accordingly: "Even if, after a long period, a nation degenerates to take on the natural character of the climate in which it settles, the traces of its previous sojourn are still to be found in long afterward. The Spaniards still have the characteristics of Arab and Moorish blood" (*Physical Geography*, II, 1, §4, Ak. IX 318).

41 The third *Critique* proposes to call it "generic preformationism"; on this conception, see Fisher (2007) and Zammito, (2007), as well as Chapter 10.

42 This is not to say, however, that we should give in to the illusion of the precursor who sees Kant as a prophet of genetics by equating his conception of undeveloped germs with the distinction between phenotype and genotype—if only because the Kantian germ, once awakened, is always transmitted in an active form, like skin color, unlike the geneticists' genotype. Better still, it erases its competitors: "once one of these dispositions has developed in a people, it entirely erases all the others" (*Determination*, Ak.VIII, p.105). The only remotely relevant comparison would be with Weissmann and his difference between *soma* and *germen*, the latter being the locus of inheritance, preserved from external influences. Bommersheim likened Kant to Weissmann: "We find . . . Weissmann's thoughts already in his doctrine of 'germline selection', which he developed on the basis of Roux's principle of the struggle of parts in the organism: the thought of a combat of hereditary dispositions (*Erbanlagen*) with one another" (Bommersheim 1918, p.215). Furthermore, the Kantian criterion of race—skin color as a criterion of hereditary disposition, thus indicating real differences between sub-species—is precisely discredited in modern genetics, since there is no detectable gene to distinguish different "races," usually phenotypically described.

43 This is the main argument of Lovejoy's study to show that there is indeed nothing in Kant that makes him a precursor of the theory of evolution: "this argument, by which Kant justifies that all men are of the same *Stamm*, directly implies that men and other animals are not of the same *Stamm*, i.e., are not related along lines of natural descent" (1959, p.181).

44 On this question of the variability of species according to Buffon, see, among others, Farber (1972), Roger (1992) and Hoquet (2007).

45 On adaptation, see Huneman (2005), and McLaughlin (2007).

46 The theology of insects developed by Abbé Pluche in his *Spectacle de la nature*, based on Réaumur, is a perfect example of this approach. When Buffon mocked it in his "Discours d'introduction à l'*Histoire naturelle*," he no doubt meant that natural history should be written from the human point of view, starting with quadrupeds, because there is no absolute order and no divine point of view—which is why, against Linnaeus, he wrote that it is absurd to have the zebra follow the horse in exposing natural history, because for us, it is rather the dog that follows it (in barnyards). But above all, he points out that the complicity between the naturalistic and the theological, as expressed in the theology of insects, makes it impossible to understand the true mechanisms of adaptation.

47 Migrations and transplants give rise to what we take to be new species of animals and plants, which are actually no more than "variants and races of the same genus, whose germs and natural dispositions have occasionally developed in various ways *over a*

long period of time" (*Races*, Ak. II, p.434, my emphasis). This is precisely where the note on the history of nature comes in, interweaving the history of the Earth and the history of organisms. See also *Gebrauch*, Ak. VIII, 173, "where they arrived by chance and continued their generation *for a long time*, there they developed for that land the germs which were in their organization and which made them suitable for such a climate" (my emphasis).

48 Adickes refers to Priestley as the source of this theory of phlogiston in blood (1924, II, p.423).

49 This is also in line with Kant's own intention when he contrasted natural classification with scholastic classification. For if Linnaeus's error consisted in taking accidental external characteristics as criteria for his classification, then Kant would in a sense incur the same objection by giving skin color as the sole criterion for races. He prevents it, however, because skin color turns out to be less accidental than it seems, since it has an adaptive value. To this extent, he is aligned with a movement we detected in Haller and Jussieu, whereby the classificatory aim of the science of life seeks criteria which, according to Jussieu's principle of subordination, respond to real hierarchies within organisms.

50 It is therefore difficult to agree with Lovejoy, (1959, p.187), that Kantian theory is a naive teleology akin to the pre-existence of germs, as the example of skin would demonstrate.

51 For an explanation of the diversity of human varieties within the framework of a single species, see Cohen (2006).

52 "This cannot be understood by the diversity of original strains. It is only if we admit that, in the germs of a *single primitive strain*, the dispositions to all these class differences (. . .) that we understand why when these dispositions occasionally, and diversely according to each of them, developed, various classes of men appeared" (*Determination*, Ak. VIII, p.98).

53 This results in a teleology that is more flexible than that of traditional natural economy, since species are not prepared for a specific region where God would put them, but for all regions, due to their multiple germs, and so they can adapt wherever chance puts them: "the development of dispositions is regulated by the places [where animals go], and they must not, on the contrary, as Mr. Forster has misunderstood, seek a place according to dispositions already developed" (*Gebrauch*, Ak. VIII, p.173). The *Difference of Human Races* already said: "This solicitude of nature, to prepare its creation for all kinds of future circumstances by means of hidden inner dispositions, so that it can maintain itself there and be in conformity with the soil and the climate, is worthy of admiration" (*Races*, Ak. II, p.434). A note from *Anthropology* then praised the Linnaean theory of world history, according to which the first humans would have lived on the only emerged land on the globe, and then, with the gradual decrease of sea level, their descendants would have spread out into the progressively discovered lands, whose climates varied according to altitude—and thus made use of all their climatic pre-adaptations. For Kant, then, this theory is not true in the order of the empirical history of nature, but is a model that shows the efficiency of man's pre-adaptation to all climates.

54 For Blumenbach: humans are "destined to inhabit almost all parts of the earth and to feed on almost all the productions of the organized kingdoms" (*Handbuch der Naturgeschichte,* §37); that's why they need more than the uniform technical instinct of animals (*Kunsttrieb*), so that reason enables them to adapt to diverse circumstances.

55 Blumenbach and Buffon found the unity of the human species on a theory of degeneration under external conditions; but Blumenbach, as Fabbri-Bertoletti (1994) notes, does not accept the Buffonian criterion of interfertility as the sole criterion for the species in general.

56 This theory of races has been read in the general context of critical theory of race by Bernasconi (2011, 2023),—this perfectly legitimate reading does not contradict mine but the present philosophical questioning of the same texts is completely different.
57 Even if I agree with Timothy Lenoir (1980, p.132) that, for Blumenbach, the stock needs not exist, that it could just as easily have disappeared with the revolutions of the globe, the essential thing is to be able to reconstruct a common human type shared by all races; on "type," see Chapter 10.
58 "These varieties are like all those which distinguish one man from another man or one nation from another nation: they are barely perceptible nuances and according to which one could only establish arbitrary classes and divisions" (*Institutions of Physiology*, section 14, §174; reproduced more or less unchanged in the *Handbuch der Naturgeschichte* section 1, 1, p.78).
59 This is why a note in *The Use of Teleological Principles in Philosophy* makes it clear, against the erroneous reading of the essay on races by the Herderian Georg Forster, that the single primitive stock does not mean a single real, empirical couple, of which all men are descendants: the essential point is that, if there were a multiplicity of original couples, these can be represented as coming from a single strain, because they contain the same germs and are therefore of the same species: "Belonging to one and the same strain does not mean at the same time coming from a single original *couple*. It simply means that the diversities currently found in a given animal species should not be considered as original differences. Now, if the first human stock consisted of as many people (of both sexes) as you like, but nevertheless all of the same species (*gleichartig*), I can derive present-day men from a single couple just as well as from multiple couples" (*Gebrauch,* Ak. VIII, 178). The assertion of the uniqueness of the *Stammgattung*, once again, is not an empirical truth, but a transcendental principle that enables the classification and representation of the history of human races. On Forster, see Beiser (1990), Zammito (2002) and Jahn (1995).
60 *Institutions of Physiology*, §8, note. Here, Blumenbach explicitly rejects Mazzini's theory that offspring develop through a process of crystallization—a theory that would seduce some of his contemporaries like J.C. Reil (see Steigerwald 2019, p.154). The same considerations occupy several paragraphs of *Uber den Bildungstrieb.* Fabbri Bertoletti (1994) rightly points out that *Bildungstrieb* is a formal organizer and, in this sense, if it does not depend on any material, accompanies only the still unformed substance: "It remains a formative principle that acts only as a formal organizer: its specific field of activity is that body of epigenetic phenomena that exist between the initially raw and formless substance, and the definitive architectural structure of the organism with its organized functioning."
61 For the role of nutrition here as part of the formation, even though it has been long overlooked, see now Bognon-Küss (2019).
62 See Jacob 1970, chapter 3, and Roger 1963, chapter IV, pp.385ff.
63 *Ideen.* . ., V, 2. And also, on these forces, Herder notes: "No eye has seen pre-formed germs that would have been there since creation; what we notice at the first instant of a creation's becoming, are acting organic forces" (*Ideen.* . ., V, p.2).
64 As Richards (1992) extensively explained, "evolution" was initially the name of organic development understood in a preformationist manner; this process indeed unfolds what is folded, which corresponds etymologically to "*evolutio*." Richards analyses the strange historical fate of this word, which ultimately denotes something almost opposite to its original meaning (to the extent that evolution supposes inheritance, which is very different from development).
65 In other words, preformist, according to the vocabulary of the time. See previous footnote about Richards (1992).

66 On Kant's critique of the *Ideen. . .*, and in particular the dispute over history contained in Herder's critique, in Book VIII, of *The idea of Universal History from a cosmopolitical viewpoint*, see Philonenko 1998, chapter IV. Herder wrote of the generic force that it is "the mother of all formations on earth, which the climate only activates in a hostile or beneficial manner." (*Ideen.*, VII, 4, p.33). On Herder's theory of development and Kant's critique of it, see Zammito 1992, pp.199–213.

67 See Hutton (2021) and Nicoglou (2024) on the Platonists Cudworth, More, etc.

68 Even if Herder himself would basically agree with Kant, since he generally rejects the idea of descent of species, thinking simply of a progression in the order of appearance of species (or their Creation), teleologically oriented toward man. But precisely, humans cannot be historically descended from other animals, nor animals from one another: "For each race nature has made enough, to each it has given its own inheritance" (*Ideen*, VII, p.1).

69 For an account of Kant and evolution, see also now Cohen (2020).

70 Since Zammito (2002), several readings of Herder's biology have been elaborated, and first of all Steigerwald (2019) and Rupik (2024). Both emphasize the proximity between Herder and Goethe, whose alternative to Kant's views will be discussed below, Chapter 10.

71 The Herderian germ thus differs from the Kantian germ in that, in Kant's view, no intelligible history of nature can ultimately be derived from Herder's principles. Herderian historicity is ultimately ahistorical for Kant, because it does not presuppose the transcendental level of intelligibility that the *Keime* and *Anlage* constitute. In this sense, the use of "germs" in *Auch eine Geschichte. . .*, and in relation to human history, presents a feature that cancels out what Kant would expect of a history, namely directionality. The Herderian germ guarantees, on the contrary a constancy of morality: "in humanity lies an invisible germ of sensitivity to happiness and virtue over the whole earth and in all epochs, which develops diversely, appears in various forms, but internally is only a single quantity and dosage of forces" (558). (This is a view shared by Moses Mendelssohn, see Philonenko 1998, chapter II.)

72 Just as in the *Conflict of the Faculties*, and in Kantian political theory in general, human history delivers its meaning only to a moral observer who sees a rational Idea in hindsight, so the history of nature presupposes the fulfillment of the transcendental requirement of species conservation; hence, the self-limitation of the plastic power, namely, the theory of germs. (While these are manifested in history, history itself cannot let us know that they exist: therefore, to understand the history of nature implies having already postulated the theory of these germs whose development is history.)

On the subject of such an Idea, which is both the "culmination of contradictory aspirations" and the "point of union" of what have different purposes, Kant writes: "The unity of a history from such an idea makes it a system. (. . .) The question is whether there is something systematic everywhere in the history of human actions. One idea drives them all, that of their right." (*Reflexion 1420*, c. 1773–1775); or: "The history of species, not of humans. *The former presupposes an idea*" *(Reflexion 1467*, ca. 1783–1784, my emphasis).

73 In essence, this brings him closer to the version of preformationism advocated by Bonnet in his *Considérations sur les corps organisés*, simultaneously with his ally Haller in his study of the chicken, namely, not the pre-existence of a living form, but the dissemination within the living body of germs corresponding to the parts and capable of being actualized; Kant's "germs" would not be integrated into an epigenetic theory that incorporates Wolff's requirements of authentic epigenesis until shortly before the third *Critique*, as we shall see in the following chapters; according

to Zöller (1988), Kant did not explicitly mention epigenesis, either in his publications or in his lessons and *Reflexionen,* until 1786.

74 On these points, see Ospovat (1981); Lenoir (1982); Richards (2002).

75 Zammito (2007) insists on this Kantian concern for non-metaphysically posed limits.

Insofar as germs imply adaptation while at their level naturalistic explanation is no longer valid, we can speak of them teleologically; insofar as, however, they are not *themselves* an explanation, we will not speak of them theologically. "In what deals with pure knowledge of nature, and as far as it extends (where it is entirely appropriate to express oneself *teleologically*), I do not find it wise to use *theological* language" (Ak. VIII, p.179).

76 In the contemporary text *On the Volcanos on the Moon* (1785), Kant does not renounce a historical explanation of the world system, despite the criticism of any cosmological account of origins in the "Transcendental Dialectic," and the consequent abandonment of the attempt at a *Universal History and Theory of Heaven*. But he is careful not to go back to the origin of the formation of the world system. "As to the cause of the first movement of these atoms in universal space (. . .) I have not made a point of indicating the first of all natural changes, which is quite impossible" (Ak. VIII, p.75). According to the regulative use of the antithesis of the Third Antinomy in the "Transcendental Dialectic," we can indeed go back from cause to cause in the course of nature—but without ever being able to claim an unconditioned, i.e., a beginning. By assigning to germs a status of inexplicability—as a self-limitation of the formative faculty that circumscribes the history of the living—Kant repeats the same gesture in the realm of the history of the living.

77 See Zammito (2018) for a critical examination of Kant's reading.

78 The very idea of the human species was ensured by the uniqueness of the human stock, as we have seen—but the reality of this unity lies not so much in the stock as in the future state of humanity. To speak of a human species or genus makes sense primarily in terms of the future. Indeed, *Reflexion* 1453, from 1771, initially noted: "mixture of races by progressive community and re-establishment of the first archetype, but only insofar as it was fully completed."

In other words, the "archetype," namely the original human stock, empirically untraceable, can also be conceived of on the horizon of history, as the result of the mixing of races, and thus of the harmonization of all now-developed dispositions. This thought suggests that the unity of the human species as an Idea, while given first as the stock of the human family, is in reality best thought of as the realization of the dispositions given in the strain, i.e., as the actualized projection into the future of what is latent in the past. The unity of the human species is ultimately to be thought of less as a strain than as a destination; these two concepts are equally non-empirical, and designate a non-empirical before and beyond time, which ultimately has a regulative status for thinking about the future of the species over time. In this sense, the human species is both a natural and a moral concept, since it was originally conceived within a theory of animal species, namely, within the framework of nature, but finds its authentic meaning in the concept of destination of man, i.e., within the framework of the purposes that freedom sets itself. This makes for a profound difference from the Buffonian definition of species we started from, and is a consequence of the transcendental viewpoint developed by Kant from an examination of the intellectual acts that constituted this biological concept.

7 Life, soul, and body (again)

Throughout Kant's writings runs another perspective on life, the main concepts of which are not those we have encountered so far, and which are critically examined in the *Critique of the Power of Judgment*. On the contrary, I will be dealing here with considerations on the living from a psychological point of view, as indicated by the pervasiveness of the term "soul" (taken from Baumgarten, whose textbooks formed the basis of Kant's lectures on metaphysics). I shall now briefly sketch out this other image of life, showing to what extent it is related to some of the conceptions of the living that I have examined.

7.1 Life as desire and representation: a text from the *Metaphysical Foundations of the Science of Nature*

Traditionally, life has been associated with motion. Aristotle saw living beings as having within themselves the spontaneous principle of their movement.[1] Leibniz and Stahl still took this approach. If we look at things in this way, we need to distinguish between living and non-living matter in motion. Since Galilean physics posits that matter as matter is inert, it becomes possible to characterize life, unlike brute matter, as matter with spontaneous motion, originating from within. It follows that animals become a privileged model of living beings, since we can see them moving, which is not the case with plants, which cling to a place. In this sense, we could deny life to plants and reserve it for animals alone.

This approach is at least once echoed by Kant. In the third chapter of his *Metaphysical Foundations of Natural Science*, devoted to Mechanics—i.e., the study of matter "endowed with this quality [motive force] in reciprocal *relation* by virtue of its own motion" (Ak. IV, p.476)—Kant sets out the principle of inertia, according to which "every change in matter has an external cause" (543), and makes a remark about the difference between matter and living matter, which I am now quoting at length before commenting on it in the course of this chapter.[2]

> The inertia of matter is and signifies nothing other than its *absence of life*, as matter as such. *Life* means the power of a *substance* to determine itself

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> to action from an *inner principle*—a *finite substance* determining itself to change, a *material substance* determining itself to move or rest, as a change in its state. Now, we know of no other inner principle of a substance that could change its state than *desire*, and in general, no other internal activity than *thought* with what depends on it, the *feeling of* pleasure and pain, and *appetite* (*Begierde*) or will. But these principles of determination and these actions do not belong to the representations of external sense, and therefore not to the determinations of matter as matter either. Matter as such is therefore *lifeless*. This is what the principle of inertia states, and nothing else. If we seek the cause of any change of matter in life, we must immediately look for it in another substance, different from matter yet linked with it. For it is necessary in the knowledge of nature to know first the laws of matter as such, and to purify it from the intervention of any other efficient cause, before we connect them with it, in order to distinguish what is the action of each for itself and how it acts. On the law of inertia (alongside that of the permanence of substance) rests the entire possibility of a genuine science of nature. The opposite of this, and thus the death of all natural philosophy, would be *hylozoism*. From this very concept of inertia, as the simple *absence of life*, it follows that it does not signify a *positive tendency* to maintain one's state. Only living beings can bear to be called so in the latter sense, because they have a representation of another state, which they abhor, and against which they strain their forces.
>
> (Ak. IV, p.544)

The first character of the living being here is *spontaneity*: the living being is determined to act from itself, this action being the change of state, in other words (insofar as the living body is material) *motion*. Life is opposed to matter, just as spontaneity is opposed to inertia.[3] Now, since the living body is thought to be something more than brute matter, which, according to the principle of inertia, is always determined to act by external causes, we presuppose in it an inner principle that determines it to act. Kant is undoubtedly referring here to the most rudimentary experience of life: movement without any apparent external cause. As the text indicates:

> When, e.g., we perceive a grain of dust on a paper, then we look to see whether it moves. If it does not move of itself, then we hold it to be inanimate mater, whihc is inert, and which would remain lying for eternity if it were not moved by something else. But as soon as a matter moves, then we look to see whether it moved voluntarily. If we perceive that in a grain of dust, then we say that it is *animate*, that it is an *animal*.
>
> (Ak. XXVIII, p.274)

In this sentence, the "internal principle of movement" attested by the living being is immediately characterized as *will*. Indeed, we have no other representation of a principle of change than what we derive from our experience of desire,

will and need: "we know of no other inner principle of a substance to change its state, than *desire*," said the *Metaphysical Foundations*. We therefore necessarily see in life a manifestation of the faculty of desire. Note that this is a constraint of our faculty of representation: matter must be conceived under the principle of inertia, so life breaks with matter; we know only *desire* as the inner principle of change, so life falls for us under the heading of "desire." Thus, the Preface to the second C*ritique* proposed this definition: "LIFE is, for a being, the power to act according to the laws of the faculty of desire" (Ak. V, p.10).

7.2 Animals and plants: Kant's *Dreams* and their ambiguities

Before grasping the implications of this proposition, I need to dwell on one point. The sentence, in the *Lectures on Metaphysics,* about the speck of dust juxtaposes "living" and "animal." Clearly, the plant does not appear to move of its own will. The notion of life, in this perspective, is therefore suited to animals. Kant often makes this implicit identification. He took it explicitly into account in the *Dreams of a Spirit-Seer*, when criticizing the idea of an "immaterial world," made up of spiritual principles. (Remember that this text is aimed at denouncing Swedenborg's claims about his visions of the spirits in heaven; see David-Ménard 1990b.) The question was what to count among these immaterial principles, and consequently, how far to extend life. Kant had to navigate between two extremes: "*hylozoism* animates everything, *materialism* kills everything, if you look at it carefully"; materialism, by which he meant what we would call mechanicism, namely (see below), the behaviors of the whole determined by the mechanical motion of its parts.

Then there is the question of vegetal life. "The undisputed sign of life in what falls under our external senses is undoubtedly the free motion whose voluntary origin (*aus Willkür entsprüngen*) is visible" (Ak. II, p.330), he writes therein, in line with the position defended in the texts we have just cited, a position which, in fact, as in the *Lectures on metaphysics* I quoted, excludes plants from the living kingdom. However, here Kant adds: "but it is not safe to conclude that there is no degree of life where this visible sign is missing" (Ak. II, p.330). Inverting Boerhaave's classical formulation of the animal as a "plant that has its roots in its interior," Kant remarks that we could argue the opposite, "the plant is an animal that has its stomach in its roots," so that the plant would have no need to go elsewhere for its food, and therefore no need to move. Vegetative and animal life would thus be separated, so that plant life is independent of the characteristic constraints proper to animal life:

> to the latter [=plants], the organs of voluntary movement and with them the external signs of life may be lacking, which are necessary to the former [animals], for a being whose instruments of nutrition are internal must necessarily be able to move itself following its need, but one for whom they sink outside

> into the element of its sustenance is already sufficiently supported by external forces, and, while it similarly holds in its vegetation a principle of an internal life, yet has no need of an organic constitution intended for external voluntary activity.
>
> (Ak. II, p.331)

In other words, the plant achieves a degree of life inferior to that of the animal, but just as authentic.[4]

Kant's argument is intrinsically finalistic: the plant, already rooted in its own food resources, needs no apparatus for voluntary locomotion, i.e., no nervous, muscular, or digestive system, unlike the animal, for which all this is implied by the fact that it must seek its own food. Beyond the empirical characterization of life by voluntary movement, for us to speak of life, we have to open the possibility of a discourse in terms of the realization of goals. This point is fundamental to understanding the articulation of the two registers of discourse on the living: the one that concerns *order*, which runs from *The Only Possible Argument*. . . to the *Critique of the Power of Judgment*, and which I have analyzed until now, and the one that translates the *immediate experience of living things*, and which I am reconstituting here.

Kant, however, does not adopt these considerations on the plant as his own. In a text of such complex status as these *Dreams,* it is always difficult to know whether or not the author subscribes to the theories he expounds.[5] "I want nothing of this in my argument," Kant writes after the passage quoted. Does this mean that he continues to identify life and animals? Probably so. Such conjectures, he adds, were those of the ancients, who admitted three species of life—vegetative, animal, reasonable, namely the three Aristotelian souls—and have against them the "whims of fashion." For Kant, finally, these ideas, though "indemonstrable," are not "absurd" once we compare them with several recent insights into living phenomena. Those include "the peculiar life of the separate parts of certain animals" (Trembley's polyp comes to mind, as well as Bordeu's "proper life of organs"), the irritability—"a property of the fibers of the animal body and of certain plants, [which is] as proven as it is unexplainable," on which Haller based his theory of life—, and finally the "close kinship" between certain polyps and plants.[6]

While life seems to be the prerogative of animals, Kant yet hesitates to decide the question. Equally important for him is the kinship that emerges between animals and plants, since these are two similarly constituted types of being. Indeed, the three points under consideration above all evoke the image of a living being made up of irritable parts, an irreducible property that separates them from brute matter. Life is ascribed to the parts before it is ascribed to the whole: such a strange discovery would bring back into fashion the Ancients' belief in degrees of life, even though modern, mechanistic thought, such as Hoffman's and Boerhaave's views, scoffed at this vision. Without telling any names, Kant here comes very close to the image of the living being depicted by Haller and the vitalists,

who, as we have seen (Chapter 2), despite all their oppositions, agreed on defining the living being based on irreducible properties inherent to its parts, thus moving away from the notion of soul as principle of life. This was the "animal economy," and elaborated mainly by physiologists and physicians, it gave primacy to animals in the paradigm of life. Several later *Reflexionen* attest to this closeness, sometimes even closer to the British tradition of animal economy (e.g., Cullen, Hunter, . . .), still more centered on nerves; for instance: "There is internal life in only two divisions of the body. Nerves and fibers. Nerves make up a system; fibers act on nerves, and vice versa" or "Muscular force is excited at the first movement by the nerve, which is only a medulla. The heart has no nerves."[7] This proximity would sometimes lead Kant to support a position close to Bordeu's doctrine of "proper lives": "On universal medicine. The life of an animal is an absolute unity of the self-moving force of matter. In it, the parts can have a *vita propria*."[8]

The end of the paragraph from the *Dream*s further reinforces Kant's uncomfortable position. At first glance, Kant endorses the mechanicism of "Hoffmann, Boerhaave and followers" (Ak. II, p.331): these, who "base themselves on mechanical reasons" follow a "more philosophical method, doubtless sometimes at fault, but most often confirmed, and which alone is of useful application in the sciences." In other words, "more philosophical" than those who, once again, rely on the immaterial, particularly Stahl, who "explains animal changes organically." And yet, Kant is "convinced" that Stahl is "often closer to the truth".[9] Strange position: on the one hand, Boerhaave follows a better method, the only one applicable; on the other, Stahl, his opponent, is more truthful. Thus, on the one hand, we understand operations, on the other, we find the observation of an "incorporeal" that "is there," such as this irritability that is as proven as it is inexplicable.[10]

This clearly shows the background to Kant's view of life as a manifestation of the faculty of desire, namely, the controversies between Stahl and the mechanicists as well as the theoretical contributions of Haller and the vitalists. His radical distinction between life and matter in the text of the *Metaphysical Foundations of Natural Science* undoubtedly refers more to Stahl than to the mechanicists: the conviction that Stahl found a truth, stated in the *Dreams*, is finally explicitly presented in the text of the *Metaphysical Foundations of Natural Science* as a radical opposition between matter and life, even though Haller and the vitalism apparently shaped the Kantian interpretation of an animal's immediate experience as spontaneous movement. Hence, the floating nature of the text from the *Dreams*, and ultimately of the conception of the living that emerges from these texts investigated here.

7.3 Desire and representation in animals

The footnote to the quoted passage in §1 of the Second *Critique* continues as follows: "The FACULTY OF DESIRE is, for the same being, the power *to be,*

through its representations, the cause of the effectivity of the object of its representations" (Ak. V, p.10).[11] If the animal, or the living being, changes states, it is because it represents a state to be reached ("the object of its representations"), which it sets up as the goal of its activity. We cannot do otherwise than attribute to the animal something like a tendency to realize the goals it represents to itself. In current-day terms discussed by philosophers of biology, only *agency* accounts for our experience of animals (see, e.g., Mrozek et al. 2022; Desmond and Huneman 2020).

In this sense, Kant's conception of the animal in these texts clearly refers back to Leibniz. As we know, the monad is representative (*perceptive*) and *appetitive*, and this is exactly what Kant grants to the animal. Admittedly, Leibniz's words do not refer to animals as such, but Kant does endorse here Leibniz's correlation of representation and desire. Once again, animal desire cannot be understood as a simple physical tendency, as a force similar to the force of attraction or repulsion. In the *Metaphysical Foundations of Natural Science*, Kant says: "We know of no other internal activity [by which we could think animal spontaneity] than thought, with what depends on it, the *feeling of* pleasure and displeasure, and *appetite* or will." We cannot think of spontaneous activity without presupposing a faculty of representation, because this activity must not be caused by something *present*, posited in the animal, in which case it would be an activity arising from an external cause and dependent on the principle of inertia. If activity is spontaneous, then it must somehow distinguish itself from what is purely present in the animal, from what is posited (*gestellt*) in it: and the "re-" of representation, the *Vor-* of *Vorstellung*, alone marks this distance by which the animal, or living thing, separates itself from what is simply posited in it, and inaugurates an activity of its own. The living being is spontaneous only if it is representative: it represents its state. "We have an internal principle that makes us act from representations, and it is life" (Ak. XXVIII, p.274). But if the animal acts, it also represents the state toward which its activity inclines: in other words, it represents a goal, the object of desire. In this sense, life is, according to *Reflexion 1034* (Ak. XV): "Nothing other than the faculty of desire in its most minute function."

Representation, insofar as it distinguishes the animal from the purely material, from what is simply posited in it, or simply present, i.e., insofar as it confers spontaneity, cannot go without desire, i.e., the faculty of being the cause, through one's representations—insofar as they produce an activity—of the presentation of a represented state not yet present at the outset. In his approach to life, Kant echoes the Leibnizian correlation of representation and appetition, which, for Leibniz, was necessary as a law governing the transition from one representation to another, so that the two were linked like a function to its differential (see Chapter 1 and Koranic (2015)). Certainly, life is a *minimal* degree of representation and a *minimal* degree of desire, which distinguishes it from humanity. Nevertheless, we need to specify how it is distinct from humanity in order to better grasp the notion of the living that is proposed here.

7.3.1 Animal and human

In the preface to his *Nouveaux Essais,* Leibniz distinguished the "consecutions of animals" from human reason: animals associate representations, but are unable to grasp the necessity of an association, and so remain in the sphere of contingent events. Reason, as the ability to grasp the reason for the links between representations, distinguishes humans from animals. Kant follows Leibniz in granting animals a representative faculty, and thus, necessarily, the possibility of recognizing, expecting, etc. But I will scrutinize two texts that make this difference clearer in terms of the representative faculty that can be granted to the non-human animal.

In the *Foundations of the Metaphysics of Morals*, Kant points out that the human, as a finite reasonable being, can represent the law of her action. This is the difference between animal and human representation: a human represents a law, the animal a state. This amounts to what Leibniz was saying: the representative faculty of a human rises to the universal and the necessary, unlike that of the animal, which is confined to the singular and the contingent. But the Kantian statement also says something else, because it concerns the practical dimension of humanity: it is about the law of *action*. In other words, whereas the animal, by re-presenting its state—by bringing it face to face (*vor-stellen*)—separates itself from what is and distances itself from inertia, thereby acting causally, humans represent the law by which they act.

For the animal, the law of its action is embedded, present in it; hence, we speak of *instinct*. For humans, the law is re-presented by them, therefore it is not a law of nature or a biological law present in themselves, posited. The representative faculty, as such, breaks with the order of material bodies; yet in humans, insofar as it represents the law of an action, it involves a double rupture. The animal acts spontaneously because it re-presents its state and a state to be reached: it is therefore not subject to the law of inertia; yet humans also re-present the law by which they desire a state to be reached, whereas for the animal this law is present in itself, so that it is subject to it and obeys it. *Spontaneity without freedom*: that is how life appears to us, in sharp contrast to both inert matter and free human beings, thereby indicating the problematic nature of its status.

In a *Lecture on metaphysics*, Kant takes another approach to the difference between life and humanity as representative faculties. In this text, he calls the "soul" the "fundamental vital principle" from which the animal moves spontaneously. No doubt this terminology comes from Baumgarten's *Psychologia*, which he comments on in his lectures, but it is clear that there is no conceptual obstacle in Kant's own thinking here to prevent him from fully adopting this term:

> Matter can only move through the intermediary of such a principle [of spontaneity, which we think of as desire]. Now, such a principle of matter is the soul of matter. Consequently, all living matter does not live insofar as it is matter, but it possesses a vital principle and is animated. As soon as matter is alive,

> it is *animated (beseelt*). In animals, therefore, there is a fundamental vital principle, and that is the soul.
>
> (Ak. XXVIII, p.275)

What about this soul? We have no experience of the animal soul, so we need to be able to form an a priori concept of its nature. By considering our own faculty of desire and representation, we must then understand how another faculty of representation is possible, which differs from our own. "We must know souls that are external to us, for which we have no *data* at all. However, we still derive this difference and these *data* from ourselves and the concept of our I" (Ak. XXVIII, p.275). How so? We know that we have an internal sense and an external sense, through which we respectively represent the states of our thought and the objects outside us. The form of the former is time and that of the latter is space, so that between them there is a difference of nature, not of degree.

Since we do not experience the animal soul, we have no a posteriori knowledge of it; we therefore need a difference in nature, because all the differences we can think a priori are differences in nature: "if we represent beings a priori, we will not notice differences in degree, but in nature" (Ak. XXVIIII, p.275). The difference between internal and external senses, a difference in nature within our faculty of representation, and which we can know a priori, is therefore well suited to thinking a priori about the difference in nature between human and animal soul (or faculty of representation), i.e., to forging a concept of the animal soul. "The difference and comparison must therefore be based on our internal sense and our external sense" (Ak. XXVIIII, p.276). Since we can imagine a faculty of representation limited to the external sense, and since it will therefore be different in kind from our own, it is clear that the animal is endowed with this faculty of representation limited to the external sense alone, which we can conceive of a priori. Its faculty of representation indeed possesses an external sense since it moves, while it is nevertheless different in kind from ours. "We can represent to ourselves beings that have an external sense faculty but lack the internal sense faculty: these are the animals" (Ak. XXVIIII, p.276).

From this characterization, the differences between animals and humans come to light:

> Animals will therefore have all the representations of the external senses; they will be deprived only of those representations that are based on the internal sense, on self-consciousness, in a word, on the concept of the I. They will have no understanding or reason, for all the actions of understanding and reason are only possible insofar as one is conscious of oneself. They will not have universal knowledge by reflection, nor the identity of representations, nor the connections of representations according to the relationship between subject and predicates, between principle and consequence, between whole and parts. Indeed, all this results from consciousness, which animals lack.
>
> (Ak. XXVIII, p.276)

Thus, the absence of internal sense, leading to the absence of self-perception, renders the animal unfit for concepts: it cannot identify its representations under a single concept and thus obtain a universal thought. Nor can it chain its representations into judgments, according to the three possible relations, categorical, hypothetical, or disjunctive, since the power to judge implies having formed two concepts A and B under which a representation X is understood to fall (e.g., "X, conceived of as an A, is a B").[12]

We thus return to the first difference mentioned: the animal cannot represent a law, insofar as it does not know itself, being devoid of internal sense. The correlation between self-consciousness and the power to judge and form concepts was one of the key points of the "Transcendental Analytic," since the "unitary synthetic apperception"—that is, the ability to grasp oneself identically as the subject who represents her various representations to herself—is at the very source of the synthesis by which we classify representations under concepts.[13]

However, Kant does not ignore the fact that animals sometimes appear to us to think and behave as if they were judging. But this is an "as if," not an identity. "We can," he writes, "attribute to animals an *analogon* of reason, consisting in the connections between representations according to the laws of sensibility, from which flow the same effects as those of reason according to concepts." The laws of sensibility are affinities and associations, by resemblance or contiguity, as conceived by Hume in the *Treatise*. Outwardly, they often imply for the subject who engages in them a conduct comparable to that of a reasonable human; moreover, it goes without saying that sometimes, and even "in most of our actions" as Leibniz said, we act according to them: in other words, there will ultimately be apparently no clear and irreversible difference between the animal soul and the human soul. Often, the animal will *seem* more perceptive or more resourceful than a human. "This is why animals are distinguished from the human soul not according to degree, but according to nature" (Ak. XXVIII, p.276). For a connection according to the laws of understanding makes use of quite different syntheses than a connection of representations "according to the laws of sensibility"; in particular, it alone can give rise to a universal proposition.

Yet Kant seems to be going a little fast in this text about animals in the Psychology section of his *Lectures on Metaphysics*, because the notions of internal sense and self-consciousness are actually very distinct. The original synthetic apperception and self-consciousness belong to *understanding*, while internal sense belongs to *sensibility*. To confuse them would be to revert almost to Leibnizian, if not dogmatic, thinking, in which sensibility and understanding are seen as different in degree (or clarity), not separate. In *Anthropology*, Kant is indeed careful to specify:

> If we represent to ourselves the inner action (spontaneity) by which a *concept* (a thought) is possible, i.e., *reflection*, and the impressionability (receptivity) by which a *perception*, an empirical *intuition*, is possible, but if we represent to ourselves these two acts accompanied by consciousness, then

> self-consciousness can be divided into consciousness of reflection, and consciousness of apprehension. The former is a consciousness of understanding, the latter of internal sense; the former is *pure* apperception, the latter *empirical* apperception; it is therefore wrong to call the former internal *sense*.
>
> (§4, note 1, Ak. VII, p.134)[14]

Thus, if we want to be rigorously Kantian, it is a mistake to go from the absence of conceptuality to a lack of internal sense. We can provisionally explain this facility by the pedagogical context of the *Lectures*, on the one hand, and by the existence of a prior elaboration of these notions in the first *Critique*, on the other—not to mention the fact that Kant's teaching relied on Baumgarten's dogmatic metaphysics, which encourages such shortcuts.

7.3.2 The animal soul as such

External sense without internal sense: this is how we should a priori conceive of the animal soul. Note that the word "without" is the second restriction in Kant's effort to circumscribe the animal's status: after "spontaneity without freedom," here is "external sense without internal sense." The animal can only be thought of negatively, compared to us, because its concept must be found a priori, and a priori we know only our own faculty of representation, as far as the soul is concerned. This is due, first of all, to the very text we are reading: it is a lecture in rational psychology, and this, as metaphysics, is an a priori knowledge of the soul. Contrary to the recommendations of the critique of rational psychology (in the "Transcendental Dialectic"), the soul is claimed as immaterial, animating matter without being spatial. Here, Kant's position still seems analogous to the one he adopted in *Dreams.* "I confess," he wrote there, "that I am much inclined to affirm the existence of immaterial natures in the world, and even to place my soul in the class of such beings." And he added in a note:

> The reason I have for doing so, which is very obscure to me and will probably remain so, also concerns the sentient existence (*empfindende*) of animals. What in the world contains a *life* principle appears to be immaterial in nature. For all *life* is based on the internal power of self-determination (*Willkür*). On the contrary, the essential character of matter consists in filling space with a necessary force, which is bounded by an external reaction; this is why the state of everything that is material is externally *dependent* and *constrained*, whereas natures that are *of themselves active* and from their inner forces must actually contain the principle of life—in short, those whose own will is capable of self-determination and self-modification—can hardly be of a material nature.
>
> (Ak. II, p.327)

In this metaphysical context of the question of an immaterial substance, Kant therefore calls the life principle of animals: "soul."[15] We could therefore link this discourse on the soul of animals to a still pre-critical attachment to rational psychology. For if a discourse on the soul is possible, in which we would establish its immateriality and non-spatiality, it is because we can feel our soul; in other words, because it is the object of internal sense.[16] Rational psychology therefore implies that there is a pure, non-empirical perception of the soul by the internal sense: hence, the confusion we noted above, and which *Anthropology* denounced, between pure apperception, pertaining to acts of the understanding, and internal sense.

The soul can then be both human and animal. The question of their difference is unavoidable in psychology, because the animal, as spontaneously in motion, indicates in itself a soul. Against this background, it is easy to see which conceptions Kant uses to formulate his doctrine of the animal soul. Stahl comes to the fore: we have seen how he elaborated a consistent animism, and Kant's admiration for him, which is obvious in the Foreword to the first *Critique* with regard to his chemistry, is also present in the *Dreams* with regard to his vision of the living.

One of the main features of the Stahlian conception was the technical vision of the soul of the living,[17] which computes obstacles and elaborates behaviors. Yet Kant's view of the soul in the psychology of *Lectures on Metaphysics* is similar: "If matter moves, it follows that such a particular principle of spontaneity exists in it. But only a being *with knowledge* [*Erkenntnis,* my emphasis] is capable of this principle of thought and will. Matter can only move through such a principle. Now, such a principle of matter is the soul of matter" (Ak. XXVIII, p.275). The soul of the animal is thus a fundamentally knowing entity, even if this knowledge is unconscious for lack of an internal sense. Although Kant denies that the animal soul has understanding, he cannot avoid thinking of it in terms of knowledge, as a certain kind of knowledge, albeit different in nature from human knowledge; in other words, unconscious knowledge. The Stahlian model thus spontaneously comes to Kant here, because it combines the faculty of representation that we must attribute to animals, and the absence of internal sense that distinguishes their souls from ours. This undoubtedly reflects the "certain truth" that he ascribed to Stahl's writings on animals in the *Dreams*. . . . Thus, we read in the anthropological texts that "the soul of the animal must have an internal image of the structure of the total bodily edifice" (Ak. XV, p.504), a blatant echo of the Stahlian "*logos*" or soul.

But Kant is clearly not to be classified as an animist, even here. His distrust of explanations involving inexperienced incorporeal entities would be enough to set him apart. Although according to the *Dreams*. . . Stahl demonstrated a more authentic sense of the living than Boerhaave or the mechanists, he nevertheless had to moderate Stahl's positions by restricting the role of the soul in understanding the living. The animal soul must be conceived as a purely external sensibility, and while our thinking cannot help but attribute a certain type of (unconscious)

knowledge to it, we must certainly not go so far as to see it, with Stahl, as a kind of little engineer present in the body.[18] Recognition of the animal soul does not, therefore, allow us to go all the way with Stahl, i.e., to put forward an animistic explanation: it simply allows us to add an external sensibility to the "mechanical principles" of animals, as a sufficient explanatory principle. To this extent, Kant comes to support an almost Hallerian doctrine of the animal. Recall that for Haller, the presence of a soul, indicated by external sensibility, distinguished the animal from less evolved beings. According to him, this animal sensibility, an organ of the soul, was supported by the nervous system. The same is true of Kant: "the cause of all sensations is the nervous system. Without the nerves, we cannot feel anything external" (Ak. XXVIII, p.281). The life principle of the animal is therefore a faculty of representation limited to external sensibility, which occurs in the body through the intermediary of nerves, whose "root" (Ak. XXVIII, p.281) is the brain. The animal is therefore dual, made of soul and body, and Kant attempted here to recapture the originality of the Hallerian position as we have characterized it: a spiritualist dualism, accompanied by a rigorous mechanistic knowledge of animal phenomena. The fact that sensibility is anchored in the nerves makes it suitable for an anatomical-physiological analysis, which is not much less certain than the analysis of the "mechanical springs" of bodies, in Kant's terms.

Within rational psychology, a traditional understanding of the living as soul and body (i.e., soul as the principle of life) develops in these Kantian texts, with references primarily to Stahl and Haller. The animal appears to us as alive, and this life rests on a principle which is the soul, the meaning of which is distantly Stahlian; it is another species of that soul which we experience through our internal sense and which is the object of psychology. The animal soul then seems to be intelligible in a physiology whose principles are close to Haller's.[19]

7.3.3 Animal thought and life

Nevertheless, the discourse on the soul of the living is not entirely dependent on the positions of rational psychology, which was dismissed by the "Transcendental Dialectic" in 1781. If this were the case, we would not understand why we find it even in the *Metaphysical Foundations of Natural Science*—precisely in the text that guides our study of this discourse—and even later in the *Opus postumum*.[20] For the necessity of attributing to the animal a faculty of representation and a faculty of desire, insofar as it moves spontaneously, is independent of the paralogism by which we reduce the object of internal sense to the *I* of pure apperception. Only such a necessity leads to the discourse on the "soul." If I posit that the internal sense gives me access to the soul, then I bring the consideration of the animal soul into rational psychology, but this is not a conceptual constraint. Without granting animals a substantial soul, I can nevertheless attribute to them empirical states of desire and representation in order to account for

what differentiates them from inert matter. I could then retain the determinations of animality we have encountered—spontaneity without freedom, external sense without internal sense—while not integrating them into the framework of a now discredited rational psychology. This is why, from the pre-critical period to the *Opus postumum*, certain Kantian conceptions in this area remained intact.

The phenomenon of a faculty of desire and representation that is not our own arises with the animal, and poses a problem beyond the status of rational psychology. The effort to understand life consists in the fact that thought is confronted with something that is not thought, yet that is not totally heterogeneous to it, something that necessarily appears to it as a minimal form of itself. A science of the "life" is clearly not Kantian. He repeatedly returns to animal life only because it reveals something ambiguous, something in-between, at once non-thought and a condition for thought. The preposition "without" first establishes an opposition: "spontaneity without freedom." But conversely, life is absolutely necessary for thought to be able to represent itself, because by doing so, our thought should represent its own condition; spontaneity *without* freedom is pure spontaneity, from which we can construct the concept of freedom. This is the positive meaning of "without."

For Kant, life has somehow to be of the same stuff as thought, because thought itself must represent itself in relation to its condition. The conditions of the animal and the human, then, are not simultaneously thinkable; they appear in a mirror game—a game from which, of course, we shall exclude the plant, too remote for thought to recognize in it anything like its condition. This is where Kant's Stahlian horizon and Hallerian program come in.

With these unsystematized statements on life, it is not so much a question of knowing about life as of *thinking about a relationship*. Therefore, the concepts Kant uses, for example, in his *Lectures on Metaphysics*, are presented as problematic. They enable us to *think*, even if no experience will fulfill what is intended by them—since the animal soul is not given to me—so that they do not give rise to knowledge. Here is another instance of the crucial difference made by the first *Critique* between "knowing' (which supposes that the concept may acquire an objective validity through possible experience) and "thinking" (which can address objects such as the three Ideas of reason, deprived of possible presentation in experience). However, we must *think* of the animal, because in it, the faculty of representation and desire seems objectified, both present and unrecognizable, so that human thought needs to circumscribe its relationship with this strange version of itself.

Without giving rise to knowledge, the concept of "external sense without internal sense" proposes a notion of the animal and its relationship to thought: it is a problematic concept.[21] As such, it enables us to construct a hierarchical tripartition: internal sense without external sense (spirit), internal sense with external sense (humans), external sense without internal sense (animals); three possible forms of life, even if the first is not empirically attested (Ak. XXVIII,

p.278). Hence, the puzzling second sentence of the text of the *Metaphysical Foundations of Natural Science* I quoted: "*Life* means the power of a *substance*, to determine itself to action from an inner principle—a *finite substance* determining itself to change, a *material substance* determining itself to motion or rest, as a change of its state." The material substance is the animal soul or the human soul, since they are endowed with external senses and are therefore material. Having the faculty of representation, they are, as we have seen, alive and spontaneously determined to act on the basis of their representations (even if these are limited to the external sense). This action is a change, and change, for a material being, necessarily takes place as motion, since motion is that by which matter signals itself in experience, as the *Metaphysical Foundations of Natural Science* established at the outset. But material substance is a special case of finite substance; we can conceive of a non-material, finite substance that is alive, i.e., that determines itself to change on the basis of its representations, i.e., a "spirit." In other words, life, defined as it is from the experience of animal self-motion as we must think of it—that is, as spontaneity—is not necessarily linked to matter. In a substance, it is the representative faculty *in general,* necessarily linked to the faculty of desire. For this reason, it is the condition of thought—or rather, it must be conceived by thought as its own condition, since it is its minimal degree. Hence, once again, a position close to Stahlian dualism: a body, says Kant in his lectures, "cannot be the cause of life," it would rather be "an *obstacle to life*," "which the principle of life resists" (Ak. XXVIII, p.285), so that a substance other than the animal's body is the cause of life in it. The vocabulary of organ and instrument, derived from Aristotle but updated by Stahl in his post-Galilean animism, then reappears: "the body is the instrument, the organon by which the living acts of the soul are performed in the world" (Ak. XXVIII, p.286).[22]

7.4 Anthropology

This schema of the relationship between life and thought defines the field of anthropology. We are not, as we have seen, in the realm of rational psychology; and we have left empirical psychology behind us, precisely because what is at stake here is not only the states of the soul as states of the faculty of desire and representation but also life, which is consubstantial with the human soul as a material substance endowed with a faculty of representation by the external sense. In other words, a discourse on the soul, in its various senses, is a discourse on the natural condition of thought, on the human being insofar as he knows himself to be alive among other living beings, i.e., a discourse whose status joins that of *anthropology*. This means the "physiological anthropology" as "knowledge of what nature makes of man," which the preface to *Anthropology* mentions by distinguishing it from the pragmatic point of view in anthropology, endorsed by Kant in this treatise.

The status of anthropology in Kantian thought[23] is intricate. It does not belong to transcendental philosophy, nor does it come under the "metaphysics of morals" (ethics), since it involves concepts of nature. The "metaphysics of nature" is divided into the metaphysics of material nature, and the metaphysics of psychic nature: the latter is impossible as a rational psychology, and cannot give rise to a science symmetrical to physics, because it cannot be mathematized, since it takes place in time, in one dimension, as the Preface to the *Metaphysical Foundations of Natural Science*[24] teaches. Empirical psychology is therefore no more than a "natural history of the soul," even less scientific than chemistry.

However, anthropology cannot be confused with it, because it is not limited to the facts that the internal sense uncovers in us, but also encompasses what might be called the objective reality of humanity: its body, its geographical conditions, etc. It is therefore close to physical geography, in that this discipline deals with the different inhabitants of various regions and their ways of life, etc., as we see in the third part of the lectures on *Physical Geography.* Anthropology is certainly the part of the "knowledge of the world" that deals with humans, while the other, dealing with nature, is precisely geography; and this then enables us to "exercise and prepare ourselves for all future experiences," particularly travels, which would enable us to get to know men (Ak. IX, p.157). But conversely, geography itself includes in its project, in addition to "mathematical geography," "moral" geography (which deals with the diversity of human customs and characters with respect to the diversity of regions), "political" geography, "market" geography and "theological" geography (IX, p.164), in other words, a whole anthropology: as if the object of geography, namely the whole of nature, were developing to cover the whole world, and geography to absorb knowledge of the world. The essay on "human races" from 1775 indeed formed part of the preliminaries to a course in physical geography.

The discourse on the soul as we read it here, commenting on the text of the *Metaphysical Foundations of Natural Science*, belongs more to Anthropology than to empirical psychology, because it confronts the human soul with its natural determination and condition, i.e., with life.[25] Not only does this discourse on the soul encompass both man and animal, not only is it imbued with what we might call anthropomorphism (attributing to the animal what we know as the principle of spontaneity), but above all it is formulated in relation to humans, against the backdrop of the question of the status of human thought, in itself and its relationship with its natural conditions. Here, the living does not intervene for its own sake, as a possible object of knowledge—even if it does give rise to knowledge, it *is expressed against the backdrop of a question about humans*. This is why, when life appears in anthropology—and it should, since it is part of humans' conditions of existence—it will essentially be expressed in *this discourse of life as desire and representation,* so prone to employ the category of soul. In this sense, insofar as we adhere to the Kantian dismissal of rational psychology, we can attribute an anthropological status to this discourse.

Such a discourse, in addition to the support it receives from Stahl and Haller, seems to be part of an overall philosophical project pervading Europe at the time, that of a "natural history of man," as Cabanis called it, which I saw (Chapter 2) as correlative to vitalist thought. For instance, in Lamarck's *Système analytique des connaissances positives de l'homme* (1820), the human being appears essentially as a living being, conditioned by physiology (which not only confers a "temperament" but also disposes him to representation and affectivity), and reshaped by education and life in society.[26] All these dimensions are to be found in Kantian anthropology: analysis of the various characters (in the so-called *characterology*), considerations on education as the cultivation of dispositions to humanity, still latent in nature, analysis of the effects of sociability, and analysis of the passions as the torsion inflicted on the animal in man by living in society. The theory of the temperaments of human feeling and activity, as a typology based on the constitution of the blood (light-heavy, hot-cold),[27] occupies the first section of the "Characteristic" of *Anthropology* (which indicates "the way of knowing the inner man from the outer man"). Similarly, the classification of temperaments, insofar as they are precisely the manifest effect in man of naturalness was a salient feature of the natural history of man proposed by physiologists (action of the physical upon the moral according to Cabanis; influence—under the name of "character"—of organic life upon animal life according to Bichat). The Kantian anthropology seems fully in line with this set of ideas, although it implies a way of thinking about animality in humans whose foundations are to be found rather in Stahl and Haller than in the French vitalists: hence Cabanis avoided the notion of soul while Kant, despite his conceptual proximity to these thinkers, could not do it in his anthropology.

Thus, while nascent German anthropology can put forward the two questions of the boundary between man and animal, and of the difference between races, as Blumenbach or Plattner[28] think of them, Kant nevertheless directs it more generally toward the guidelines of the "natural history of man" invested by vitalist physiology, in order to deal with these questions.[29]

Nevertheless, his analysis of animality would be incomplete if it did not go to the third essential point mentioned in the text of the *Metaphysical Foundations of Natural Science,* namely the "feeling of pleasure and pain." Without it, the articulation of representation, desire and movement in the animal would be inscrutable.

7.5 The feeling of pleasure and pain

Our text of the *Metaphysical Foundations of Natural Science* indicates that the feeling of pleasure and displeasure (or pain) (*Gefühl der* Lust und Unlust) must belong to living beings. It implies that it acts as a determining principle. The *Critique of Practical Reason* states: "*PLEASURE is the representation of the agreement of the object or action with the subjective conditions of life,* that is,

with the causal power of a representation in relation to the causality of its object (or to the determination of the subject's forces for the action that produces it)" (Preface, Ak. V, p.10, footnote). In representing itself, the living being also represents the relationship of its object to itself, to the life within it, a relationship that can be one of agreement or disagreement. The former defines the feeling of pleasure, the latter the feeling of displeasure. As a faculty of representation and desire, life necessarily implies the feeling of pleasure and pain. This, in turn, becomes the determining principle for life: a living being seeks to avoid the feeling of displeasure.

In his psychology course (a part of the *Lectures on Metaphysics*), Kant developed at length the characterization of pleasure as a feeling induced by the representation of an object's relation to the subject's vitality. "The subjective representation we have of possessing the full vital force to welcome or exclude objects constitutes the state of satisfaction (*Wohlgefallen*) or dissatisfaction (*Missfallen*). Feeling is therefore not the relation of objects to representation, but to the power of the mind (*Gemüth*) either to welcome them intimately or to exclude them. Acceptance is the feeling of pleasure, and exclusion is the feeling of displeasure" (Ak. XXVIII, p.247). Life and pleasure/displeasure are thus intimately linked, because these feelings are the very act of life insofar as it measures itself against the objects it deals with. No life can therefore be free of pleasure or displeasure, any more than it can be free of representation, in the sense that these feelings indicate the involvement of life itself in any encounter with objects, its non-indifference toward the things with which the living being is brought into contact.[30] Kant would maintain this position right up to the *Critique of the Power of Judgment*, since in §1 he writes, with regard to the sensation of satisfaction induced by "a regular edifice, responding to a purpose," that "here, representation is entirely related to the subject and precisely to his *vital feeling*, under the name of feeling of pleasure and displeasure; which grounds a very particular power of discernment and judgment, which contributes nothing to knowledge, but only maintains a given representation in the subject in the face of all the power of representation, of which the mind (*Gemüt*) is aware in the feeling of its state" (Ak. V, p.204, my emphasis). In the aesthetic section of this work appears an important element of the discourse on the soul analyzed here appears: the identification of life with the feeling of pleasure/displeasure. It also underpins the analysis of laughter later in the book.

This means that life itself is the measure of pleasure and displeasure. To be alive is, above all, to experience life in every event in which we participate. Representation, which defines the living, goes hand in hand with its corollary, the "vital force," which at the same time as it represents the object, measures itself against it according to whether it suits or disagrees with it, according to whether it exceeds it or fits in with it. In the context of human psychology, which deals with notions of pleasure and displeasure, this "vital force" is what Kant calls the "power of the mind" to accept or reject representations. But the vocabulary

of the vital force is a necessary part of the discourse on the soul, because the concept of force is necessary to apprehend the relationship of convenience or disconvenience that constitutes the feeling of pleasure/displeasure: in the case of displeasure, it is indeed the feeling of a conflict,[31] which by definition implies two forces in presence.

The idea that life cannot exist without feeling is undoubtedly the Kantian tribute to vitalist thought. One of the main themes of vitalist thought, as we saw with Bordeu, was the identification of life with sensibility. This sensibility was a discriminating force: the vital element rejects what does not fit with it, and integrates what suits it. Bordeu explained in this way the interplay between secretions and membranes. Admittedly, Kant does not bring sensibility down to the elementary parts of the body, but he does retain from vitalism the indissociability of feeling (as enjoyment/suffering) and living. Heir to the vitalist tradition, Bichat had made feeling the immediate consequence of sensation, the first contact of "animal life" with the world: before we perceive distinctly, we—and every animal with us—experience the impression of pleasure or pain. Shortly before him, and in accordance with the vitalist anthropologists I mentioned earlier, and whose positions he shared, Kant derives the feeling of pleasure/displeasure from vitality itself.

However, the context of the Kantian analysis takes up these elements in a theory that is no longer vitalist, because it brings the concept of representation to the fore. His conception of the feeling of pleasure and displeasure is ultimately based on the distinction between two types of representation: that which concerns the object and that which concerns the relationship of the object to the subject. The content of a judgment, insofar as it belongs to the first order of representations, is said to be "logical"; insofar as it belongs to the second, it is said to be "aesthetic." This "aesthetic" does not refer to the doctrine of sensibility as presented in *Critique of Pure Reason*, but to *sentiment* (*Gefühl*); by such a sentiment life experiences itself in the objects of its representations. The distinction between logic and aesthetics, present though as yet unnamed, radically affirms the link between vitality and the feeling of pleasure and pain at the level of the principle of life:

> When a representation fits with the whole force of the mind, with the principle of life, then it is *pleasure*. But if the representation is such that it contradicts the principle of life, then this situation of conflict (*Widerstreit*) in us is *displeasure*. Objects are therefore not beautiful, ugly, etc., in and of themselves, but in relation to a living being. *But what takes place only in relation to living beings must have its principle in the living being.* This is why there must necessarily be in the living being a *faculty* for perceiving such properties in objects. Pleasure and displeasure are therefore a faculty of the harmony or contradiction of the principle of life, in reaction to certain representations or impressions caused by objects.
>
> (Ak. V, p.204, my emphasis)[32]

The sentence emphasized in the quote clearly indicates the core of the Kantian argument: because pleasure (displeasure) implies life, because it is aroused by the confrontation of vitality with something, then the faculty of experiencing pleasure (displeasure) goes hand in hand with the fact of living.[33]

To this extent, the *Anthropology* provides us with several clarifications on the Kantian doctrine of life as linked to the sentiment of pleasure and pain.

The *Anthropology from a Pragmatic Viewpoint,* studying human sensibility, distinguishes between two types of "impression" (*Empfindung*): *organic* impression (*sensus fixus*), i.e., linked to an organ and therefore localized in the body, and *vital* impression (*sensus vagus*), such as the impression of hot and cold, which has no specific location but runs throughout the body. This distinction is based on the arrangement of nerves in the body (since we only feel through the nervous system). Thus:

> since both [the two types of impression] can only be found where there are nerves, we can distinguish between those that affect the whole nervous system, and those that only affect the nerves belonging to a certain part of the body. The impression of hot and cold, and even that which is aroused by the mind (for example, a rapidly increasing hope or fear), belong to vital sensitivity. The shiver that runs through man in the representation of the sublime, and the terror of children that nursemaids' tales pursue late into the night, are of the latter type: they furrow the body, as far as there is life in it.
>
> (§16, Ak. VII, p.154)

Life is thus accompanied by the faculty of feeling everywhere in the body, and this faculty carries, above all, the unpleasant, the painful: fear, shudder. More precisely, it immediately associates the obscure representation of a state of the body—hot, cold—with its measurement in pleasure/displeasure. The hot or cold felt is never felt objectively, for its own sake, but always in relation to the subject's vitality. It is when I am *too* hot or *too* cold that I feel it is hot or cold. The vital impression is the privileged place where vitality as a faculty of representation is articulated with the sentiment of pleasure/displeasure, because in it there is never a purely objective representation, but, insofar as I therein feel states of the body, it is always indicated to me whether these states suit me or not. Life is lived in vital impressions, grasped entirely within the body, and thus becomes the faculty of experiencing pleasure or pain.

Anthropology also clarifies the vital forces involved in the feeling of pleasure/displeasure. Pain and pleasure are like antagonistic demands on vital forces. Yet, "as physicians too have already remarked, life (of the animal) is the continuous play of their antagonism" (§60, VII, p.231). The allusion to physicians refers both to the vitalists mentioned above, who highlighted the interplay of actions and reactions in the animal economy, and to Brown's system (*Elementa medicinae* 1780).[34] The latter is explicitly invoked in §76, in order to classify

affects. "Affects are, in general, pathological accidents (symptoms); they may (by analogy with Brown's system) be divided into *sthenic* (if strong) or *asthenic* (if weak). It is in the nature of the former to excite the vital force, but by the same token to excite it often; it is in the nature of the latter to relax it, but by the same token to often spare its recovery" (Ak. VII, p.255). *Affect* (*Affekt*) in general designates "the sentiment of a present pleasure or displeasure which does not let the subject reach *reflection* (*Uberlegung*) (on that representation of reason which indicates whether to surrender to it or repel it)" (§73, Ak. VII, p.251). Thus, the feeling of pleasure or pain is itself twofold, depending on whether it excites or relaxes the vital force it measures against the object encountered. First, an object arouses such a feeling in the subject, insofar as it is confronted with the vital force that must welcome it; second, this feeling, whether pleasure or pain, if it is an affect, i.e., if it inhibits the faculties of knowledge, can stimulate the vital force to welcome or repel the object, and thereby strengthen it in itself. It can also relax it—that is, insofar as it requires little of this vital force to welcome or to exclude the object, leaving this force largely unused. We understand here the reason for the appeal exerted by the Brownian pattern of pathological affections in medicine, sthenic and asthenic, i.e., exacerbating or inhibiting the irritability of the vital fiber; simply, Kant transplants it from the domain of the organic element to that of the sentiment of pleasure and pain, inseparable from the living.[35] Thus, both laughter and tears—whether of pleasure or of displeasure—as strong affects, are equally sthenic: "laughter and tears reassure: their effusions free the vital force from that which hinders it (one can weep with laughter, if one laughs to exhaustion)" (§76, Ak. VII, p.255).[36]

Using the example of affects, we can see how the integrity of the sentiment of pleasure and pain could be undermined by exposure to purely sthenic or purely asthenic affects. This reformulates in the language of Brown and the French vitalists a Hippocratic understanding of life in good health as *balance*. It also applies precisely to the two modalities of pleasure/displeasure. For, if affect excites or relaxes the vital force, the sentiment of pleasure/displeasure promotes or hinders life even more originally (since this is the case even if it does not cause affect). This sentiment modifies the vital force qualitatively, while the affect goes on to modify it quantitatively. The former would be to the latter as the intensive to the extensive. But the alternation of feelings is just as important for health as the alternation of sthenic and asthenic affects. This is why Kant described life as the "continuous play of their antagonism" (§76, Ak. VII, p.255).[37]

7.6 The two avenues

7.6.1 Archaism or Necker cube?

When it comes to thinking about the relationship between human thought and the vitality it grasps as its condition, Kant's discourse borrows its terms from

psychology. It unfolds under a strongly Stahlian horizon, while the insistence on the representation/desire pair seems reminiscent of Leibnizian monadology. The animal world lends itself better to a psychology than to a mechanistic physics, because without such psychological vocabulary, the key question proper to physiological anthropology, that of the articulation between thought and animality in humans, would not be formulable.

Kant's approach to the question of the living world is thus generally twofold: the first one, based on the question of *order and purposiveness*—scrutinized in the present book until the previous chapter—, an established on a critique of Leibniz, employs motifs proper to the renovation of natural history by Buffon and Maupertuis, as well as to the notions of vital forces and development according to Wolff and Blumenbach; the other one, *anthropologically* grounded, is tied to the question of the relationship between thought and vitality, and is first anchored in Stahl, then borrows some motifs from Haller and vitalism.[38]

The "Essay on the maladies of the head" (1764)[39] belongs to this latter line of questioning, as it concerns the disturbance of thought by disorders of the animal economy. And it precisely invokes such physiological references, based upon Haller and vitalism. In particular, Pigeaud showed that it was built around the thought of Johann Unzer, whose journal *Der Arzt* (Hamburg 1750–1764)[40] is quoted extensively by Kant. Unzer was, after Gaub, a physician whose approach to animal economy shifted away from Stahl and leaned toward views close to the Scottish school of physiology.[41] Here, Kant's anthropological approach to madness is essentially physiological, in the manner of the Scot William Cullen at the same time.[42]

Kant's articulation of these two perspectives (order/anthropology) also reflects the tension at play between such different approaches as we have analyzed them. This raises the question of how, in Kant, they can coexist. While the psycho-anthropological approach—life as desire and representation—reflects Kant's conviction of some truth intrinsic to Stahl's conception, the ultimate inadequacy of this Stahlian truth could not yet be overcome within such an approach, so that the solution could only be achieved within the other approach, which focuses on the organism concept. To go further than Stahl, further even than vitalism, to understand how a living thing functions, we need to rally the other approach to the living. In such an account, the vision of the living being as composed of soul and body is set aside. The movement by which a way of thinking about living things emerged, which freed itself from the dualistic vision of life, would thus appear recomposed within the texts of Kant, because we find juxtaposed in him the two discourses: one that needs the concept of soul and borrows it from psychology, the other that ends up doing without it, and to this extent opens up the field for questioning the concept of purposiveness.

As long as we think of the living being as directed by a soul, the teleology inherent in the living being is indeed too obvious to be seen, because it is entirely taken care of by the lexicon of psychology: if it is in the essence of the living

being to *desire*, and therefore to tend toward an end, the purposiveness of the living being somehow enters into its definition, and there is no need to question it further. If, on the other hand, we speak of *organized beings*, the model of desire and tendency is set aside; the reference to desire may indeed reappear on occasion, when we need to understand the meaning of the concept of purposiveness, but it would no longer have the status of a *given.*

To speak or not to speak of the living in terms of organization: this is what ultimately distinguishes the two approaches to the living that we are now specifying. As we have seen, the plant seems to be excluded from the realm of life, at least when Kant speaks of "life," whereas it surely belongs to the field of organized beings. But ultimately, the difference between talking about "life" and talking about "organisms" covers a difference in the perception of living things. As we have seen, all the texts in which Kant deals with life and its soul grasp living beings in terms of their *spontaneous movement*—hence the privilege of animality. When it comes to organized beings, movement is irrelevant, as it is the *internal constitution* of the being that comes into play. Of course, there is no guarantee that these two criteria coincide in reality, and indeed *they do not*: plants meet the second criterion, but not the first. The example given in the *Lectures on Metaphysics* made this discrepancy clear: if we see a speck of dust *move by itself*, we will say it is alive, because it is animated. But the grain of dust is clearly not organized: hence, the two criteria do not match a priori.

The second criterion, organization, is in some ways the most modern: it goes beyond the immediately perceived, gesturing toward the depth of the living body. Spontaneous movement refers to an Aristotelian understanding of the living being, as indicated by the necessary appeal to the vocabulary of the soul; the criterion of organization refers to the modern disruptions I analyzed previously: the organism according to Leibniz, and beyond that, the animal economy according to the vitalists. In the first approach, the perception of movement defines a specific field of knowledge, that of the animate; in the second approach, the fact of organization defines the domain of the living differently, and implies different concepts and vocabulary for dealing with it. The transition from the immediate experience of movement to the observation of a configuration within the body accompanies the transition from a natural history in which the living kingdom has visible criteria, to a biology in which life cannot be seen, but is the result of a hidden organization, as Foucault (1966) analyzed in other texts.

However, the *psychology of life* and the *knowledge of organization* are still curiously juxtaposed in Kant: the latter does not surpass the former, nor does it replace or perfect it. As far as life is concerned, we must point to a *conceptual irreconcilability* between Kant's approach to "organized beings" and the discourse on life studied in this chapter. Yet, for us, the organization-centered approach goes beyond the psychological one. Why does Kant not think of this overcoming?

Well, first, the question of the soul is never evacuated by Kant, since the immortality of the soul—a foundational issue in Western metaphysics since Ficino, as Gaukroger (2006) made it clear—is given content in the practical

perspective in the second *Critique*. A discourse on the soul remains, therefore, necessary. More generally, the question of the relationship between our thought and that which it grasps as its condition and which is at the same time alien to it—namely, life—is undoubtedly not eliminable from Kantian philosophy. But to express this relationship, Kant needs a discourse on life as desire and representation, so that the minimal affinity between thought and its condition can be acknowledged; hence, the coexistence of two discourses.[43] With the latter, Kant subscribes to the project of a natural history of man, and the discourse on life as desire and representation is part of this project.

The relationship between the two discourses on the living world could thus be formulated as follows: the organization perspective, as a critical elucidation of the concepts by which the perception of the organism is formulated, precedes the discourse on life as desire, just as transcendental philosophy precedes anthropology. And just as anthropology is not a science, but a boundary discourse (between theory and practice, a duality reflected in the double structure "physiological/pragmatic anthropology"), so the discourse on life as desire does not give rise to a science, but offers a bundle of indications for conceiving the enigmatic anchoring of thought in vitality. On the other hand, while transcendental philosophy in the first *Critique* sets out the conditions of possibility for scientific knowledge, the organization approach leads to the discovery of the conditions of possibility for a science of the organism. John Zammito elucidated such a duality in Kantian thought, showing that his anthropological work, initiated in the 1760s and culminating in the *Observations on the Sentiment of the Beautiful and the Sublime*, connects him to a nascent anthropological tradition in Germany, inspired by Hume and Scottish philosophy, and reacting against Leibnizian academic philosophy. In turn, the transcendental and critical philosophy would be built up along other lines, and might even supplant this first tradition, which Herder, the "Kantian of the year 1765," would be the first to take up and bring to fruition.[44]

If we want to read this duality in retrospect, we should say that it is rather a question of insubstitutability, of incompatible co-presence, as in the case of the famous Necker's cube. When Kant speaks of "life," we're dealing with psychology and anthropology, but above all, philosophically, Kant makes it explicit *in the first person*, while the organism constitutes life in *the third person*. Such a gap, for us today, heralds the question of subjectivity and vital agency.

But agency is now a hot topic among philosophers of biology (e.g., Walsh 2015; Mrozek et al. 2022); hence, in light of this revival, we can avoid consigning the second Kantian discourse on life to the graveyard of pre-scientific ideologies.

7.6.2 The Kantian divide now? Reviving agency

The analytics that we will find in the third *Critique* (see Part 3) essentially addresses the question of what an organism is, and the necessary conditions

under which to think about it. For a contemporary philosopher, this question can be formulated in relation to evolutionary biology, which we know to be a fundamental framework of all biological understanding.

In short, it has three problematic dimensions:

1. What *status should be granted to the organism when evolutionary theory is based on population genetics*, whose explanatory apparatus consists of genes and gene populations, and for which evolution is, above all, a change in allele frequencies, according to Dobzhansky's classic formula? Very briefly, current controversies about the need to think of an alternative to classical Darwinian theory that is more pluralistic in terms of explanatory factors (Odling-Smee et al. 2003; Müller 2017), channels of inheritance (including epigenetic or non-genetic heredity, e.g., Danchin 2022), and explanatory entities (genes, populations, but what else?), are formulable in terms of the *causal role of the organism* (Bateson 2005; Huneman 2010, 2017a, 2017b; Walsh 2015).
2. Generally speaking, *why does life essentially take place in the form of organisms?* Dawkins's controversial theory of gene selectionism in *The Selfish Gene*, according to which natural selection targets genes, had the merit of clearly raising this question, since we can imagine that life could essentially consist in genes living their lives. But, as Michod says, "Life exists as hierarchically nested levels of organization, in which higher-level units are composed of lower-level units (gene, chromosome, genome, cell, multicellular organism, society)." (1999, p.xi) Why did they assemble into complex units—first bacteria and then, two billion years later, multicellular organisms? This question has given rise to the very fruitful research program known as "major evolutionary transitions in individuality" (Michod 1999; Maynard Smith and Szathmary 1995—see also Bouchard and Huneman 2013).
3. Here, evolutionists think of the organism in terms of group- or rather, "multi-level" selection (Sober and Wilson 1998). Certainly. But an even more general question, *concerning the very existence and nature of organisms,* would target *the claim of the all-sufficiency of the explanation in evolutionary terms*. Thus, we sometimes distinguish between explanations that think of the emergence of the first organisms in terms of *information* and heredity, and theories that see the organism above all as *metabolism*. In her book on the "origin of life," Fry (2000), among others, makes explicit the opposition between *metabolism-first* and *information-first* accounts of this origin. The second path implies genetic evolution, since genes are supposed to store and convey information, so we remain within the Darwinian framework; whereas the first branch of the alternative seems to be the Kantian branch, since metabolism—as a circular causality by which the organism maintains itself in contact with its environment—comes under the Kantian notion of organism (analyzed Chapter 9).

> Some, like Godfrey-Smith (2013), accordingly distinguish between an evolutionary biological individual—conceivable in terms of multi-level selection acting on populations of genes, as it is endowed with heredity—and a physiological individual, understood primarily in terms of metabolism, with no necessary connection to heredity and thus to reproduction. It is plausible, then, that "the organism" constitutes the second kind of entity, and the first can be called "the biological individual"; the two things, conceptually distinct, do not always overlap empirically (a cell or a bee colony would be biological individuals but not organisms) but quite frequently coincide: a fertile mammal is both an evolutionary individual and a physiological individual, in other words a "biological individual" and an organism.

The first two problems I pose here seem to fall entirely within the scope of an analytic of the organism in the Kantian sense; they will indeed be addressed in Chapters 10 and 11. The third one indicates the limits of such interrogation framework—it raises the question of whether "organism" in the Kantian sense defines the ontology of biology (whatever the strictly Kantian caveats about the somewhat purely epistemological character of the concept), or whether biological individuality *generaliter* pertains to another understanding. And in the end, we come across a major question for the philosophy of biology, that of determining the miscibility or non-miscibility of a Darwinian conception of biology with a Kantian conception—each approach proposing a non-eliminativist conception of biological purposiveness, one transcendental and possibly projectivist (Lewens 2007; Ratcliffe 2000), the other indexed on natural selection (Neander 1991; Godfrey-Smith 1994; Huneman 2019b). To a less general degree, this question may have been posed concerning the naturalization of biological functions (Kitcher 1993 vs. Godfrey-Smith 1993), or concerning the miscibility of developmental biology within Darwinian biology (Huneman 2010, 2013; Walsh 2013).

But the Kantian discourse on life (§2) shows us that this problematic "great alternative" (Darwinism vs. Kantianism), which will be tackled more precisely later in Chapter 11, is not the only one. It ultimately underlies a division within the philosophy of biology, taken in the broadest sense. In what sense?

We could imagine, along the lines outlined in this chapter, that *life* is not identical to *organisms*, even if, as in the case of organism versus biological individual mentioned above, the extensions of the two concepts largely overlap. And indeed, some, like Mark Bedau, propose a well-argued definition of life as a metabolism/information/compartmentation articulation, which should consider financial ecosystems or the Internet as alive (Bedau 2008). Generally speaking, the *metabolic* relationships that characterize life can extend beyond organisms; for instance, classical ecologists such as Shelford (1931) saw ecosystems as endowed with metabolism, an approach taken up by Eugene Odum, one of the founders of ecosystem ecology (Odum 1971; see Huneman 2025). Conversely,

purely *informational* theories of life can attribute life to entities that we would refuse to call organisms: typically, artificial intelligence. I am not arguing in favor of either position, but simply pointing to the plausibility of a decoupling between life and organisms, which is no longer the Kantian divide between plants and animals, but passes between objects of biological science proper and other objects that, under certain conditions, can be said to be alive.

However, the tension between life and organism that the Kantian views display can even be detected from a completely different perspective. Today's recognition of an organism's causal role in evolution reactivates such views in a very different way (Bateson 2005). As I indicated previously, some authors currently think that to understand phenotypic plasticity or niche construction, we need to see living organisms first and foremost as agents (e.g., Walsh 2015; Mrozek et al. 2022). Now, if this vision is valid, then we need to detach agency from cognitive capacities, since oysters and plants in any case do not have any of the latter. But how could we conceive of this non-cognitive agency?

As for agency, one should not see any current occurrence of the term as a commitment to the view that organisms are genuine agents. Orthodox Darwinians indeed use it very differently, in a much less ontological sense. There indeed exists a controversy between agency advocates and evolutionary biologists who use the "optimizing agent analogy," as Grafen (2002, 2014) puts it. Such controversy can be easily stated as follows: where the former think of agency as a *real* property of the furniture of the world, the latter see it simply as an analogy.

This distinction sounds familiar to a reader of Kant's critical philosophy, since a Kantian would never attribute finality as an ontological property to systems—it is the biologist's transcendental presupposition. Admittedly, the optimizing agent analogy and the Kantian transcendental presupposition of finality are not the same thing, but the structural affinity between them is patent, since in neither case is an ontological assertion legitimized (see Huneman 2017b), as I will explain in the next two chapters. This is unlike the claim of proponents of the true agency of living things.

But in turn, agency as a real property comes very close to the Kantian notion of life detailed in this chapter: the minimal degree of the faculty of desire. In other words, the controversy between these two parties, one analogy-irrealist and the other realist, often understood as a controversy between two versions of the organism (see, e.g., DiFrisco and Gawne 2025), could be seen more radically as an avatar of the Kantian duality between life and organism.

Indeed, what does an "external sense without an internal sense" mean, as defining the life of the non-human animal according to Kant, if not a subjectivity without cognitive capacities, like the agent-plants of contemporary biologists? For some biologists, the agent as an essential element of the furniture of the world still means a desire, a tendency, and an obscure knowledge of the world. Its logic is less that of organized totality than that of "life," according to the second Kantian conceptuality, which grasps life as a face of desire.

According to this interpretive framework, life is the perception of the world in the dual modes of pleasure and pain. I reminded you that, before Kant, this life, which is always a tendency, is part of a Leibnizian lineage for which the "monad," the soul, is both perceptive and appetitive, perception and appetition mutually conditioning one another. The motivating character of pleasure and pain in the Kantian analysis of life reproduced such a schema. Today, in contemporary theories, we witness something analogous: the biological agent projects itself onto the world, defining and seizing its "affordances," that is, points of environmental salience determined by its own specific situational needs. Affordances are defined by pleasure and pain, which project positive or negative tones onto the world. Taken over from the founder of "ecological psychology," James Gibson, this notion of affordance fuels the theoretical construction of the living agent, as attested by the recent work of Denis Walsh (Walsh 2015, 2018). Repositioned in the Leibnizian and then Kantian wake of "life," the ontology of the living agent and its affordances thus appears alien to the vision of biology structured by reference to the concept of organism, itself deeply indexed to philosophical views of the third *Critique* analyzed below, which in turn reflected on the essays on races (and their view of generation, vital force and species), and, more generally, upon the conceptual shifts toward "organism" studied in the former chapters.

In this sense, Necker's cube is a good illustration of the situation. Life is a desire, and only a desire knows itself. It is a proto-first person, just as, for Kant, it is a proto-desire. First and third person, life and organism, cannot take place together for us. Thus, Desmond (2024), following in the footsteps of ethologist Richard Prum, argues that "female choice"—for Darwin a component of sexual selection, and itself explainable by selection (which forges females likely to choose the males who will best replicate their genes)—can just as easily be part of an agential perspective, in which females display a particular aesthetic sense. Irreconcilable, the two approaches are like Necker's two cubes, each unfolding the same reality in its own order. The modernity of the duality of the Kantian discourse on biology, as I have argued here, still persists today by the persistence of such a cube.

7.7 Conclusion

For a philosopher, the analysis of the Kantian discourse on science involves both the metaphysical approach or gesture by which the critical philosopher intervenes in the conceptual order he inherits, and the inscription of scholarly discourse in the field of empirical knowledge debated by the proponents of the various positions available in natural philosophy. From this perspective, my analysis has shown that a tension runs through the Kantian discourse on biology itself. Where critical philosophy deploys a transcendental analysis of natural purposiveness, whose instantiation is necessarily an organism, which, as will appear

in Chapter 9, should be thought of as self-organizing, another discourse has stuck to life as inner movement, self-determination, desire, and, ultimately, soul.

This tension can be seen as a problem, a sign of incompleteness whose consequences would eventually doom the criticist philosophy; I have chosen on the contrary to read in it, the diagnosis of a tension intrinsic to philosophical thinking about biology. And, in this sense, it is still with us today. This line of tension, between the analytic of the organism and life as desire, can be found in several ways, most notably in attempts to think about the specificity and autonomy of the organism (e.g., Moreno and Mossio 2015). It is as if transcendental philosophy grasped life in the third person, through the conditions that make possible a knowledge of it; while there remained—more uncertain, more hesitant, more archaic, some would say—a language of life in the first person, one that flows into the words of desire, pleasure, and pain, that never ceases to return, and whose epistemological fruitfulness cannot be denied. That said, we can now engage the explicit arguments and issues presented in the *Critique of the Power of Judgment.*

Notes

1 In Aquinas, the correlation between signs of life, movement, and animality is exemplary: "It is in beings in which life is manifest, that we must grasp what is and what is not life. Now, life is suitably manifest in animals. It is said in the Book of Plants (Aristotle, Book I of Plants, chap.1) that life is manifest in animals. It is therefore appropriate to distinguish the living from the non-living on the basis of what makes us say that animals live. This is what first reveals life, and how it persists to the end. We first say that an animal lives, from the moment it moves spontaneously (*ex se motum habere*); and we continue to judge that it lives, as long as this movement appears in it. When, in reality, it no longer has any spontaneous movement, but movements from the outside, then we say the animal is dead for lack of life (. . .) We will therefore call alive any being which brings itself to some movement or operation; those in whose nature it is not to bring itself to some movement or operation, cannot be said to be alive except by some similarities (*similitudinem*)" (*Summa Theologica,* Question 18, art.3).

2 Two major extensive commentaries are devoted to Kant's *Metaphysical foundations of Natural Science*, by Jules Vuillemin (1987) and Michael Friedman (2013). My own take is very different from theirs since I address this text only in relation to my inquiry about organism concepts and (in this chapter) life in Kant's writings, mirroring the constitution of the concept of organism. Moreover, Friedman's book came after the publication of the French version of this book. Hence, I will not discuss it in detail or extensively use it.

3 Friedman (2013) rightly views this text as a major critique of the assimilation of inertia to a force, which was Kant's own view in the *Physical Monadology,* and then, slightly renovated, in the *Nova Dilucidatio.*

4 Here, Kant is not far from the theme of the division of functions between kingdoms: vital functions common to plants and animals, and "animal" functions specific to animals. We saw in Bichat the different ways in which this division is conceived in Chapter 2. See also Courtès (1989, note 6), on the disappearance of the meaning of

plant life in Kant's time; he cites a text by Hoffmann in which, without blood, there is no life.

5 On the place of *Dreams* in Kant's itinerary, as a sign of the "professional identity crisis" he underwent in the 1760s, and of his profound disaffection with academic philosophy—hence a temporary inclination toward *Populärphilosophie*—see Zammito (2002, chapter 5). On the theme of vital forces in this text, see Beiser (1992, p.81).

6 On this kinship, see Lovejoy 1936; Ratliff 2004.

7 Ak. XV, *Refl.* 1132, 1556.

8 Ak. XV, p.957.

9 Pecere (2021) recently proposed another interpretation of these passages in the *Dreams*. Especially, he relates them to Kant's critique of Sömmering in his text on the organ of the soul. Our two readings are not incompatible, though.

10 In a sense, Kant here anticipates the dialectic of the teleological faculty of judgment, but let us make no mistake: his text here does not clearly pose anything like an antinomy. No doubt this is a digression in a pamphlet that does not primarily concern the science of living things; nevertheless, we must undoubtedly think that Kant does not yet have the means to formulate, let alone resolve, the antinomy of teleological judgment.

11 The same conception is stated in reverse by the Introduction to the *Metaphysics of morals*: "The *faculty of desire* is the faculty of being, through one's representations, the cause of the objects of one's representations. The faculty possessed by a being to act in accordance with its representations is called *life*" (Ak. VI, p.211).

12 On this Kantian conception of judgment, see Longuenesse (1995, pp.96ff).

13 On the "synthetic apperception" and its foundational role, among a wide literature which includes Allison (2003), Guyer (1987) or Longuenesse (1995), see the detailed commentary by Westphal (2021).

14 On this, see also Cohen (1989, pp.54–55).

15 The end of the footnote can be quoted here: "One cannot reasonably ask that such an unknown species of beings, about which we have almost only hypotheses, should be conceived even in the division of its different kinds; at least these immaterial beings, which contain the principle of animal life, must be distinguished from those which in their own activity include reason and are called spirits." The difference between souls as principles of animals, and souls endowed with reason, which we will call "spirits," is of course a Leibnizian conception that Kant takes up exactly here, although he is less assertive about the existence of souls as such, since the reasons that make him assert them have become "obscure," whereas they were self-evident in Leibniz. Indeed, the affirmation of the "simple," hence of the monad, hence of the soul, representative and appetitive being, opens Leibniz's *Monadology*, as if, from the acceptance in principle of the Leibnizian premises—the existence of immaterial souls—which Kant still holds to be plausible, the rest of the Leibnizian conception was self-evident. These premises will gradually become increasingly unacceptable, as Kant examines their motivations and recognizes their amphibologies.

16 "We obtain the concept of the soul only through the "I," consequently through the internal intuition of the internal sense, insofar as I am conscious of all my thoughts, so that I can speak of myself as a state of the internal sense. This object of internal sense, this *subject*, *consciousness* in the strict sense, is the soul (. . . .) The soul is an object of internal sense" (Ak. XXVIII, p.265).

17 See Chapter 1.

18 "We thus lend to these beings a faculty of feeling, imagination, etc., but all this in the sensible mode only, as an inferior faculty and unrelated to a consciousness. *From this*

external sensibility and the *mechanical principles* of their bodies, we can explain all animal phenomena without assuming consciousness, or internal sense. The philosopher must not multiply the principles of knowledge without cause" (Ak. XXVIII, p.277, my emphasis).

19 This is where the problem raised by the text on Soemmering's *On the Organ of the Soul* comes in. The question of the seat of the soul as the common seat of sensations is at stake in a conflict between philosophy "in its metaphysical-psychological part" and medicine "in its anatomical-physiological part" (Ak. XII, p.31). To resolve the problem, Kant dismisses the notion of a local seat, insofar as it implies a determination of space and time, and thus entails the confusions denounced by the critics; what is involved here is simply a "virtual presence" (Ak. XII, p.32). On this condition, we can think that the water discovered in the cerebral cavity is indeed "this immediate organ of the soul, which on the one hand separates from each other the nervous networks, which precisely find their end here, so that the sensations which operate through their mediation do not mix, but on the other hand produces between them a total community so that certain sensations, although captured by the same mind, are not outside it (which is a contradiction)" (Ak. XII, p.32). But then Kant raises a major problem: water in itself is not organized, whereas the soul is the principle of an organized body, and so its seat must by definition involve organization. "Given that water, as a fluid, can scarcely be thought of as organized, but that, without organization, i.e., without an arrangement of parts finalized and stable in form, no matter could constitute such an organ of the soul, this beautiful discovery does not yet achieve its goal" (33). The Kantian solution, then, is to propose a different kind of organization, one that is no longer mechanical, as an arrangement of rigid parts, but dynamic, "based on *chemical* principles" (my emphasis), so that we can conceive of an organized fluid—which is what the new chemistry helps us to do, as it has split water into two kinds of air through "pneumatic experiments." This decomposition of water is the first step toward thinking about its chemical organization. From there, from this "infinite diversity of chemical elements" organized in water, the nerves "at their termination in the cerebral fluid" would have a great diversity of possibilities to "capture the sensible world." Kant can thus establish a correspondence between the psychic acts of composing and decomposing representations and the chemical operations of composing and decomposing water. The unity of the soul and its activity are conceivable to us in their corporeal anchorage, since water is a "continual *process* of organization without ever being organized" (34).

Kant writes all this in the conditional and emphasizes that it is a hypothesis. This is all that physiology can do to get out of the dilemma in which its discourse on life as soul and body places it: to account for the action of the soul in or on the body, and *at the same time*, to acknowledge the metaphysical impossibility of thinking a presence of the soul in the body. (On this text, see also McLaughlin 1985.)

20 *Opus Postumum* is generally left aside in this book; for a detailed analysis see Mahieu (1991), Van den Berg (2014).

21 "Now we can imagine, in a problematic mode, that there are beings that have no internal sense, for there is no contradiction in admitting such beings" (Ak. XXVIII, p.275).

22 In this way, of course, we can think of a "spiritual life" beyond animal and human life, corresponding precisely to the "spirit's life" whose concept is so problematic, and which we could problematically situate beyond death. For Kant, even before the critique of rational psychology developed in *Critique of Pure Reason*, this conceptual framework is extremely dubious. That's why, in 1773, he warned Marcus Herz that in his anthropology lectures he was "not at all tackling the subtle but *forever vain*

question, in my opinion, of how the organs of the body relate to thought" (*Correspondence*, letter no. 79).

23 On this point, see Krüger (1931, §8), pp.58–65; Mischel (1969), and more generally Hatfield (1992).

24 "Empirical psychology is even further removed than chemistry from the rank of a natural science in the strict sense of the term, firstly because mathematics cannot be applied to the phenomena of the internal sense and their laws, since it would then be necessary to take account of the *law of continuity* alone in the flow of its internal modifications; but this would be an extension of knowledge which would be for that which mathematics provides to the theory of bodies in much the same way as the theory of the straight line relates to the whole of geometry. Indeed, the pure inner intuition on which the phenomena of the soul must be built is time, which has only one dimension. It can never even come close to chemistry as a systematic art of analysis or experimental theory, because the variety of internal observation can only be separated by a simple division into ideas, but cannot be preserved in a separate state, nor can it be combined again at will; moreover, it is not possible to subject another thinking being to experiments suitable for our purposes, and observation itself already alters and distorts the state of the object observed. This psychology can therefore never be anything other than a natural historical theory of the inner sense, and as such as systematic as possible, i.e., a natural description of the soul (*Naturbeschreibung der Seele*), but never a science, not even an experimental psychological theory" (*Metaphysical Foundations of Natural Science*, Preface, Ak. XI.). The "natural description of the soul" is an indication of the project for a natural history of man discussed in Chapters 2 and 6.

25 By saying "discourse on the soul" to evoke the understanding of the living that I am commenting on here in Kant, I take up a Kantian indication: after the characterization of life in the *Critique of Practical Reason*, he notes "I have no need, with respect to criticism, of more concepts *borrowed from psychology*" (Ak. IX, p.164, note 4, my emphasis).

26 I have sketched out an overall analysis of this natural history of man proper to the end of the 18th century, based on a commentary on the first part of *Recherches physiologiques sur la vie et la mort*, in Huneman 2023a, chapter 2; I gave more precise elements in Huneman (2007c).

27 This typology does not imply that the quality of blood has any effect on man—which would be incomprehensible from a critical point of view. It is simply based on "the analogy of the interplay of feelings and desires with bodily moving causes (among which blood is the principal one)." In this sense, we don't know someone's temperament by analyzing their blood, but by observing their behavior: the expression blood quality is not an explanation, but a principle for classifying individuals (taken from the medical tradition) (*Anthropology*, Characteristic, A, II). But while Kant, like all the proponents of the anthropology mentioned here, refutes the direct causality of blood, the fact remains that, like them, he sees in the typology of temperaments, on the one hand, an element of this anthropology, and on the other, one of the loci of the effects of naturalness upon the individuation of men.

28 Günther, *Die Wissenschaft vom Menschen in 18ten Jahrhundert*, p.287, quoted in Lovejoy (1959, p.178.) On this anthropology, see Lepenies (1976), Linden, 1979.

29 On German anthropology and its relationship to Kant, see Zammito (2002, chapter VI, "Constituting the discourse of anthropology"). Plattner published his *Anthropologie für Ärtze und Weltweise* in 1772. A physician himself, he turned anthropology into a discipline for "philosophical physicians." He quickly became a classic of the discipline, not only for Blumenbach, who wrote his essay on varieties in the human

species three years later, but above all for university lectures on the subject, which Marcus Herz reviewed very favorably. For Plattner, anthropology was a synthesis of physiology and mental science or psychology (with aesthetics, logic. . .). Like the French proponents of the natural history of man, he was concerned with the mental origin of diseases.

30 From a phenomenological perspective, Hans Jonas finds the same result, insisting on the *indirect* or mediated character of animal existence (the object of its desire needs to be perceived, identified and grasped, it is not co-present): "The pursuit (of desire) itself can end in the disappointment of failure. In short, the indirect character of animal existence contains from the moment of its awakening the double possibility of pleasure and pain (*enjoyment and suffering*), both linked to effort" (Jonas 1966, p.105).

31 "If the representation is such that it contradicts the principle of life, then this situation of conflict in us is displeasure" (Ak. XVIII, p.247).

32 Kant's text is ambiguous in terms of later Kantian aesthetics. Here, it would have been better to say "objects are beautiful etc. in relation to a human being," not "to a living being," or to replace "beautiful" with "pleasant"—the pleasant is common to living beings as such, not the beautiful.

33 Admittedly, the Kantian position is nothing new. It is strongly reminiscent of the vision of pleasure and life formulated by Hobbes in his *Leviathan*. In Book I, chapter 6, setting out the "inner beginnings of voluntary movements," he begins by considering life in animals, distinguishing between "vital movement" (pulse, respiration, etc.) and voluntary "animal movement." He then introduces the notion of "endeavor" as a small, insensible movement within the human body, leading to the visible movements of human behavior. Desire and aversion, love and hate, belong to the genus "endeavor," as endeavor specified by a precise goal: avoiding an object that causes them, getting closer to it, etc. . . . *Pleasure* and *discomfort* then take on a meaning very close to the Kantian definitions given here: they are the appearance of an endeavor created by the final effect of a movement on the heart, and are distinguished by their effect on vital movement. "This motion, which is called appetite, and for the appearance of it delight and pleasure, seemeth to be a corroboration of vital motion, and a help thereunto; and therefore, such things as caused delight were not improperly called *jucunda* (*a juvando*), from helping or fortifying; and the contrary, *molesta*, offensive, from hindering and troubling the motion vital." (p.34). In Hobbesian thought, the feeling of pleasure and pain is therefore the response to an affection—and even, more physically, to a movement from the senses that has been transmitted to the heart. It qualifies the sensation of endeavor that reacts to this movement. Although Hobbes's model of sensation (movements transmitted to the heart) is neither that of Kant, nor even that of the physiology of Kant's contemporaries, we can nevertheless note the similarity, on the one hand in a definition of pleasure/displeasure that consists in a relationship of congruence between vitality itself and an object (to promote/hinder), on the other hand, in the use of a vocabulary of forces (movement—effort in reaction—obstacles in Hobbes, stimulation of the vital force in Kant) and of conflict, to express the logic of the sentiment of pleasure and pain. In this sense, this dimension of Kantian psychology of the living goes back a long way, since it traditionally manifests some of its elements in Hobbes.

34 On Brown's system and its major impact in Germany, see Canguilhem (1993).

35 The theory of temperaments also benefits from the Brownian scheme, since temperaments are firstly "of sentiment" and "of activity," and each of these two headings is divided in a Brownian manner according to whether there is "excitability (intension)" or "relaxation (remission)" of the vital force (*Anthropology,* Characteristic, A, II)

Brown does indeed believe that there are sthenic and asthenic types, supposedly the most frequent in the society in which he lives. Pfaff, a fellow student of Cuvier's (see Chapter 9), wrote in the preface to his 1796 translation of Brown that the latter had "founded the science of living matter with a kind of mathematical certainty." Novalis would be seduced for a time by this general theory of irritability, present in numerous fragments of his *Encyclopedia*. Kant may well have been attracted by the mathematical generalization of the subject.

36 And also §54 of the third *Critique*.

37 On the Kantian conception of affects and its contribution to a theory of affects, see Marty (1991), Guyer (1979).

38 This discrepancy between "life" and "organism," which we analyze here less as different concepts than as evidence of two different types of discourse or analytical strategies, has naturally troubled commentators. In particular, Löw (1980) identifies life and organism, and is quickly embarrassed by the plant examples in the third *Critique*, since "life," which we analyze in this chapter, does not cover plants (p.154). Claude Piché (1999) has highlighted and attempted to resolve this difficulty. Now I offer another solution here.

39 Translated in *Anthropology, History and Education*, Kant Cambridge Edition, Louden and Zöller (eds.) (2013).

40 Pigeaud (2001, pp.115–138). See also David-Ménard (1990a).

41 He was inspired by Whytt. On Whytt see Canguilhem (1977). On Unzer now, see Steigerwald (2019, p.68). Unzer wrote the treatise *Erste Gründe einer Physiologie der eigentlichen thierischen Natur thierischer Körper* (Leipzig: Weidmanns, 1771).

42 Pigeaud writes: "Passion is merely the occasion for revealing illness, the cause of which is physiological" (Pigeaud 2001, p.131).

43 To this extent, we find in Kant what Cross (1981) showed in Hunter, and what I highlighted in Bichat's *Recherches physiologiques sur la vie et la mort* (Huneman 2023a, chapter 4), namely the coexistence of two conceptual registers, one belonging to 18th-century physiology, the other to 19th-century biology. For Hunter, this coexistence involved, on the one hand, a physiology of vital properties, and on the other, in his comparative anatomy, a vision of animal groups and the interaction between parts close to Cuvier's comparative anatomy—for Bichat, an approach related to the natural history project of man on the one hand (present in the first part of *Recherches*), and the foundations of experimental physiology on the other (in the second part).

44 "We must adopt the Euristic solution of conceiving Kant as advancing on two fronts in the late 1760s, one leading to critical philosophy via his *Inaugural Dissertation,* and the other moving towards an empirical science of anthropology along the lines of popular philosophy [Garve, Reimarus, Mendelssohn. . .]" (Zammito 1992, VII, p.256). See also, on the final anthropology text: "the fact remains that 'pragmatic' anthropology, insofar as it claimed to be derived from universal (albeit 'practical') philosophical principles, systematically deviated from the 'empirical' impulses of the 'general science of man' of the late eighteenth century. On the other hand, Kant's former student [Herder] not only espoused but, above all, extended each of these impulses" (Zammito 1992, p.307).

8 The critical elucidation of purposiveness in the *Critique of the Power of Judgment*

The lawfulness of the contingent as such

8.1 Introduction

The analysis of the concept of purposiveness preoccupied Kant in various ways. We have seen how, around the time of his "essays on races," animals and plants required a teleology, even though in the first *Critique,* life enjoyed no particular positive status, and purposiveness immediately sounded as a language generalized to nature overall. In this sense, his teleology of the living creature in development, materialized in the vocabulary of germs and dispositions, required a re-elaboration of the concept of purposiveness.

On the other hand, we have seen how the question of architectonics, raised in the Methodology of the *Critique of Pure Reason*, opened up the task of a history of nature, which brought to the fore the notion of species derivation in the organic kingdom. This invites us to take up the issue of kinship between a genus and a species from where the "Appendix to the Transcendental Dialectic" had left off, i.e., with the three presuppositions of reason. For these reasons, Kant developed a new conceptual framework for these questions, centered on the power of judgment. Identifying an encountered bird as an owl, concluding that a mammal is a vertebrate, are two cognitive actions, namely, judgments of a specific kind, unlike, for example, the judgment that the trajectory of a "material point"—as physicists say—undergoing a given force will have such properties.

Thus, it is only in a critique of the power of judgment, targeting such a particular cognitive realization, that the analysis of the concept of purposiveness can be taken up again, in a way that satisfies the new requirements raised by the elaboration of the problems just recalled and examined in the previous chapters: the history of nature and architectonics, the teleology in the understanding of species and of adaptation.

This third *Critique* essentially concerns the concept of purposiveness, which, according to its Introduction, mediates the domain of the legislation of concepts of nature and the domain of the legislation of concepts of freedom.[1] The reasons set out above demand a profound reworking of this concept, but to do so, I must first consider the diversity of its uses.

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I will first investigate the formulation and resolution of the problem of classifying nature into genera and species in the third *Critique*. This will enable me to understand the decisive interest in shifting this question to an analysis of the *power of judgment* (and no longer of reason), and the novel concept of purpose. I will then be able to study in the next chapter the Kantian conception of teleology as applied to organized beings.

8.2 The problem of genera and the unity of the empirical laws of nature

In the first *Critique*, the possibility of nature was assured by the categories of understanding and the a priori synthetic principles developed by Transcendental Analytic. Then the problem of an order of nature, which Kant had already envisaged in *The Only Possible Argument*. . ., was taken up again in the Appendix to the Transcendental Dialectic, based on the problem of the Ideas of Reason. Nevertheless, the final unity presupposed by reason in nature, as a generalized language embracing nature in its entirety, undoubtedly did not allow for the diversification of purposes between the teleology of the living discovered by the physiological investigation of the essays on race (Chapter 6) and a rational system embracing the empirical laws of nature (Chapter 5). In the *Critique of the Power of Judgment*, Kant tackles this issue anew, starting from naturalist concerns: the unity of empirical laws meets the problem of the classification of given individuals.[2]

8.2.1 Universal analogy and particular analogy

The "task" fulfilled by our faculty of knowledge, and which we have to account for, according to Kant, can be stated as follows: "to constitute a coherent experience from the given perceptions of a nature comprising a certainly infinite diversity of empirical laws" (*CJ*, XXXIV, p.184). This task, he adds, "resides a priori in our understanding" (*CJ*, XXXIV, p.184). Indeed, while the understanding guarantees a priori the legislation of nature, i.e., the possibility of an *experience in general*, an order of nature is not ipso facto guaranteed: particular experiences could be so discordant that an experience would prove too incoherent, even though experience in general is possible. The necessity of the particular laws of nature is beyond our understanding, because it involves the *matter* of experience, whereas only the *form* of experience is determined a priori by understanding.[3] The only necessity that superimposes itself on the understanding is that which results from the conditions of possibility of experience in general, as formulated by the "Analogies of Experience" explicated in the Transcendental Analytic: it is referred to in the text as "the universal analogy of a possible experience." Yet the empirical laws of nature do not derive from these conditions of possibility, since

they do not concern possible experience but our actual experience. In this sense, their necessity is obscure: on the one hand, appearing as regularities, or rules in particular experiences, they must be thought of as instantiating a *necessity* in order to support the "particular Analogies of Experience," i.e., the possibility of producing inferences in limited domains of nature;[4] on the other hand, these laws are *contingent* with regard to the nature of experience and to the possibility of experience in general, since experience could have been at the same time possible and different.

Since the empirical laws are contingent with regard to the universal necessity instantiated by the understanding, their *unity* appears radically contingent. Yet, were this unity not realized, no knowledge would be possible, because the particular domains of nature could not be reconciled. Natural history is the most salient locus affected by this difficulty: faced with a new animal, I need to be able to compare it with certain others, so as to identify, through the interplay of differences and similarities, hence, across the diversity of various empirical laws, the species to which it belongs. Since Aristotle, analogy has been precisely the vector of possibility for natural history, in the sense that, for example, the statement "scales are to fish what feathers are to birds" makes it possible to treat birds and fish together and recognize a unity beyond generic distance.[5] A note in the First *Introduction* to the third *Critique* juxtaposes "the Aristotelian school" and Linnaeus, precisely on the topic of specification and natural history (Ak. XX, p.215). Linnaeus indeed provides Kant with an example of the problem of the unity of the contingent laws of nature: "Could Linnaeus really have hoped to conceive the plan of a system of nature if he had had to stop at the fact that, when he found a stone, which he called granite, it could be distinguished, according to its internal constitution, from every other stone having quite the same appearance, and if, consequently, he could have expected always to encounter only singular things, isolated as it were for the understanding, and never a class of these things that could be arranged under a concept of genus and a concept of species?" (Ak. XX, p.215)[6] The essential point here is the threat we face: the contingency of the empirical laws of nature, and hence the impossibility of founding their unity, would make it impossible to classify into genus and species, and hence to treat two distinct individuals in the same way, applying to one the explanation of the other. This is the "internal constitution" referred to in the text on Linnaeus cited above: if two pebbles have the same appearance, how can I be sure that internally they are identical? If I am not sure a priori, then I have no way of classifying them into the same genus, and thus, more generally, of relying upon the visible characteristics on the basis of which I divide the world into species and genera. Hence, ultimately, there would be no ground for classifying into genera and species.[7]

This is *the particular analogy* of experience, not to be confused with the *analogy of experience in general*, which assures me that events in the world have causes to be sought ("if the stone moves, someone has touched it"), and that a substrate remains through all changes ("this blackened stone is the same as

when I passed it under the soot"), etc. It is quite possible to conceive of a nature in which each individual would have an "internal constitution" heterogeneous from the others, even though the whole of this nature satisfies the three universal Analogies of Experience set out in the Transcendental Analytic. There would thus be no unity of empirical laws, which we would discover on a case-by-case basis for each natural individual.

This is why additional principles are needed to warrant the "particular analogy of experience," in other words, to guarantee stability in the relationship between manifestation and the "internal constitution" of the products of nature. The contingency of the empirical laws of nature, if it were radical, would imply that these laws are not laws *stricto sensu*: in order to be thought of as laws, they must somehow be necessary, so "*a principle* must *be posited* from which they necessarily derive, even though the understanding cannot penetrate their necessity" (CJXXXVI, p.180). This principle is translated into several rules,[8] whose list seems very close to the transcendental presuppositions of reason set out the "Appendix to the Transcendental Dialectic." We cannot yet see that, in this text of the Introduction, Kant has substantially shifted the problem. But presented in this way, and in relation to the question of the passage from the universal analogy of experience in general to the particular analogy of empirical inferences, the revival of a problematic of the order of nature fits well with the latent question I had raised from the writings on races and the teleology of living nature, namely, that of a *history of nature*. Recall that, defining the method of natural history, Kant thought that it should progress "according to analogy" (Chapter 5). In other words, the causality we see at work in this or that area of nature must doubtless have operated in the same way in such an area in the distant past, since it had a similar appearance. A reference to the geological issues that were soon to emerge, concerning uniformitarianism and catastrophism, is undoubtedly enlightening.[9] Before this, and present in Kantian references, Buffon's history of the Earth (in *Histoire Naturelle*, vol. 1, and then in *Époques de la Nature*) made use of this particular analogy, since when he wanted to imagine what was originally happening on Earth he had to assume processes analogous to the present ones with respect to some of their constituents. The possibility of a history of nature is thus well and truly embraced by the Introduction to the third *Critique*.

The difference from the "Appendix to the Transcendental Dialectic" becomes apparent when we read the remainder of the quoted text, which completes the solution to the problem of the unity of the empirical laws of nature:

> The convergence of nature with our faculty of knowing is presupposed a priori by the power of judgement for the benefit of its reflection on nature according to its empirical laws; but the understanding at the same time regards this convergence as objectively contingent, and it is simply the power of judgement that attributes it to nature as a transcendental purposiveness (in relation to the subject's faculty of knowing); indeed, if we did not presuppose it, we

> would find no order of nature according to empirical laws, and consequently no guideline for experience and research in which these laws must be considered in all their diversity.
>
> (*CJ*, XXXVI, p.185)

We need only note that the necessary presupposition of purposiveness is attributed here to the power of judgment to mark the distance from the problem solved in the Appendix to the Transcendental Dialectic. However, the insistence on *natural history and the classification of species* mentioned above not only shows a shift away from the problematic of the Appendix, which focused on *the unity of forces,* but, above all, enables us to understand the introduction and major role of the power of judgment in this matter.

The unity of the empirical laws of nature is required, particularly in natural history, because without it we would not be able to *classify*; and, being unable to classify, faced with a new individual we could not assign it to either a species or a genus, and finally, subsume it *under a concept*. Thus, we could not even form a concept for it. Therefore, the possibility of forging empirical concepts rests on the presupposition of this order of nature. And conversely, the particular laws of nature are defined by the fact that they concern only those particulars that fall under the same concept: one law for fish, one for gold, etc. The unity of empirical laws of nature is based on the presupposition of this order of nature. *The unity of the empirical laws of nature and the formation of empirical concepts are therefore two identical problems*, seen from the metaphysical angle on the one hand, and from the epistemological angle on the other. And more profoundly, the question of the objective validity of empirical concepts—what we might even call, in non-Kantian terms, their relevance—refers back to that of the possibility of empirical laws: the concept of "green or spaceman" is not a relevant empirical concept, because no empirical law embraces the totality of objects that fall under the concept. The existence of a particular law, here, seems to be the only criterion for the objectivity of empirical concepts.

In these pages, Kant deals with the issue of natural kind, today hotly discussed in the wake of Kripke's revival of metaphysics. For Kant, no natural kind is possible without a set of laws that govern the behavior of things of this kind; and without these laws, no natural kind concept could reliably be forged, no natural kind term could have a robust reference, or what Kant calls objectivity or "objective validity." What Nelson Goodman termed "projectibility," namely the possibility and legitimacy of ascribing a predicate of *a* to another token *a'* of the same kind, is for Kant ensured by this notion of "empirical law of nature" proper to a particular, which ultimately relies upon the particular analogy of nature.

The two notions of law and concept are indeed correlative for Kant: a particular empirical law of nature L is of the form: "for any x, if P(x) then F(x)," where P(x) means "falls under the empirical concept P" and F(x) specifies a predicate of which x is the subject. Clearly, then, the relevance of a particular empirical

law rests upon the objective validity of the empirical concept P; if P is empty, or is a spurious kind, in the manner of Goodman's *grue*, then L will not be a particular law of nature. Kant's approach to this question of the foundation of kinds is based on the problem of laws, and not of concepts or terms, as is often the case in the current state of the debate.[10] Yet, Kant's solution is not completely at odds with Goodman's, since both of them link the robustness of kinds to something that has to do with our epistemic nature, namely, analogy or projectibility. However, Goodman gave up finding foundations for the legitimacy of projections; he is a *pragmatist*, while Kant, by anchoring the analogy into the structure of the transcendental subject, claims a foundation for natural kind concepts.

The Transcendental Deduction of the *Critique of Pure Reason* showed that our *a priori concepts* can be applied to objects, but there is still no guarantee that, in actual experience, objects will otherwise be capable of giving rise to *empirical concepts*.[11] In other words, we know a priori that the nature we experience will be the object of a physics, whose first principles we can enunciate employing the empirical concept of motion alone. We even know a priori, as the "Appendix to the Transcendental Dialectic" showed, that this physics will be systematic enough to bring into play only a minimal number of forces, and to classify the various phenomena into subordinate genera according to the hierarchy of forces. Nevertheless, we do not know a priori whether the products of nature that obey a priori this systematic physics will not be so heterogeneous that, in the absence of natural kinds, they cannot even be conceived. This is why the discipline of classifying and naming (i.e., ultimately finding concepts for) the beings of nature—minerals, plants, animals—is at the heart of the problem of the *Critique of the Power of Judgment* and confers upon it a unique character compared to the Appendix.

8.2.2 The reflective power of judgment

If the problem is the formation of empirical concepts, then the solution to the question of order is no longer to be found in reason, but in the power of judgment. Why? "The power of judging in general is the faculty that consists in thinking the particular as understood under the universal (*CJ,* §IV; XXV, p.179). Let us consider an individual, given in an intuition: attributing a concept to it—"this is an elephant"—subsumes it under a universal; in other words, I *judge*. Now, faced with an elephant, a hippopotamus, and a rhinoceros, I can notice that they have something in common as regards their skin, and lump them together under the same concept, "pachyderms." Here, my power of judgment constitutes a novel empirical concept. The act by which it does so is *reflection*, since it considers the relation between its own concepts. "This origin of concepts—origin as to their simple form—consists in reflection, which gives rise to a representation common to several objects (*conceptus communis*) as the form required by the power of judging."[12] The matter of the empirical concept is intuitions, but its form—this

community of characters between various intuitions, which it synthesizes into a single representation—is the form involved by the use of the power of judging, which constitutes it through its own act of reflection.

The importance of the moment of reflection clearly shows why the reflective faculty of judgment is of utmost importance for the problem of the unity of the empirical laws of nature, a problem to which the very possibility of forging empirical concepts is related. Let us pause for a moment to consider the subsequent distinction between the *reflective* power of judgment and the *determining* power of judgment. "If the universal (the rule, the principle, the law) is given [a], then the power of judging, which subsumes the particular (even if, [b] as a transcendental power of judging, it indicates a priori the conditions in accordance with which alone there can be subsumption under this universal), is determining. But if only the particular is given, for which it must find the universal, then the faculty of judging is merely reflective" (*CJ,* §IV, XXVI, p.179). When I know the law of gravitation and predict the position of a planet based on it, I am making a determining judgment of type [a]. When I state the equation $\boldsymbol{F} = m\boldsymbol{a}$, I am indicating the conditions under which I can identify the presence of a force in a physical situation, hence, I am making an a priori determining judgment, type [b]. But when a physician examines a sick person with a few symptoms and formulates a diagnosis, this is a reflective judgment; similarly, when, as a judge, I have to find the exact legal qualification of a criminal action and the sanction that should be applied to it.

To reflect is, as Kant said in the introduction to the third *Critique*, *to find the rule for the case*. The important thing is that the rule is not given in advance: so, when the zoologist names and describes a new animal, the concept she creates on this occasion not only wasn't given with the animal, but simply did not exist. In this sense, reflective judgment can give rise to several concepts from an empirical representation, since, by depending on the series of representations into which this representation is put to extract a concept, it can lead to these different concepts, just as a particular tree according to the *Logic* could lead to "tree" as well as to "conifer" or "vegetal." This example shows just how inconceivable reflective judgment would be if a gradation into genus-species, once again, were not assured; the status of this assurance will occupy me in a moment.

But first, let us clarify the operation of reflective judgment, using the following text from the "First Introduction":

> The power of judging (*Urteilskraft*) can be considered either simply as a power to reflect according to a certain principle on a given representation, thus making a concept possible, or as a power to determine by means of a given empirical representation a concept that stands on the foundation. In the first case, the power of judging is reflective; in the second, it is determining. Now, to reflect is to compare and hold given representations conjoined either

> with others, or with one's power of knowing, in relation to a concept made possible by this means.
>
> (§V, Ak. XX, p.211)

The mention of a "principle" of reflection again refers to the assurance of being able to order nature into kinds, which would constitute the principle of the power of judging. But here, Kant insists on two points: the reflective power of judgment makes an empirical concept possible from a representation; this reflection can be achieved in two ways, as follows. First, when the power of judging extracts the concept from a confrontation with other concepts, we create the form of an "empirical concept," as the *Logic* described it, and as happens in the examples offered by natural history. But it can also confront this representation with our "power to know" itself. In the case of the reflective power of judging, this alternative corresponds to the duality [a, b] emphasized by the presentation of the determining power of judging in the §IV of the Introduction of this *Critique* I quoted such a power can either subsume a particular under a given universal (a), *or* indicate the conditions of any subsumption under such a universal (b). This distinguishes between the empirical and the transcendental exercises of the determining power of judging; and one sees that the reflective power of judgment too allows for both types of operations, namely (a) finding a universal for a particular or (b) indicating the conditions for finding such a universal.

But the third *Critique* shouldn't be read as a theory of reflective judgment supplementing a theory of determining judgment that in turn would be the first *Critique*. More profoundly, the former makes explicit the reflective moment of the overall judgment as considered in the latter. It does so because the question of the creation of empirical concepts in natural history came to the fore, especially since the construction of the "Appendix to the Transcendental Dialectic" proved insufficient, for the reasons analyzed above (Chapter 5) concerning the status of the living, the possibility of a history of nature and the architectonics. What emerged as the proper object of the third *Critique* is the *simply reflective* judgment, i.e., one that does not result in the determination of a concept.[13] Indeed, when I make a determining judgment, empirical representations are first subjected to a reflection that places them under the logical forms of judgment—even during the formation of the perceptual judgment, which determination through categories would lead to being a "judgment of experience"[14] (according to *Prolegomena,* §20).

The involvement of a reflective moment within the determining judgment, which is the topic of the *Critique of Pure Reason,* is attested by the following text from the "First introduction":

> With regard to the universal concepts of nature,[15] under which in general a concept of experience (without particular empirical determination) is first

> possible, reflection is already guided by the concept of a nature in general, i.e., by the understanding, and the power of judgment needs no particular principle of reflection, but schematizes this a priori and applies these schemas to each empirical synthesis without which no judgment of experience would be possible. In this case, the *power of judgement is at the same time determining in its reflection* (my emphasis), and the transcendental schematism of the latter serves it at the same time as a rule, under which given empirical intuitions are subsumed.
>
> (§V, Ak. XX, p.212)

This text concerns *reflection*: if we call "reflection" the moment of concept formation, *how is a universal concept of nature formed*? This is a fundamental question, because the concepts of experience, whatever they may be, must be able to be subsumed under these universal concepts of nature. In the case of the formation of such universal concepts, reflection simply follows the guiding thread provided by the understanding through the concept of nature in general, i.e., the possibility of experience in general. The reflection of the faculty of judgment thus behaves as a determining judgment when it comes to universal concepts of nature. In this sense, reflective judgment was already involved in the judgments studied by the *Critique of Pure Reason,* even if these, from the point of view of the third *Critique*, appear to be determining ones.

But in these judgments, reflection is guided *by the understanding*, which provides the framework for the possibility of experience. The reflection of the power of judging is therefore not *pure*, because its principle comes from somewhere other than the power of judging. The determining judgment leads to the determination of a concept because, with the understanding and thanks to the principles of a priori synthetic judgment that constitute the possibility of experience, it is ensured that reflection can grasp something of the object as a phenomenon. But, when the rule for a novel case is not given, the faculty of judging has no guarantee that any rule can be grasped, in other words, that a concept can be formed, endowed with an objective validity. This is precisely the case when it is no longer a matter of the universal concepts of nature, i.e., when the principles of the understanding can no longer guide judgment. Hence, to guarantee objectivity in this case, it needs a *principle of its own*, which the first chapters of the "First Introduction" (hereafter *FI*) and the introduction to the *Critique of the Power of Judgment* are intended to capture. But to examine *the objective validity or status of its result*, especially when it involves a reflection that compares with our power to know (as in the operation of type (b) distinguished above), both investigations of the two sections of the third *Critique* are needed.

Thus, for those "concepts which must first be found for given empirical intuitions and which presuppose a particular natural law" (*FI*, p.212), for instance the concepts needed when we see a never encountered animal, or a set of uncanny symptoms, the rule really is not given, because here we cannot even refer to the

requirements of the *possibility* of experience (as is the case when forging universal concepts of nature) to make up for its absence, since the required concepts are not fully universal: it would only be about an animal, a disease, etc. When we are no longer dealing with *universal* concepts of nature, the contingency of the *particular* laws of nature prevents the reflective moment of judgment from extending into a determining judgment. We do not find here the transcendental necessity, roughly formulable by a statement of the type "it must be this way, otherwise experience in general would not be possible," which allowed the power of judgment to take the understanding as its guide in the case of universal concepts of nature, and thus to apply the schematism associated with the categories. This second use of reflection—that is, a use not leading to any determining judgment—gives rise to the *simply* reflective power of judgment, and this is the problem of the *Critique of the Power of Judgment.*

Now, a simply reflective judgment yields *reflective reasoning*, in which the rule is in no way given. In the "Appendix to the Transcendental Dialectic," Kant distinguished between the "apodictic use" of reason, in which a certain rule was applied to particular cases, and the "hypothetical use," in which a rule was admitted as problematic in order to identify its possible application to nature (Chapter 5). This second type of reasoning embraces the syllogisms around which the account of order and systematicity revolves in this text, as I construed it.[16] Henceforth, from the point of view of the reflective faculty of judgment, these two uses of reason now appear as determining reasonings: either the universal is given as certain (e.g., the force of attraction), and the *apodictic* use of reason mobilizes a regulative principle such as that indicated by the Idea of the world, namely, regressing to infinity in the search for antecedents according to the laws of attraction; or it is given as *problematic*, for example, the idea of a fundamental force, and the regulative principle is then that of the systematicity of nature as ordered by the interest of reason, according to a theme developed in Chapter 5.

But it may also be that the universal *is not given at all*, and then we would face what we would call "simply reflective reasoning." In §82, the *Logic* refers to such reasonings: "the reasonings of the faculty of judging consist in certain ways of reasoning that enable us to arrive at universal concepts by starting from particular concepts. They are therefore not functions of the *determining* faculty of judging, but of the *reflective* faculty of judging; nor do they determine *the object*, but only the way of reflecting the object in order to arrive at its knowledge." Thus, *reflective* judgment starts from given empirical intuitions and goes to the universal concept; *simply reflective judgment* starts from the particular concept. Since it does not determine the object, it can only inform us about our own possibility of knowing it.[17] The etymology of "reflective" already tells us that simply reflective judgment is primarily about the subject itself and its power to know; this quoted text on reflective *reasoning* explicitly indicates that the reflective moment in judgment is not about knowing the object, but about forming the

concepts by which the object, first given as an empirical representation in intuition, can become an object of knowledge in a way that is adequate to our faculty of knowing.

The rule for judging, in this sense, cannot be given in nature; nor can it be given by the understanding, because in that case the judgment would end in the determination of the object. At the same time, we still need a principle in order to judge, i.e., to find the rule that suits the case and to verify that it does indeed suit it. How, then, is the proper principle of the reflective faculty of judgment formulated, and how is it justified?

8.2.3 The principle of the reflective power of judgment: the "heautonomy of the power of judgment"

Reflection cannot be achieved simply by comparing new things (e.g., living forms) with empirically known things. Comparison itself implies an a priori principle that makes the comparison feasible, by guaranteeing a priori the comparability of everything that would be empirically encountered. And so Kant comes to the presupposition that the faculty of judging must admit for its comparisons: "Any comparison of empirical representations aimed at knowing in things of nature empirical laws and *specific* forms that follow these laws, while *agreeing generically* with other forms as comparison does, presupposes that, even with respect to its empirical laws, nature has observed a certain economy that fits our faculty of judging and a uniformity that is accessible to us; a supposition which, as a principle of the faculty of judging a priori, must precede any comparison" (*FI* §V, p.213). *Uniformity* and *fit with* our faculty of judging are thus the two dimensions of the presupposition of the reflective power of judging.

This presupposition is tantamount to assuming the unity of the empirical laws of nature. It then ensures the harmony of the power of judging with the understanding. Indeed, this power of finding empirical laws to subsume events, and then broader empirical laws, can regress to more and more general empirical correlations. Thus, it proceeds in the reverse order to the determining judgment, which starts from the universal of the understanding to go to the particular. As Friedman put it:

> The task of the reflective judgment is not somehow to provide a kind of necessity that the understanding itself cannot provide, but rather to systematize the potentially infinite multiplicity of empirical laws under more and more general empirical laws, so as to approximate the a priori necessity issuing from the understanding and from the understanding alone. (Friedman 1992a, p.190)[18]

Only the inaugural presupposition of the reflective power of judgment can guarantee this progressive inclusion. Without it, the upward orientation of this

power would not be compatible with the downward orientation of the determining power of judgment, and reflective judgment would therefore not be able to provide knowledge comparable to the theories of the understanding and capable of being articulated within it; in other words, it would be useless for science.

The status of such a presupposition of the reflective judgment, according to Kant, is twofold: it is transcendental, and it is a law that this power of judging prescribes to itself and not to nature. *Transcendental*, because with this principle we are not dealing with the form of concepts of thought—which one might claim is infinitely divisible, and so gives rise to a logical subdivision into genera and species—but with *nature itself* insofar as it is susceptible to knowledge through empirical concepts. A merely logical principle would tell us how to compare concepts with one another, but the principle of the reflective power of judgment presupposes that nature presents objects that would lead to comparable concepts, and is thus a transcendental presupposition (*FI,* p.212).

Hence, the reflecting power of judging produces this principle to make its reflection possible, whereas even without it, a nature would nevertheless be possible: it would be, as I said, a nature without particular unified laws, hence nature in which we would not recognize anything. Consequently, this transcendental principle, which is not received from observation, nor from any other faculty (such as the determining faculty of judgment, which is guided by the understanding), is not superimposed on nature; it is subjective, but in a new sense, for it no longer presupposes an object-in-idea that would confer it a certain objective value, as did the maxims of reason according to the "Appendix to the Transcendental Dialectic." This is what Kant calls the "heautonomy" of the principle of the presupposition of the reflective power of judgement.[19] This principle of the power of judging being universal in the sense that it should govern the thinking of every human, such a universality means a *subjective universality*.[20] In this sense, it will only provide regulative statements—i.e., statements indicating *how reflection itself should proceed* in knowing the given—and not constitutive statements unraveling *how things are.*

8.2.4 Purpose, order, and the technique of nature according to the presupposition of the reflective power of judgment

8.2.4.1 The Critique's *stance on the power of judgment*

The order of nature is no longer a systematicity projected by the Ideas of reason (first and foremost the Idea of God), which appeared in the "Appendix to the Transcendental Dialectic" as final unity. The maxims of reason, according to the Appendix, are now often presented as connected to the power of judgment,[21] due to the shift in viewpoint toward natural history that I highlighted at the beginning of this chapter.

It is worth recalling here the categories of *The Only Possible Argument*. . . to situate the position of Kantian thought in the evolution of the system/technique distinction. Kant then opposed the necessary order of the laws of nature, i.e., purposiveness as a system, to the contingent order, which called for divine technique, i.e., purposiveness as technique. He evolved toward the gradual suppression of the contingent order, a temptation I spotted in the "Appendix to the Transcendental Dialectic," and which gradually obscured the status of the living (Chapter 5). But the motif of contingency recurs in *Critique of the Power of Judgment*, in a new framework since "necessity" has been given the status of modal categories in the first *Critique*, i.e., it has meaning only in relation to objects of possible experience. To this extent, the *necessity* of the laws is no longer exactly a metaphysical property, as in *The Only Possible Argument*. . ., but points to their constitutive role in the possibility of experience, while *contingency* is defined by contrast with such a role. In the third *Critique* the unity of empirical laws appears now fundamentally contingent for our understanding.

According to the account proposed by the "Appendix to the Transcendental Dialectic," reason "prepares its field" for the understanding, which basically could not even exercise itself without such propaedeutic of reason, since it would not be able to deploy its activity of comparison (Chapter 5). What was at stake here, however, was the understanding, and therefore ultimately the determining judgment, whose guide it is, together with the activity of subsuming cases under the universal laws of nature, as well as deducing particular rules from these laws. Yet the reflective judgment and the formation of empirical concepts that it brings about were not explicated in this order-centered account.

For Kant, the aesthetic judgment undoubtedly highlighted the autonomy of the reflective moment of judgment, since it manifests this most purely. The aesthetic judgment confronts representations with our power of knowing, and we can clearly see that it does not determine the object, but concerns only such a relationship to our power of knowing, so that its reflective dimension is obvious. Thus, the aesthetic problem commands the project of a critique of the power of judgment.[22] Precisely, however, it enables us to elaborate the concept of reflective judgment,[23] which serves as a tool for revisiting the question of the purposiveness and systematicity of nature, a revival required by theoretical advances concerning the problem of life, as I have shown in Chapter 6.

Rachel Zuckert (2007) extensively defended the idea that "judging purposively without a purpose" constitutes the practice of judgment and is exactly instantiated by the aesthetic judgment. According to her, this claim allows one to "see, too, the continuity between Kant's descriptions of the practice of aesthetic judging (the 'free harmony' of the faculties) as purposive, and of purposiveness as an 'objective' structure holding of the parts/functions of an organism" (p.18), which will be at the core of the next chapter.

In *The Only Possible Argument*. . ., the necessary order of nature resulted from the application of the universal laws of nature over a very long period; most of

the seemingly contingent orders were reducible to this. Beyond this application of universal laws, order was a matter of divine technique. The *Critique of Pure Reason* already distinguished between the levels of synthetic principles of understanding, *constitutive* of possible experience and therefore of nature formally seen, and that of the system, the Idea of reason, *regulating* the order of nature. It implied, however, as my analysis of the "Appendix to the Transcendental Dialectic" tended to show, that the systematicity presupposed by reason was a general systematicity, in line with the universal laws of nature, and inspired by the idea of necessary order according to *The Only Possible Argument*. . . . The third *Critique* then radicalizes the separation of the notion of "universal law" from that of "system," since there is now on the one hand the system of these universal laws, constituted by the understanding, and on the other hand the system of empirical laws, grounded in the transcendental presupposition of the reflective power of judgment.[24] What stands in opposition to the *system of universal laws* is no longer, as in *The Only Possible Argument*. . ., divine technique, but, here, *another system*, presupposed by the reflective faculty of judgment. Rather than meaning the absorption of technique into the system, as we saw in the "Appendix to the Transcendental Dialectic," this means a reinterpretation of the idea of "divine technique" that dispenses with God, as I will show now.

8.2.4.2 Specification as a goal for our understanding

The power of judgment presupposes for its reflection a nature that is specified in genera and species. Its principle can therefore be expressed as follows: "nature specifies its general laws into empirical laws, in accordance with the form of a logical system, for the use of the power of judging" (*FI,* Ak. XX, p.216). Thus, this power presupposes a logical systematicity of nature, yet it is not posited as constitutive of nature (unlike the system of universal laws of nature). Nature must be *presupposed to specify itself*, i.e., to divide its highest genera into sub-genera, and so on downward (*FI,* Ak. XX, p.214), if the operation of the power of judging, which ascends from the given particular to its universal genus, is actually to encounter nature. This means that nature *specifies* itself *in such a way that* our understanding can be found in it. In this sense, the idea of purposiveness is included within this presupposition of a system of nature. Nature is somehow designed—"fit"—for our knowledge, insofar as it makes this possible by enabling us to form empirical concepts.[25]

This is why a second formulation of the principle of the reflective faculty of judgment can *refer to another, original, understanding of nature*, since this makes it possible to express the strange affinity between nature and us by articulating it through the tautological affinity linking two understandings. If there is a system imposed by our understanding on nature according to its universal laws, and a system of nature according to its empirical laws, the latter can, *by analogy*, only be superimposed by another understanding (*CJ*, XXVII, p.180).

This concept is not aimed at an understanding that would be at the origin of nature, but at the necessities of our power of judging to conceive of nature. The principle of the reflective faculty of judgment thus appears to be fitness for our understanding, and therefore *purposiveness*, in the sense that the multiplicity of empirical laws of nature is *presupposed to be possible by the project of a form of systematicity* that would be inherent to it.[26]

For our power of judgment to be able to find its way through the mass of empirical laws, and to be sure of always being able to seek out new ones, as well as always being able to form new empirical concepts, nature must be systematic, and even *systematize itself*. In other words, if everything happens as if nature were made so that we can know it, i.e., made for us, then nature is systematic. Hence, the presupposition of the systematicity of nature by the reflective power of judgment is the presupposition of *the purposiveness of nature*—not in its products (i.e., that the objects are constructed for this or that use), but *in its form*, i.e., that what appears to us in nature can be ordered into a system. Thus, the second chapter of the "First introduction" shows the identity between the principle of "nature's *purposiveness* with regard to our power to know it," and that of "experience as a *system* following empirical laws" (Ak. XX, p.202, my emphasis).

8.2.4.3 Nature's technique

According to this presupposition, nature appears as founded in a project of systematization, in other words, as a *technique*, understood rather in the sense of creating a harmonious object, than in the artisanal sense of making a machine with an end in view: we are far from *The Only Possible Argument*. . . and even from the linguistic—and not objective—use of purposiveness in the "Appendix to the Transcendental Dialectic."[27] The faculty of judgement presupposes this *technique of nature*—thus, the concept of technique intervenes, once again, to account for a contingent order of nature, but *without now opposing systematicity*, as it used to do in the 1763 treatise. On the contrary, the technique of nature is here opposed to *mechanics* (point 1, below); it concerns only the *form of* nature, and this is why (*CJ* §IV) the analogy stops with human technique (art, morals) (point 2, below).

1 The *technical* is now opposed to the *mechanical*, just as the use of an instrument according to a plan is opposed to the execution of an artistic project, which therefore only sets an overall pattern (e.g., writing a sonata with a fugue and counterpoint, and a cyclical form). The determining judgment applies the scheme on the basis of a given universal concept: it is a mechanical execution. Reflective judgment, in turn, holds only one overall idea—the systematics of nature—and from there must find the universal for each particular: in this sense, judging is an art.[28] This artistic dimension must be heard when

Kant speaks of the "technique" of the power of judging.[29] Thus, proceeding technically, the principle of the power of judging is the presupposition of a technique of nature, as the construction of the system that itself presupposes the applicability of our art of judging.[30] Such a technique of nature is not constituted by a set of a priori rules, otherwise we would remain in the domain of the principles of understanding that are constitutive of nature, but by an indeterminate regularity: "The faculty of judging gives itself a priori the *technique of nature* as the principle of its reflection, *without however being able to define or determine it further*" (*FI*, V, Ak. XX, p.213, my emphasis).

"Technique" and "mechanics" are therefore opposed at the level of nature itself. This "technique," in particular, is closer to art than to craft and industry, because in craft or industry, instruments are available for many purposes, whereas the technique of nature means a project—namely, logical specification—at the origin of the system's formation. Nature's mechanics is like the instrumental application of nature's laws: only such laws account for the forms produced.[31] In *The Only Possible Argument*. . ., Kant refused to see instrumental purposiveness in nature's dispositions, precisely because they could serve one end as well as another; in this sense, he preferred the notion of systematics to "divine technique" as a set of instruments, when it comes to accounting for the appearance of finality in nature. Now, by *reinterpreting* the technique of nature, Kant reconsiders the opposition that separated it from the systematicity, and makes possible, *alongside* the necessary order of the universal laws of nature, a lawfulness that belongs to the technique of nature, without falling into the difficulties that previously rendered the concept of "technique" inapplicable. Such a renewed concept of technique, to the extent that it is opposed to the mechanical, will underpin the difference between the *organism*, insofar as it pertains to purposiveness as a technique of nature, and the *mechanism*, a difference that is crucial in the third *Critique.*

2 This technique of nature as a principle of the reflective faculty of judgment, insofar as it is only a regulative principle of judgment, cannot *constitute* natural phenomena. In this sense, it concerns only the "connection of phenomena in nature, a connection given according to empirical laws" (*CJ*, IV, XXVIII, p.181), their ordering in the form of a system. It is not, therefore, a "fabrication," so that the two types of human activity directed toward ends that Aristotle originally distinguished under the names of *poiesis* and *praxis* are in no way models of this technique of nature: "This concept (of purposiveness in nature) is quite distinct from practical finality (of human art or even of morals) although it is thought of according to the analogy with the latter" (*CJ*, IV, XXVIII). This distinguishes Kant's subtle view of purposiveness from any direct projectivism, i.e., any doctrine according to which we project into nature our capacity to produce things or engage in long-term programs. Purposiveness in nature is only "practical" *by analogy*, but its concept is not the extant concept of practical finality. This caveat also signals the gap between

Kant's criticist view of purposiveness and the other Kantian discourse of life as desire that I reconstructed in the last chapter.

8.3 The structure of the concept of purposiveness: contingency and lawfulness

8.3.1 Purpose and its figures

As a principle of reflection, purposiveness does not determine the objects of nature; it does not penetrate to the heart of their constitution; it only gives indications of the relationships between their forms in order to enable their conceptualization and classification.[32] In this sense, Kant speaks of "logical purposiveness." Purposiveness does not penetrate natural things, because it is a concept of reflection, specific to the power of judging, and not a concept of reason, whose model is poetic or practical finality.

Having set out the principle of the reflective power of judgment, Kant continues: "It is here that the concept of a *purposiveness* of nature comes into being, and this as a concept proper to the reflective faculty of judging, and not to reason, since the purpose is placed not in the object, but solely in the subject, and this in its simple power to reflect" (XX, p.216). Now, since the concept of purposiveness originates in the demands of the reflective power of judgment, it *can no longer be understood as that generalized language of reason* referred to in the "Appendix to the Transcendental Dialectic," which could express nature in terms of utility. The meaning of purposiveness here is not utility, as in the sentence I quoted in Chapter 5 ("everything has its utility and good intention"), but the fitness of nature to the reflective power of judgment.

The statement "everything is useful in the animal," which, in the "Appendix to the Transcendental Dialectic," was an example of purposiveness imposed by reason, finds itself totally irrelevant here; finality in living things, on the contrary, will have to be the object of specific investigation, uncoupled from usefulness concerns. The utility of the things of nature for one another, which the first *Critique* reconquered through the demands of reason, finds itself frankly rejected at the beginning of the *Critique* of the Teleological Power of Judgment (§63), even though the "Appendix to the Transcendental Dialectic" invoked its lawfulness. This move underlines Kant's breakthrough regarding the treatment of the concept of purposiveness. The finality of nature is no longer simply a language, but a principle of reflection. To rethink the sphere of the living within its own teleology, Kant would thereby have to extend the concept of purpose and diversify it.[33]

The subjective finality of nature systematics that we just saw concerns the *relationships* between the forms of natural products: groupings such as genera or species. But we can also look at these products *themselves* and ask whether they imply the use of the concept of finality. This purposiveness can concern (1) the *intuition of the* empirical *object*, or (2) its *concept*. In the first case (1) the

appearance of a natural object may seem to be made in such a way that it fits the configuration of our power of knowing, which is indicated in a feeling of pleasure—as the critique of the aesthetic power of judgment will develop—and we call this a *beautiful* object. Then, just as for the purposiveness of the whole of nature in relation to our understanding, here the appearance of an object of nature is in some way fit to our faculty of apprehension, our intuition. Insofar as no knowledge of the object is at stake in this purposiveness, which affects only the fitness of its appearance to the constitution of our power of knowing—namely, the articulation of sensibility, imagination and understanding—such a finality is therefore *subjective*, like the purposiveness posited at the principle of the reflective faculty of judgment. In the second case (2), however, we may encounter objects whose possibility we could not account for without presupposing something at the basis of their existence, exactly as we presuppose a system of nature in order simply to be able to name things.[34]

In "subjective purposiveness" (1), the form of the object seems made for the *subjective conditions* of our apprehension; in "objective purposiveness" (2), this form seems to rest on the *concept of the object*; in other words, the object appears not to have been possible otherwise than in this form (*CJ*, §VIII, XLVIII, p.192). Thus, in all its aspects, purposiveness rests on the complexities of the concept of "possible"; recall that in the *Critique of Pure Reason*, "possible" (in the transcendental sense, and not in the logical sense of non-contradiction) means a fit with the conditions of experience in general, and thus, ultimately, at the level of the metaphysics of nature, fitness with the universal laws of nature. In this sense, a stone is possible in any shape or form. In the case of a living being, however, we know there are *viable* and *non-viable forms*, all of which are equally consistent with the universal laws of nature that enable their production. Yet inviable forms are *vitally impossible*; this inflection in the concept of possibility implies the need to appeal to the concept of purposiveness, to say that the vitally impossible are the forms that cannot fulfill their task of enabling life. Such objects then appear as *natural purposes* (*CJ*, §VIII, L, p.193), as will be developed below.

8.3.2 Instantiating purposes

These natural purposes entail a complexification of the cardinal distinction operated by Kant in 1763, between system and technique, since the two notions of "aggregate" and "mechanical" are now at stake, and "mechanical" reminds us of the discussions that accompanied the emergence of "organism," whether by Leibniz or by Stahl. Here is the "First Introduction":

> Nature, as *mere nature*, proceeds *mechanically* with regard to its productions considered as aggregates; but it is *technically (künstlich)*, i.e., at the same time as an *art (Kunst)*, that it proceeds with regard to them if we consider

> them as systems: thus crystallizations, the varied figures of flowers, or the internal structure of plants and animals.
>
> (*FI,* §VI, Ak. XX, p.217). (A)

The absolute finality of some forms of nature is distinct from the form of purposiveness of nature in general, which Kant characterized above. The character of this purposiveness is the system. For example, a stone can be part of a system—mineralogical—and thus fall within the principle of purposiveness presupposed by the reflective power of judgment—and at the same time have no proper *systematic* form, being no more than an *aggregate*.[35] The existence of purposive forms is therefore contingent compared to the formal purposiveness of nature in general, as presupposed as a principle by the reflective power of judgment.

In this text, the *aggregate* is opposed to the *system* as the *mechanical* is to the *technical*. This opposition governs the reflective power of judgment, since its principle can be seen as serving to "introduce into *the aggregate of* empirical laws, taken as such, whenever possible an organization of a *systematic* order" (*FI*, §II, Ak. XX, p.205, my emphasis) Thus, purposive forms of nature, if there are any, are likely to be considered *systems*, and in this sense be thought of as belonging to a *technique of nature.* By shifting both systematicity and technicality through the analysis of the reflective power of judgment, the *Critique of the Power of Judgment* has reconciled the two notions that *The Only Possible Argument*. . . had separated, overcoming in the same move the one-sided suppression of the technical previously defended by the "Appendix to the Transcendental Dialectic."

The systematicity of the purposive forms of nature then consists in the fact that we must find them to be founded on a design. While an *aggregate* could be other than what it is, and still be an aggregate, when we apprehend the *systematic item*, everything happens as if production had taken place according to a plan: unlike the aggregate, if we change one element, the system is no longer one. To this extent, the system seems to stem from a plan, since for our power of judging its possibility must be founded on an idea of it: "their possibility [of the forms of nature as purposive forms] must be grounded in our faculty of judging on an Idea of them" (*FI,* p.217).

Kant then makes a fundamental distinction, depending on whether the system affects the *external configuration* of a thing or *its internal constitution*. In the former case, we have an object whose manifestation, i.e., its relationship to our intuition, must be thought of as part of a technique by which it fits our faculty of thinking, and in this sense as purposive: this is the *aesthetic* domain. In the latter case, the object itself is systematic in its *internal* constitution, hence in what we do not see, what does not affect our intuition: in other words, it is systematic *in what makes it conceivable to us*; it is only possible for us as a system. This is *teleology*. Here, the technique of nature is "real," in the sense that teleological judgment implies real finality; but there, it was "formal," in the sense

that aesthetic judgment involved formal purposiveness;[36] real and formal here respectively pertain to the objective and subjective purposiveness distinguished above (but do not exactly overlap; see next section).

In the text from the *First Introduction* quoted above (A), let us take a look at the examples. On the side of aesthetics, or formal technique, we have "crystallizations" and "varied figures of flowers"; on the side of teleology, or real technique, the "*internal structure of plants and animals*." Clearly, then, the boundary passes between a domain where life and non-life are mixed—the domain of *natural history*, where we find flowers as well as crystals—and a domain *of living beings*. The problem of the unity of empirical laws as a problem of reflection, dealt with up to now, through a reading of the First and the Second *Introductions* of the *Critique of the Power of Judgment*, was coalescent with this realm of natural history, while we find it also at the level of aesthetics; each time, it is a matter of appearances, whether of the visible characters that enable classification or of the aesthetic pleasure they are likely to provide. On the other hand, "real technique" concerns the internal arrangements, often invisible, sometimes unlikely to give rise to aesthetic emotion (think of cockroaches), but without the systematic character of which the plant or animal would not even be possible, even independently of the existence favorable external conditions around it. Kant referred in this sense to "internal possibility" when he wrote that "their internal possibility presupposes an end": plants and animals have external conditions of possibility (temperature, air, light, etc.), but they also have an internal possibility: their organs, their parts, must be arranged in a certain way, otherwise they are not viable. The analogy between crystals and living beings, all of which display a certain systematicity, is broken here, because crystals exhibit finality in their figure, at the level of intuition, which detects regularity in them, whereas living beings may display no visible regularity, be misshapen and in this sense be ugly, though at the same time possessing an *internal* systematicity. So, moving on from formal finality (presupposition of reflection *generaliter*, or aesthetics) to real finality, we move from the realm of natural history to that of the study of objects definable by a specificity of their internal structure, in other words, the realm where life becomes an object by proving itself to be a specific internal arrangement endowed with its autonomous necessity, what the vitalists called "animal economy," but which became clarified as " organism" throughout the Wolffian moment and Kant's essays on races and germs/dispositions. Analyzing the prerequisites and legitimacy of teleological judgment thus means defining the specific principles on the basis of which the concept of organism can provide a proper understanding of life.

8.3.3 Objective purposes and techniques of nature

The objective purposiveness actually includes several varieties. Once again, Kant appeals to the example of mathematics, which illustrates how purposiveness as

apparent usefulness can stem from one unique pattern. The circle is indeed a means of finding solutions to a diversity of geometric problems (*CJ* §62). This "formal" objective purposiveness, proper to mathematical beings, is distinct from the *real objective purposiveness*, which we saw instantiated by the "internal structure of animals and plants."[37] Purposiveness does not enter into the definition of the circular figure in question, which is first possible and constructed, and afterward serves as a means to the resolution of problems.[38] The objective purpose of mathematical figures is thus *formal*, in the sense that no purpose is involved in the production of the reality of the concept.[39] Conversely, mathematical purposiveness provides a means to several different ends (*CJ*, p.365).

The formal objective finality of mathematical figures is reminiscent of finality as a system in *The Only Possible Argument*. . ., in the sense that it could produce diverse ends from a unitary principle, let us say from a single law of nature, simply because of its systematic character and without regard for each of the particular ends. But, retrospectively, *The Only Possible Argument*. . . could not conceive of the living as such, because its model of formal objective finality *does not posit the purpose in the concept*, as does the real purposiveness proper to the "structure of animals and plants," which would have to be called "material objective."[40]

Now, material purposiveness has a complex relation to judgment and reason. Judgment is teleological when the understanding by itself is insufficient to think the object in question, and must therefore join with reason to arrive at the concept of the object. The power of judgment therefore contains no a priori principle for judging natural purposes: it includes the idea of a finality of nature, from which it can detect a purposeless finality in the objects it calls beautiful, but, in order to recognize objects that are natural purposes, it must borrow from reason the concept of this purpose aimed at by the finality, so that the production of such objects becomes intelligible.

The concept of a natural purpose, signifying a material objective finality, differs, however, from all the a priori concepts of the understanding as well as from the a priori principle of the reflective power of judgment, in that it finds its use, and even its genesis, in the mere fact that we *encounter* objects that are natural purposes. There might not be any—we might never encounter any. In that case, the teleological faculty of judgment would have no place. Unlike the synthetic principles of understanding, or the principle of the reflective faculty of judgment concerning the systematicity of nature in its empirical laws (analyzed in the Introduction of the *CJ*), teleological judgment does not precede the experience of nature, but unfolds *on the occasion of* encountering certain beings, as a framework within which this encounter can lead to something intelligible.[41] Clearly, we are generally justified in assuming a principle of purposiveness in nature, since, as we have seen, the reflective power of judgment posits it as a necessary presupposition for its reflection. However, teleological judgment, by assuming ends in the internal possibility of some objects in nature, constitutes a

purposiveness defined *by a relation internal to the object*—a relation between its possibility and its concept: the object must therefore lend itself to it, which only experience can reveal us.[42] We constitute the principle of teleological judgment a priori, but on the occasion of encounters with certain bodies of nature. As the *Critique of the Power of Judgment* states (§74), the concept of natural purpose is "empirically conditioned."[43]

Hence, one must define the criteria according to which the concept of natural purpose is actually applicable to objects of nature; in other words, one should answer the question: *how must objects of nature present themselves in order to be considered natural purposes?* (i.e., the task of §§ 64–66 in *CJ*). This is where the meaning of the concept of "organized being" (or "organism," see Introduction) will be elaborated, those beings whose internal structure, as we have seen, required a teleology to be taken into account. Before turning to this question, I will wrap up the concept of purposiveness now elaborated, as instantiating a new knot between contingency and necessity.

From a Kantian viewpoint we witnessed in the third *Critique* a complexification of the initial dual characterization of the purposiveness as system and technique: figures of purposiveness are diversified, including subjective purposiveness such as aesthetics and the systematicity of empirical laws, and material and formal objective purposiveness, which correspond respectively to plants/animals and mathematical devices. Technique and system are not completely opposed: for instance, *technique of nature* means the presupposition of a *system* of empirical laws in nature. Hence, purposiveness is divided into the various ways system and technique can be deployed. The fact that nature itself is not a *Ding an sich*, but is constituted in a transcendental manner, makes it possible to see the technique of nature as something not wholly opposed to a system of nature, since thinking of this technique does not mean assuming an objective divine understanding that creates things. This rapprochement comes from the fact that, even though contingency and necessity still define two cardinal dimensions of purposiveness, they are not anymore simply opposed as in 1763, when they meant technique versus system. Purposiveness, *Zweckmässigkeit*, cannot be mere necessity, since we saw that teleology is an additional principle with respect to the necessary laws of nature (stemming from the a priori synthetic principles of the understanding) (Chapter 6); it cannot be either pure contingency, since appealing to the divine technique of God as accounting for contingency, as both Leibniz and *The Only Possible Argument*. . . did, is now impossible, due to the findings of the Transcendental Dialectic.

Purposiveness has to do with the idea that we should presuppose at the roots of nature or of some things, and Kant formulates it clearly here: "By *absolute purposiveness* of the forms of nature, I mean their external configuration or their internal constitution, which are such that their possibility must be founded in our power of judging on an Idea of them." And, gesturing to the novel relations between contingency and necessity, he adds: "For purposiveness is a *lawfulness*

of the contingent as such" (*FI,* 217, my emphasis). This notion of lawfulness of the contingent as such, which now defines what purposiveness is, summarizes this novel configuration, and the rest of the chapter will spell this definition out.

8.3.4 Purpose and contingency: the "lawfulness of the contingent as such"

The fundamental link between purpose and contingency is present in the phrase quoted above: "purposiveness is a *lawfulness of the contingent as such*" (*FI,* 217).[44] This claim envelops something already established: the empirical laws of nature are contingent, and, to the very extent that they are contingent, the reflective power of judgment presupposes a logical systematics that organizes them, and thus a purposiveness of nature. Similarly, the "internal structure of animals and plants," mentioned as an example of natural purposes, is contingent with regard to the universal laws of nature, since it could be both different and still conform to these same laws (gravitation, action–reaction, repulsion, etc.); yet, there is a kind of lawfulness in it, since if the internal structure of an animal or plant were too different, it could not be *viable*. Contingent in the eyes of the understanding, the internal structure of animals and plants must therefore, *in the eyes of something else* (to be determined), not be contingent, since from the viewpoint of life itself it is not contingent. The possibility of these structures, as viable animal or plant structures, must therefore rest on a concept, because a concept is needed to account for this difference between two equally contingent types of structure (viable/non-viable). This is why Kant, in this sense, can speak of the concept of natural purpose as "the lawfulness of the contingent as such." Purposiveness comes into play wherever something non-contingent seems to arise within contingency itself: an ordering in a logical system, a beautiful form, an organ.

One measures here how the novel concept of purposiveness downplays the dimension of usefulness that was constitutive of the vernacular concept of purpose, and still underlying the physiological tradition of the Galenic "usefulness of body parts," the Hallerian anatomical deduction, and even Leibniz's notion of *maximes de convenance.* The argumentative role played by Kant's mathematical examples emerges here: it contributes to uncouple purpose from usefulness, something already undertaken in 1763 with the same example of a circle. In §64 of the CJ, another example allows us to make sense of the novel concept of purposiveness, while situating it in the respectable tradition of conceptions of design. Kant talks here about a regular hexagon traced on the sand, which a traveler notices: she immediately thinks that someone authored this geometric figure. Why? The regularity is not significant in terms of natural laws, which could just as easily have produced an irregular hexagon. Here, says Kant, the traveler should invoke a principle other than the laws of nature, namely a production according to a concept, in order to explain satisfactorily that this regularity and this arrangement were possible. I will gloss on this example to capture the subtle reasoning here.

Think of the six dimensions of a hexagon, $a_1 \ldots a_6$. All a_i can vary. Suppose now that a demon randomly picks out six values for the a_i. The chances that for any i, a_i takes the same value A are extremely low. Mathematically, the set of sextuples of a_i such that for whatever i, $a_i = A$ is of measure zero in classical measure theory (which underlies the measures in probability theory). Thus, not only with regard to the laws of nature, there is no reason why a hexagon here should be regular, but the chances that nature itself, building a hexagon from scratch (assuming nothing more than the mere laws of matter), creates a regular hexagon, are infinitely low.

Therefore, the regular hexagon is extremely improbable in terms of natural laws alone. So, in order to account for its existence, reason other than the laws of nature is needed, which is easy in this case because we can safely assume that some people might have walked this beach previously. This reason is that someone thought of the equality of the lengths of the sides of the hexagon, thus someone had in mind the concept of "regular hexagon."[45]

That figure appears as a "technical purpose," which, says Kant in the First Introduction, "concerns the simple possibility of things, and is *the lawfulness of an intrinsically contingent connection of the manifold* in this very object. We can take as an example the purposiveness that we think necessary to a hexagon in its possibility, since it is quite contingent that six equal lines in a plane intersect exactly in as many equal angles, for this lawful connection presupposes a concept, which, as a principle, makes it possible" (*FI,* VIII, p.228). Kant's example here belongs to a very long tradition of thinking about inference to an intelligent designer. In Latin, about the regular hexagon, he says *Vedi vestigiae homini*, "I see traces of someone." The natural theology, exemplified later by Reverend Paley—a major reference for Darwin—coined the sentence *Vedi Deo vestigiae*, "I see traces of God," by analogy. As I will explain in detail later, this analogy for Kant is blocked, because the teleology here does not talk about nature in itself; it is *regulative* and not *constitutive*. But one could also today question this example by alluding to the bees, who build hexagonal cells to store their honey. Why are these cells hexagonal? Actually, it is hard to think that the bees had in their "mind" the concept of a regular hexagon, yet hexagons are there. So, is Kant wrong here, since regular hexagons in nature could be there without anyone thinking of them?

The bees' hexagons stand indeed at the center of current philosophical discussions on scientific explanations. Biologists have asked why the storing cells have this regular hexagonal shape; the answer is that when accumulating cells, the hexagonal shape is the one that minimizes the wasted space, and therefore, maximizes the stored honey per unit of volume. This seems the best explanation, but should one grant bees the mathematical capacity of a master's student in maths? Of course not. Natural selection, at the scale of species, does the job: with respect to honey storage—which obviously contributes to survival and reproduction—the regular hexagon is the optimal shape, hence, after a long enough time, and

through the process of small variations (in the cell-building genetic program, to say it quickly) and natural selection (of the best storing shapes) bees reached this geometric figure, and the appropriate hexagonal-cell-building genes went to fixation in the population. The story is simplified, but this is how biologists explain regular hexagons in (bee-centered) nature. I will not enter into the question of the proper type of such explanation; a debate exists between philosophers who think that the mathematics here explain things (Pincock 2011; Batterman 2010), those who think that mathematics are just the background of a causal explanation (Craver and Povich 2017), and those who think that mathematics are accounting for the *explanandum* even though they do not constitute the whole explanation, since natural selection obviously plays here an explanatory role (Lange 2016; Huneman 2018) (even if I have a horse in this race).

But even though he philosophized outside of what is now science (which stands on an evolutionary or Darwinian ground), Kant still has a point here. The logic of purposiveness is, remember, that the concept of A plays a role in accounting for the possibility of the production of P. The explanatory story that we tell in our bee example, which involves a non-trivial mathematical property and then natural selection, is more complex than simply pointing to the concept in the mind of someone (here, the bee), but the explanatory logic sounds similar. The concept of a regular hexagon indeed plays an explanatory role in addition to the laws of physical nature here, since it accounts for why natural selection yielded this figure. And we also see provisionally that, with the Darwinian shift, Kant's idea of biological explanation may turn out to be expressible in terms of natural selection. In a word, what Kant sees as *a concept at the root of the possibility* of something becomes now *a reason for natural selection* to favor an allele/trait against the others.

Two points need to be emphasized in this overall analysis: on the one hand, the fact that the regular hexagon *differs* from all other hexagons in that its shape is based on a particular concept, that of the equality of the sides; on the other, *the improbability* that, among all hexagons, such a hexagon could be drawn without the initiative of a concept.

As a consequence, the notion of technique, which Kant initially sketched in *The Only Possible Argument*. . ., boils down to this hypothesized presence of a concept at the roots of the production. Then the synthesis of technique and system that the third *Critique* realizes relies exactly on this notion of a presupposition of a concept. When dealing with empirical concepts, the reflective power of judgment assumes an *overall* concept of nature as specification (it "specifies itself" so that our faculty of knowledge can grasp it); when dealing with the "internal structure of animals and plants" as well as the hexagon traced on the sand, it presupposes *particular* concepts that lie at the root of the production of the object. Technique means the production based on a concept; system now means the product of such a production grounded on a concept.

The hexagon case thereby presents the logic of the teleological judgment *generaliter*. I paraphrased it in a way so as to make another instance of teleology (bee hexagons) immediately intelligible, but *real* purposiveness proceeds precisely in the same way: the production of something which is made up of multiple parts whose reunion is contingent vis-à-vis the laws of nature, but which displays a remarkable outcome that relies on such a multiplicity, calls for a concept that accounts for the "common ground" of these parts, and provides a reason for their reunion:

> But now we find among the products of nature special and very widely distributed genera, which contain within themselves a combination of efficient causes that we must ground in the concept of a purpose, even if we wish to employ only experience, i.e., observation in accordance with a principle suitable to their inner possibility. If we wished to judge their form and its possibility merely in accordance with mechanical laws, in which the idea of the effect must not be taken as the ground of the possibility of their cause, but vice versa, then it would be impossible to obtain even one experiential concept of the specific form of these natural things which would put us in the position to move from their inner disposition as cause to the effect, since the parts of these machines, not insofar as each has a separate ground of its possibility but rather *only insofar as all together have a common ground*, are the cause of the effect that is visible in them.
>
> (*FI*, Ak. XX, p.235, my emphasis)

Only the presupposition of such a reason, as a common ground for the reunion of parts, allows us to explain the functioning of the system at stake. Kant gives the example of the vertebrate eye, exposed in the "First Introduction" and already considered in *The Only Possible Argument* (Chapter 3). Kant here takes his turn in the long tradition of admiration for the highly teleological performance of the animal eye:

> E.g., by saying that the crystalline lens in the eye has the purpose of reuniting, by means of a second refraction of the light rays, the rays emanating from one point at one point on the retina, one says only that the representation of an end in the causality of nature is conceived in the production of the eye because such an idea serves as a principle for guiding the investigation of the eye as far as the part that has been mentioned is concerned, with regard to the means that one can think up to promote such effect. No cause acting in accordance with the representation of purposes, i.e., no intentionally acting cause, is thereby attributed to nature, which would be a determining teleological judgment and, as such, transcendent, since it would suggest a causality that lies beyond the bounds of nature.
>
> (*FI*, Ak. XX, p.236). (B)

More precisely: in the eye coexist many distinct parts—retina, cones, rods, crystalline lens, cornea, etc. All of them follow their proper, distinct empirical laws, as Kant says, using the phrase "empirical laws" exactly in the sense the analyses of the systematicity of nature employed it in the Introduction of the CJ. If the parts were arranged differently, for instance, the retina slightly more to the left, then we would see nothing. To explain why all the parts are where and as they are, and, at their roots, the contrivance of the empirical laws that underlie the behavior of each part, one has to posit something: the notion of a seeing-machine, at the ground of the production of this organ. Otherwise, it seems that pure chance arranged all these elements in such a way; whereas if the concept of vision is the ground for the construction of the eye, this harmony between its laws becomes necessary.

Suppose now that we have a set of laws of nature, which, applied to material things, can define behavior, each law including some parameters (for instance, the gravitational constant G). And suppose that we randomly pick out values of these parameters, exactly as we picked out the length of the sides of the hexagon. The chances that we pick out exactly this combination of values that make the eye functional are the same as the chances of picking out the same length for each side. The eye is as improbable as the regular hexagon is. And what turns this improbability into something highly probable, and even into a necessity, is precisely the *concept* (here, of a seeing device). When the concept of a_i =A is given, we necessarily have a regular hexagon; when the concept of vision is given, then all parameter values are fixed, and we have an eye. In this latter case, the very low probability of the product in question becomes highly probable (when conditioned upon the relevant concept), and the contingency of its existence is reinterpreted as lawfulness since the requisites for vision determine the parameter values of each law and finally the laws themselves.

What appeared as contingent in nature becomes indeed law-like and cannot be otherwise once the concept of "vision" is given. The same purposiveness unites the example of the eye and the example of the regular hexagon: a concept is at the root of the production of the object, turns its contingency into necessity, and provides laws for its design. It is the reason why the contingent unity between the various parts of the eye, endowed with their respective empirical laws, exists. The difference between the examples lies in where the concept "lies," so to speak, namely, in the mind of presumed traveler on the beach, or within the explanatory project of the naturalist studying the eye. In the latter case, we have what Kant calls a "regulative principle." While in *The Only Possible Argument*. . . contingency and necessity defined two kinds of purposiveness, here we have one general concept, "lawfulness of the contingent as such", that summarizes the connection between necessity and contingency that defines "purposiveness."

8.3.5 Chance, purposiveness, and concepts

For this reason, Kant sees purposiveness as the "lawfulness of the contingent as such" (*FI*), and, at the same time, purposiveness (objective) means the

requirement of positing a concept at the root of the possibility of the object. What is *necessary* cannot be otherwise; it follows the laws of nature. Whatever X is *contingent* could be otherwise: X is contingent upon the antecedent state of the universe, in the sense that, had this state been different, X would be different. But some systems are such that in order to understand them one needs to consider that the contingency of their states (as contingent upon other antecedent states) can be bracketed in favor of a sort of necessity of their features, exactly as the appeal to the concept of a regular hexagon, which renders the equality of the sides necessary; or the concept of vision, which renders necessary the contrivance of all particular empirical laws relevant to the eye. The "concept" alluded to by such a teleological judgment is an instantiation of this necessity, a sort of rule for behavior proper to these kinds of systems.

Thus, the teleological judgment comprehends three correlated features: the emergence of a *necessity proper to* a system otherwise contingent; the *positing of a concept* that yields this necessity; and finally, the *extreme improbability* of the system from the viewpoint of the basic laws of nature, which turns into something highly probable when the concept at the root, hence its proper lawfulness, is posited. Those are the three dimensions unpacked from the definition of purposiveness.

This holds for biology: even if contingent with regard to the laws of physics, as contingent, living things have some lawfulness of their own when taken as living entities. For instance, it is merely physically contingent that the development of a chick embryo results in a chicken or a monster; yet from the viewpoint of a biologist, these two states are not at all on a par. We usually call this difference: viability versus teratology. *Viability is a norm*. While physics knows no norms—one could not say a trajectory is "abnormal," except to state that it was unpredicted—, biology does. For instance, besides the norms of development, any *function* in biology states a norm; "functioning versus malfunction" is normative: a kidney that does not eliminate toxins is abnormal even though (or rather, because) its function is to eliminate toxins.[46] Obviously, these norms constitute a "lawfulness of the contingent as such": they superimpose a regularity, a lawlikeness, upon states of affairs that are contingent. And the "concept" assumed in any teleological judgment instantiates such a norm, like "vision" does for the eye. Moreover, regarding the totality of living beings, the possibility of classifying, and therefore identifying new individuals by their species and genera, given the apparent mess of the distribution of species and the contingent distribution of individuals into species, requires a supervening necessity, namely the concept of systematization of this totality, which once again instantiates some lawfulness of the contingent as such. In this sense, teleology provides a *further principle* (*CJ*, §61, p.360) for the science of nature where intelligibility according to natural laws is lacking, i.e., where a natural disposition proves to be contingent in relation to them while at the same time indicating for us a non-contingency in relation to something else that is, it is only thinkable (for us) according to a certain lawfulness.

Norms of nature correspond to this lawfulness theorized by Kant; things may fail to fulfill norms, yet they are judged in relation to the norm. "This newborn chick is a monster"; "this kidney does not eliminate toxins as it ought to." What is lawful in the contingent states of affairs—a viable development, a functional item—fulfills a norm. As a consequence, normativity can have two statuses, exactly the ones distinguished by Kant as constitutive and regulative. The constitutive principles state what nature must be (i.e., instantiating the Analogies of Experience, etc.); the regulative principles state what natural systems should be, to the extent that they are the kinds of systems we recognize in nature: embryogenetic developments, organs with functions. And then, some individuals of a given kind do not feature what they should instantiate: this possibility staying always open is exactly what is meant by "regulative and not constitutive principles."

The dimension of normativity introduces something peculiar to biological systems, and more precisely, organisms, namely the fact that one can here talk about *reasons*. The adult chick, which defines the norm for development, in the sense that it is presupposed by the embryologist as a standard for judging steps in the embryogenesis is also the reason why the development goes through these stages. Similarly, the function of eliminating toxins, which is the norm according to which the mechanisms of the kidney can be judged, is also the reason why the kidney produces such and such actions.

To sum up, the phrase "lawfulness of the contingent as such," indicates a dimension of intelligibility that is not what "laws" mean but that resembles laws because it is about what things should be and do, namely, modal constraints. Things may fail to match the norm, hence there is no absolute necessity, which means there is contingency; yet something still stands as a standard for judging about natural things, and it is what we call normativity. To this extent, lawfulness happens as *normativity*. And, in this domain, norms can also be seen as *reasons* why things happen (sometimes, but not all the time). This leads us to the distinction made by Kant between living systems and humans: the latter can *represent* the reason for their actions (this is exactly what the notion of "maxim" means); while for the former, such reason is not re-presented, it is present, intrinsic to an animal. Once norms can be *re*presented, the epistemology changes since the norms are no longer in the eye of the modeler, but they exist in the object itself (e.g., a farmer vs. a gorilla). Yet this does not reform the logic of explanation: in both cases, something is a reason why things happen in such and such a way, even though they could have happened differently while this reason still obtained.

8.3.6 Reflective necessity

Lawfulness of the contingent makes the contingent somehow less contingent and therefore, more necessary. How? This new kind of necessity is expressed by Kant, about the eye, as an adherence of the purpose to the structure, as exposed in the continuation of the above-quoted text (B) from the *First Introduction*:

> We have the immediate experience that the eye enables us to see, as well as of its internal and external structure, structures which imply the conditions of its possible use, and consequently causality according to mechanical laws. But I can also use a stone to break something, to build something, etc., and these effects can also be related as ends to their causes, without my being able to say that this stone must (*sollen*) have been used for construction. It is from the eye alone that I judge that it *must* have been suitable for vision, and, although the form, the constitution of all its parts and their arrangement, appraised according to the simple mechanical laws of nature, are entirely contingent for my faculty of judgment, I nonetheless think it necessary in its form and organization that it should have been formed in a certain way, namely according to a concept that precedes the formative causes of this organ, a concept without which the possibility of this natural production is not intelligible to me according to any mechanical law of nature (which is not the case for the stone).
>
> (*FI*, Ak. XX, p.241)

The difference between the eye and the stone here lies at first sight *in the adherence of the end to the means* in the case of the eye, compared to the equivocity of the relations of finality into which the stone can enter. The eye is ascribed only *one function*—to see—so that the eye must be made to see; or rather, we cannot think of it otherwise without breaking the adherence of the purpose to the object, of vision to the eye, unlike the case of the stone, which is susceptible to multiple ends. In this sense, the simple laws of nature, known as mechanical laws, are not the only explanation at work in the case of the eye. While they explain its formation, they must nevertheless have been preceded by a concept, that of "seeing" or "vision," for the eye to be possible, that is, more precisely, for us to be able to account for the difference between a stone, available for multiple ends, and an eye, which is adherent to its own purpose.[47]

Thus, there are two kinds of necessity, the one of mechanical laws, and this necessity that I will call reflective. Moreover, reflective necessity has several aspects. Indeed, if we consider the functioning of the eye, vision is the *norm* of its functioning: it ought to see, even though it may always fail to see. If we consider its genesis, vision is the *goal* of the process by which the eye is built, while in general the embryogenesis of the organism aims at an adult type that realizes all the functions of its organs and therefore sets the norms for organic functioning. These are correlated forms of reflective necessity in the biological domain. All this confirms the distance Kant has now taken from the "Appendix to the Transcendental Dialectic," where, far from being a "further principle" for knowledge when it stumbled, purposiveness was a legislation of reason regarding the general principles of knowledge. For the purposiveness of nature to constitute itself as a "further principle," it must have been recognized as a principle of the power of reflective judgment.

Regarding taste, *psychology* studies the causes which, according to a given history, character, etc., and the laws of human nature, lead or have led a given subject to consider a given landscape or work of art beautiful. But *aesthetics* indicates the rules according to which we *ought to* judge this landscape or this object. When we judge it differently, psychology can account for the discrepancy by invoking the way in which the pleasurable, i.e., the inclinations and sensuous pleasure relating to the subject's personal constitution, have subverted aesthetic judgment. But beauty itself, insofar as it pertains to the aesthetic reflective faculty of judgment, is different both from the sensation of the agreeable and from any supposedly determinate concept of the beautiful—this is the well-known Kantian key claim in his aesthetics.[48] Beauty does not depend in any way on psychological considerations, since it refers to the principle of the reflective power of judgment, that is, purposiveness in natural forms understood as their suitability with regard to the structure of our faculties of knowledge. Such suitability is indicated in the feeling of pleasure resulting from the agreement that arises from the free play of the imagination and the understanding, on the occasion of the perception of the object judged beautiful.

Some authors interested in aesthetics look for a principle of explanation of what happens, which would be of the order of either the "general science of nature" (indicated in the Transcendental Analytic and *Metaphysical Foundations of Natural Science*) and empirical mechanics, or of psychology, all of whose principles are empirical, except the law of continuity of psychic phenomena, which derives from the very form of internal sense (namely, time) (*FI,* X, Ak. XX, p.237). Kant opposes to them aesthetic judgments themselves, insofar as they contain such a *sollen,* an ought-to. Thus, the psychological or physical "explanation" would say why we sometimes judge in this way and not otherwise, and would sketch out with great difficulty a natural history of taste, but would be unable to say what the a priori principle of taste is, i.e., how we should judge aesthetically, in other words, it could not elucidate the concept of the beautiful. Quite simply, because this is not an inquiry into the facts of nature, but an investigation into the content of a specific *norm*, and a transcendental identification of the faculty of knowledge to which it belongs.[49] The content of the judgment of pure taste, which belongs to the faculty of aesthetic judgment, therefore has a normative value in itself: since aesthetics says how a judgment should be in order to be an aesthetic judgment, the aesthetic judgment itself says at the same time that everyone *ought to* judge in this way, and this normative dimension eludes psychological explanation; it intantiates another form of the reflective necessity.[50]

This consideration of aesthetic judgments motivates a parallel with teleological judgments, insofar as they also encompass a dimension of *sollen,* hence are governed by a *norm*: "a teleological judgment compares the concept of a natural production according to what it is with what it ought to be" (*FI,* Ak. XX, p.240). In this sense, as this "ought" is not understood in experience (which only teaches what is), we must, once again, resort to an a priori principle, that of the reflective

power of judgment (*FI,* Ak. XX, p.240). Clearly, the judgment here is normative since what ought to be is a norm for what is; and, by definition of "ought," what ought to be could be absent, and we would then talk about abnormality. But above all (and here the parallel with aesthetics comes into play), the universal laws of nature by which *we explain* natural objects cannot tell us what natural objects *ought to be*, and in what way they can obey such an "ought."[51]

Teleology thus stands in the same position vis-à-vis *mechanics*—the explanation of objects as they are—as aesthetics (i.e., the study of how we should judge beauty) stands vis-à-vis psychology (i.e., the study of how we judge beauty). Teleological judgment thus attributes a certain ought-to to its objects. This ought "implies a necessity that is clearly distinct from the physical-mechanical necessity according to which a thing is possible according to the simple laws of efficient causes (without a prior idea of that thing), and it can *no more be determined by merely physical (empirical) laws than the necessity of aesthetic judgment can be determined by physiological laws*" (*FI*, Ak. XX, p.241, my emphasis). What is at stake with the teleological judgment, then, is a *new, reflective necessity*, irreducible to the necessity defined in the *Critique of Pure Reason* on the basis of the requisites of possible experience and the addition of the concept of matter in the *Metaphysical Foundations of Natural Science*. The question of the lawfulness of the contingent as such, raised by purposiveness understood as a principle uncovered by reflection, leads to a duplication of the concept of necessity.

As a reflective act, teleology indeed finds itself between two types of statements: determining statements, which provide knowledge of natural objects as the result of a blind mechanism, and transcendent statements, which relate the object to an intention. The latter kind goes far beyond what the reflective power of judgment allows us to do, since such judgment does not determine the object and therefore does not posit any actual intention at its origin (only practical reason can indeed do that). Thus, the fact that the concept of finality belongs to the reflective power of judgment implies a *separation between the idea of purposiveness* (its proper autonomous principle) *and the idea of intention*. This is what makes teleology and aesthetics possible: otherwise, they would simply be theologies, i.e., discourses on nature as the work of God. Why is this?

As the power of judging that attributes finality is not determining, since purposiveness is the principle of the *reflective* power of judging, it does not posit the purpose within the objects themselves, so the object need not be specified as the intention of a will.[52] In the *Critique of the* Aesthetic *Power of Judgment*, this allows Kant to apprehend beauty as a "purposeless" purposiveness. As Lebrun said, "At the origin of the *Critique of Judgment* there is the desire to preserve the benefit of the notion of purposiveness while warding off the finalism of the metaphysicians and its classical form: intentional or technical finality" (Lebrun 1970, p.295). To posit a creative intention would be to go beyond the reflective, that is, the merely regulative use of the principle of the reflective

faculty of judgment, insofar as it concerns only the form of our knowledge of the object and not the object itself (*CJ*, p.361).

Purposiveness simply expresses a certain relation of the given to the power of judging, and says nothing about the object; *intention*, on the other hand, is a concept that concerns the production of the object itself, and in this sense is an objective concept proper to the determining judgment,[53] but which refers to a transcendent object. Thus, the technique of nature differs from art, where we experience the work of an intentional finality, i.e., we have "experience of the causality of our own power" (*FI,* Ak. XX, p.234). But the purposive causation of nature is not known by experience; it is presupposed by reflection, and in this sense, we cannot detect any productive intention in it, since such an intention, correlative to our experience of art, is given in experience and not known or posited a priori. The triplet "reflecting—regulating—technical" is now opposed to the triplet "determining—constitutive—intentional," in the sense that each of these terms maintains the same relationship with its correspondent as the other two.

Necessary order and contingent order, the cardinal categories of *The Only Possible Argument*. . ., are thus redistributed. The dimension of natural *technique* reappears in the concept of purposiveness, and thus the horizon of the problem of order is no longer the reabsorption of contingency into necessity (as in the first *Critique*), but the *status of contingency* insofar as it might give rise to an order pertaining to an autonomous faculty of knowledge, i.e., a lawfulness proper to contingency. In other words, what is at stake is the correlation *between contingency itself and the organization of our powers of knowing*.

8.4 Conclusion: organisms, systems of nature, and purposiveness

To conclude, let me summarize the parallel between *teleology*, as it has just appeared, namely *objective material purposiveness*, and the problem of the reflective faculty of judgment posed from the outset by the *Critique of the Power of Judgment*, that of the *unity of the empirical laws of nature*. *The Only Possible Argument*. . . already unified the two, as we remember, because the set of laws that are instantiated by a living being was a contingent unity. But here, since the categories of order used in 1763 have been displaced, the unity of the two problems can be read differently.

First of all, unlike aesthetic judgments, teleological judgments and simple reflections on nature involved in creating empirical concepts share the character of being "logical" rather than "aesthetic" reflective judgments, i.e., of contributing to the meaning of the objects rather than merely qualifying the subject's relationship to the object.

Second, in both cases, we are dealing with *contingency*: contingency in relation to the laws of nature, either insofar as they do not guarantee the unity of empirical laws, or insofar as they in no way guarantee the teleological performances

manifested by natural purposes. In both cases, then, the problem is *the lawfulness of contingency insofar as it affects the object itself*. However, in the case of the problem of species and genera, lawfulness should be presupposed, since without such a presupposition, reflection is simply impossible; whereas in the case of teleology, lawfulness is a given: as we have seen, some objects manifest in themselves such features that it is impossible to think of them without the concept of natural purpose. They might not exist, but this would not change the possibility of reflection as such.

More generally, however, the philosophical problem here is *the derivation of the particular from the universal.* This, as we have seen, was the question raised in the Introduction to *Critique of the Power of Judgment*, which led us to elucidate the presupposition of the reflective faculty of judgment regarding the purposiveness of nature: *particular* laws, empirically discovered, being contingent in relation to the *universal* laws of nature stated a priori by the Transcendental Analytic and the *Metaphysical Foundations of Natural Science*, cannot be derived from them. Likewise, the beings we need to think of as natural purposes are *particular* beings (the internal structure of plants and animals, for example). Their problem is that we need one more "principle" to move from the universality of nature to the particular ontological region they constitute.

Kant expresses the relationship between the *universal* laws of nature and the teleological principle that must be employed for the knowledge of *particular* beings that are "natural purposes" as follows:

> In fact, (those who dissect plants and animals) can no more renounce (the) teleological principle than they can renounce the universal principle of physics, for, just as by the abandonment of the latter there would be no *experience* left *in general*, so the abandonment of the former principle would leave no thread for the observation of a *species of natural things*, which we have already thought of teleologically under the concept of natural purposes.
>
> (*CJ*, §66, p.376, my emphasis)

Note the contrast between *experience in general,* i.e., the form of a nature, on the one hand, and a *species of natural things* on the other. There is a discrepancy between the generality of nature and a particular species of things, without which the same principles would allow knowledge to pass seamlessly from one to the other. In other words, the problem of a critique of the power of judging, as a problem underlying both the question of the unity of empirical laws (and hence of the existence of genera and species) and the teleology inherent in beings that are natural purposes, *this problem is that of the passage from the general to the particular*.

Recall that the judgment can be *simply reflective*, because sometimes we have to find the rule for the case, so the rule is not given with the case. The first *Critique* could identify the status of the overall set of universal rules by

reinterpreting the a priori as transcendental, i.e., as a condition of possible experience. In this context, acknowledging the fact of merely reflective judgment means that this set does not *by itself* produce its particularizations, namely its species. Such a discrepancy is then instantiated in the two problems of the unity of empirical laws and of teleology, and constitutes their common root.

But we can now see the difference between these analyses and the *Critique of Pure Reason* and especially its claims on the system of reason. There, Kant noted in the "Canon of Pure Reason":

> Even if the existence of a supreme intelligence were proved, we could doubtless thereby make conceivable purposiveness in the arrangement and order of the world in general, but we would not be at all authorized to derive from it a particular arrangement and order, or, where they are not perceived, to conclude them boldly, insofar as it is a necessary rule of the speculative use of reason not to leave out natural causes, and not to abandon what we can learn from experience in order to derive something, which we do know, from something entirely beyond all our knowledge.
>
> (A799/B827)

So, if there are particular orders in nature, the doctrine of purposiveness elaborated in the "Appendix to the Transcendental Dialectic" cannot account for them. The transition to particular orders—and primarily that of life, addressed in the essays on races—clearly remains a requirement left unfulfilled by the *Critique of Pure Reason.*

While the first problem addressed in the third *Critique* (Introduction), that of the systematization of empirical laws, refers to the possibility of a natural history, the second, that of teleology, refers to physiology and embryology, where teleology is used. From the first Introduction to the third *Critique* to the "Critique of the teleological power of judgment," the reference is no longer to Linnaeus but to authors such as Haller, Blumenbach, and Wolff.

But remember that this philosophical inquiry into the science of life is only possible on one condition: the revival and diversification of the concept of purposiveness, as I have outlined it, which developed the questioning of teleology in Kant's 1763 essay. Let me recall that this questioning stems both from the inadequacy of the general doctrine of purposiveness in the "Appendix to the Transcendental Dialectic" with respect to the organic theme (Chapter 5), and the correlative need to take up the technical theme again, as well as from the persistence of the motif of the contingency of the particular with respect to the general.[54] These questions, intrinsic to Kantianism, are crystallized by life, a phenomenon of our common experience and, at the same time, the object of an inchoate science whose principal schemes began to take shape precisely when Kant addressed these problems.

Notes

1 For extended discussions of the two notions of freedom and nature and their relation in this context, see Guyer (1979), Zuckert (2007), Lebrun (1970).
2 Several commentators addressed the question of the difference between systematicity in the Appendix of the CPR and systematicity in the Introduction to the CJ. While it is a key element of Lebrun's interpretation of the CJ, Zuckert (2007) addresses this in a similar manner (pp.43–49).
3 "Certainly, the understanding is a priori in possession of the universal laws of nature, without which it could not even be the object of experience; but in addition it also needs a certain order of nature, in the particular laws of the latter, which can only be known to it empirically, and which are contingent in relation to it. These rules, without which there can be no progress from the universal analogy of possible experience to the particular analogies, we must think of as laws (i.e., as necessary); if it were otherwise they could not constitute any natural order (*Naturordnung*), although the understanding cannot know their necessity, or even ever penetrate it" (*CJ,* XXXIV, p.184).
4 In Goodmanian terms, this is about *projecting* predicates from one instance of something to similar ones.
5 Admittedly, Aristotle's project is not the taxonomic one of classical natural history (Pellegrin 1982, chapter 1); nonetheless, the use of analogy as a tool for gathering animal forms can play a relatively similar role—at least according to the Kantian perspective of the unity of empirical laws proposed in the third *Critique*—despite the profound difference in the concepts of "genus" and "species" according to Aristotle and natural history. Kant was unaware of the particular destinies of analogy, from Cuvier's renewal of comparative anatomy to Owen's subtle construction of homologies and analogies as identity of structure or of function—and finally to the Darwinian use of them (identity through descent or identity due to identical selective pressures, see *Origin*, chapter 6). This is why I refer here to Aristotle, whose *History of Animals* was commonplace for the naturalist of the time, and whose conception of analogy is probably not as far removed from Linnaeus's use, an explicit Kantian reference in the field, as later elaborations of comparative anatomy. In any case, the method of definition by genus-species is at the heart of Aristotelian natural history, and Linnaeus's natural history became paradigmatic of such dual definitions.
6 See also *CJ*, XXXVI, p.185.
7 In a way, this is where Kant takes up what after Hume one called the problem of induction. It has been little noticed that the Humean question was in a way divided in two issues by Kant: the problem of causal lawfulness in the first *Critique*, the problem of generalized empirical concepts in the third. The link between induction and the possibility of classification (rather than inference) constitutes something original in this latter text. Schrader (1953) rightly concludes that, by posing the problem in the third *Critique* and resolving it, as we shall see, by the principle of reflective judgment, i.e., a judgment to which no rules pre-exist, he shows that induction is indeed rational, but of a rationality unlike the one of deductions: "Induction is therefore an entirely rational procedure despite its lack of formulas" (p.221).

Recently, Guyer (2018) directly acknowledges the similarity between Hume's riddle of induction and Kant's problem of systematicity of laws. Yet he argues that while Hume's worry is "academic," since we can still place confidence in our empirical knowledge, Kant's notion of systematicity of laws, either in the first *Critique* or in the introduction to the third, is more substantial, because the homogeneity of laws prescribed by their systematicity is never empirically certain: " It is in this way that

Kant does not refute Hume's academic worry about induction, but rather replaces it with a substantive theory of the imperfection of our knowledge of natural law" (p.67).

8 "Although it can decide nothing a priori about objects, the understanding must, in order to investigate these so-called empirical laws, lay at the foundation of all reflection on nature an a priori principle, namely that an order of nature is possible according to these laws, which principle is expressed in the following statements: there is in nature a subordination of genera and species that we can grasp; these in turn approximate to one another according to a common principle, so that a passage from one to another and thereby to a higher genus is possible; it seems at first inevitable for our understanding to admit as many different species of causality as there are specifically different effects in nature, but they can nevertheless be arranged under a small number of principles whose search we have undertaken" (*CJ*, XXXV, p.185).

9 Uniformitarianism, as canonically formulated in geology by Lyell, has four meanings: uniformity of laws in space and time, uniformity of operative processes, uniformity of the rate of change, uniformity of the physical state of the earth (Gould 1987, pp.125ff).

10 For a more detailed recent treatment of the Kantian account of laws, see Massimi and Breitenbach (2017) and Watkins (2019). I consider this issue only in relation to my own question about organisms, teleology, and contingency.

11 Lebrun (1970) developed this point: "I live in a world where *there is meaning* before there are 'objects'—where, consequently, even the artificial concepts of classification possess a "presumptive objectivity" (Lévi-Strauss). Starting from the observation that the principle of the possibility of experience does not fully fulfill the office of the pre-critical God, since it does not legitimize the order observed in empirical laws, Kant comes to the conviction that this principle is not the only transcendental principle, and that the analysis of meaning goes beyond that of knowledge. This is why the problem of classification becomes essential. The moment the transcendental philosopher realizes that his question is far from limited to the fact of objectivity, that he spontaneously addresses qualitative, pre-scientific, inexact thought—the "*Gedankenspiel*," not knowledge. *The interest taken in nomenclature prefigures the interest that will shortly be taken in language and myth; it indicates the substitution of the question "How can we know?" by the question "How can we think? "* " (p.272, my emphasis). In this way, transcendental investigation reveals itself as grouping together two "pathways," that of "the formal legislation of nature in general" and that of "the genesis of concepts and the search for rules" (p.278).

Schrader pointed out that while in the first *Critique* the categories become objective through the schematization that relates them to space and time, they are not yet "made applicable to the concrete empirical manifold," this last stage to be elucidated by the third *Critique* (1953, p.210). There is "a necessary material ingredient in experience" that is no less essential than "the formal component" dealt with in the Transcendental Analytic (p.216); the latter will finally have outlined "the necessary but not the sufficient conditions of the possibility of experience" (p.210). In the *Critique of the Power of Judgment*, teleology will then be "the transcendental principle that informs judgment in its original synthesis of sensible manifold" (p.218).

12 *Logic*. Doctrine of the Elements, ch.1, §5.

13 "The peculiarity of aesthetic and teleological judgments is therefore, not, that they are reflective judgments (every judgment about an empirical object is a reflective judgment); but that they are *simply* reflective judgments, judgments in which reflection never achieves conceptual *determination*" (Longuenesse 1995, p.210).

14 Longuenesse further notes: "The *reflective* character of judgment is not incompatible with its *determining* character: *reflection* according to the logical forms of judgment

is, on the contrary, an indispensable moment in the thought process that leads to the *determination of* a phenomenon by a category" (1995, p.213).

15 That is, on the side of the principles of pure understanding that make experience in general possible by establishing a priori the form of a nature.

16 On the concordances of hypothetical reasoning in the "Appendix to the Transcendental Dialectic" and the reflective faculty of judgment according to the third *Critique*, see also McLaughlin (1990).

17 In the Amphibology of the *Critique of Pure Reason*, Kant noted that reflection is the state of mind in which we prepare to find the subjective conditions for arriving at the concept of the object. The reflective reasoning according to his *Logic* keeps this character.

18 Friedman here challenges Buchdahl's interpretation (Buchdahl 1965), which holds that the rule according to which every event must succeed another in the Second Analogy is not a universal rule, but a case-specific empirical rule, which therefore cannot be given as a transcendental principle by the understanding.

19 "The power of judging possesses in itself as well, but only from a subjective point of view, an a priori principle of the possibility of nature, thanks to which it prescribes a law for reflection on nature, not to nature (as autonomy) but to itself (as heautonomy)," (*CJ*, XXXVII, p.185). Autonomy belongs only to the understanding, because in giving itself its law it gives it to nature: this is not the case with the faculty of judging; see Floyd (1998) on heautonomy. Allison (2003) sees heautonomy as the proper principle of the power of judgment. See also Teufel (2011, pp.117–118).

20 Cassirer (1938, p.154) distinguishes three meanings of "subjective" in Kant, depending on whether a judgment concerns the subject, has a character of universality, is based on a determined a priori principle, or not (such as aesthetic judgment).

21 *CJ,* Intro §V XXXI, p.182; XXXV, p.185.

22 For a pure Kantian, the core of the *Critique of the power of judgment* is the aesthetic faculty of judging, for it contains the a priori principle of the faculty of judging, that of the "formal purposiveness of nature according to its particular empirical laws for our faculty of knowing" (*CJ*, p.193). The "First Introduction" is very clear on how the discovery of the a priori principle proper to the reflective power of judging, due to the consideration of aesthetic judgment, leads to a critique of teleological judgment, insofar as it too is reflective: "It is thus properly only in taste, and even in relation to the objects of nature, that the faculty of judging manifests itself as a power with its own principle, and thereby raises a well-founded claim to take its place in the critique of the higher powers of knowing, a claim that could have been contested. But *once the faculty of judging has been granted the power to give itself a priori principles*, its extension must still be determined and this completion of the critique requires us to recognize that its aesthetic power is, together with its teleological power, involved in the same power and rests on the same principle, for teleological judgment about the things of nature belongs, like aesthetic judgment, to the reflective (and not determining) power of judgment" (*FI*, XI, Ak. XX, p.244, my emphasis). Kant specifies here that we are talking about taste applied to nature, unlike works of art, which require a less immediately pure judgment of taste, since they include a reference to the project of the work, hence ultimately to a concept. See Guillermit (1986, p.11) and Cassirer (1938, pp.163–165, who points out, however, that the teleological judgment is more in need of criticism, insofar as it is more prone to believing itself to be objective).

23 In a remarkable paper, Daniel Dumouchel has shown how the concept of merely reflective judgment was formed during the elaboration of the *Critique* of the Aesthetic Faculty of Judgment, which, as the 1785 letter to Reinhold points out, was initially intended to be a "critique of taste." During the composition of the Critique of the

Aesthetic Power of Judgment, Kant moves from a "pre-critical conception" of taste (analogous to a power of judgment) to a "critical conception" in which it is the result of a particular activity of the faculty of judgment (Dumouchel 1994, p.426). The whole demonstration is part of the more general work (Dumouchel 1999). Then, "it is in what we should call the formal deduction of judgments of taste (§31–38) that the sudden valorization of the notion of *power of judging in general* occurs, which appears as the key to this deduction (. . .) (it) appears in retrospect as the architect of this process of harmonization of the representative faculties, which defines the nature of aesthetic feeling" (p.431).

24 "It is true that pure understanding already teaches us (albeit by means of synthetic principles) to think of all things in nature as contained in a transcendental *system according to a priori concepts* (categories); but the (reflective) faculty of judgement, which also seeks concepts for empirical representations as such, must further admit for this purpose that nature, in its unlimited multiplicity, has arrived at a division of this same system into genera and species, such that it enables our faculty of judgement to find unison in the comparison of the forms of nature and to reach empirical concepts and their hierarchical organization, by ascending to more general concepts that are also empirical; which is to say that the faculty of judging presupposes a *system of nature also according to its empirical laws* (my emphasis) and this, a priori, thanks to a transcendental principle" (*FI*, V, Ak. XX, p.212).

25 "It is clear that the reflective power of judging could not undertake, in accordance with its nature, to classify the whole of nature according to its empirical diversities, unless we suppose that nature itself *specifies* its transcendental laws according to some principle. Now this principle can only be that of *fitness to the power possessed by the faculty of judging* itself to find in the immense manifoldness of things according to possible empirical laws a sufficient affinity between them so that we can arrange them under empirical concepts (classes) and then these under more general laws (higher genera) and in this way arrive at an empirical system of nature" (*FI*, Ak. XX, p.215, my emphasis).

26 For an interpretation of systematicity as a substitute for the inadequacy of analogies in establishing science, see Guyer (1990). Notice that some interpretations of the "First introduction," as Guyer's, focus on the systematicity of nature; others, such as Ginsborg (2018), begin with the presupposition of purposiveness, from which systematicity derives. Given that since the origin (i.e., the OPA) Kant's notions of purposiveness tie the purposiveness and systematicity, I think that the strict correlation of these two notions, and the impossibility of establishing a logical order between them, is constitutive of Kant's account.

27 Schrader strongly emphasizes this point: "The kind of teleology that Kant has in mind is presented more in the harmonious unity of diverse contents in a work of art, than in the conceptual means-ends adaptation (. . .) such a unity is unanalyzable, not because it is *simple* but because it is non-conceptual." He then draws the consequences for the fundamental role of aesthetics in criticism: "Experience as an intelligibly ordered system is impossible outside the principle of aesthetic unity" (1953, p.220).

28 Looking at Kant's early reflections on taste and common sense from an anthropological point of view, Guillermit (1986, p.41) observes that the thoughts that bring judgment of taste and understanding together in this way, contrasting them with the "abstract process of knowledge," depend in retrospect on the difference between technique and mechanics that would later emerge.

29 "When it comes to reducing given intuitions to empirical concepts of natural things, the reflective power of judgment does not proceed according to the method of schematism, but in a technical way; it does not proceed, as it were, in a merely mechanical

way, in the manner of an instrument, under the guidance of the understanding and the senses, but in the manner of *art*; it is governed by the universal, but at the same time indeterminate, principle of a purposive disposition of nature as a system, so to speak for the benefit of our power of judgment, in the fitness of its particular laws (of which the understanding says nothing) to the possibility of experience as a system" (*FI* §V, Ak. XX, p.213).

30 To this extent, H. Cassirer states: "Strictly speaking, it is not nature that is technical, but the power of judging itself" (1938, p.138). An analogous configuration can be found in this third *Critique* for the concept of the sublime, which concerns, above all, the state of the soul in the presence of the so-called sublime nature.

31 "I would call the causality of nature, from the point of view of the form of its products as ends, the *technique* of nature. It is opposed to the mechanics of nature, which consists in its causality through the connection it makes of the diverse, without a concept that grounds the unification to which it proceeds, much as we would call machines, but not works of art, certain elevators whose effect can be ordered to an end, without this purpose even being founded on an Idea, for example a maneuvering lever or an inclined plane, for they can be used with regard to ends, but it is not only with regard to these purposes that they are possible" (*FI*, VII, Ak. XX, p.219).

32 "In these conditions, it is not the forms themselves that are thought of as final, it is only their relation to each other, and the suitability, in their great manifoldness, to a logical system of empirical concepts" (*FI,* Ak. XX, p.216).

33 On the multiple meanings of the concept of finality in the third *Critique,* Tonnelli (1959) constitutes an exhaustive study. Marc-Wogau (1938) offers us a table of the meanings of finality in Kant. More recently, Zuckert (2007, chapter 2) and Ginsborg (2015) renewed our understanding of this variety of meanings, searching for their intrinsic unity. I deal with these differences here only in the context of my topic.

34 "We can look at the *beauty of nature* as the *presentation of* the concept of formal (merely subjective) purposiveness and at *natural purposes* as the presentation of the concept of real (objective) finality, and we judge the former by taste (aesthetically, thanks to the feeling of pleasure), the latter by the understanding and reason (logically, according to concepts)" (*CJ*, L, p.193). Hence a division of *Critique of the power of judgement* analogous to that which runs through the first *Critique*: "So the *Aesthetics* of the reflective faculty of judging will occupy one part of the critique of this power, just as the Logic of this same power constitutes, under the name of *teleology*, the other part. But in both cases, nature itself is considered as technical, i.e., as purposive in its products, in the first case subjectively, from the point of view of the subject's simple mode of representation, in the second case as objectively final with regard to the possibility of the object itself" (*FI*, XII, Ak. XX, p.249).

35 "It is thus that we see earths, stones, minerals and other similar things devoid of any final form, yet showing in their intrinsic characters and in the principles of knowledge of their possibility such an affinity that, under empirical laws, they lend themselves to a classification of things into a system of nature, without yet revealing *in themselves* any form of system" (*FI,* Ak. XX, p.216). The specificity of the living, learnt from Stahl and Leibniz, in relation to the inorganic is clearly apparent here.

36 "By the *formal* technique of nature, I mean its finality in intuition; by the *real* technique, its finality according to concepts. The former provides the faculty with final figures (*Gestalten)*, i.e., the form that the imagination and the understanding spontaneously and harmoniously collaborate to represent in order to make a concept possible. The second signifies the concept of things as natural purposes, i.e., as such that their internal possibility presupposes a purpose, consequently a concept which, as a condition, is at the foundation of the causality of their production" (*FI* §IX, p.232).

37 "Purposiveness here is manifestly objective and intellectual, and not merely subjective and aesthetic. It expresses the conformity of the figure to the production of several intended figures, and is known by reason" (*CJ*, §62, p.362).
38 "Purpose does not make the concept of the object itself possible, i.e., it is not considered possible only because of this use" (*CJ*, §62, p.363).
39 "But this intellectual finality, although objective (and not, like aesthetic finality, subjective), can be conceived, albeit in general, as merely formal (not real), i.e., as a purposiveness without a purpose residing at its foundation, for which a teleology would be necessary" (*CJ*, §62, p.364).
40 Note that the distinction between the formal and the material was already made within aesthetic finality, where "the aesthetic judgment of the senses involves a material finality, that of reflection a formal finality" (*FI* §VIII, p.224). The aesthetic judgment of the senses then corresponds to the pleasurable: the feeling of pleasure and displeasure is immediately affected by the object. The Kantian distinction between the matter of intuition (sensation) and the form of intuition justifies the application of the distinction here, since in the aesthetic judgment of reflection it is sensibility in its ability to provoke a priori agreement between imagination and understanding that is concerned by the judgment—i.e., sensibility in its form and not in its matter.
41 "Even though the principle of the power of judging the finality of nature in the specification of its general laws does not extend far enough for us to conclude from it the production of forms of nature *that are purposive in themselves* (since even without them the system of nature according to empirical laws is possible, a system that only the power of judging was postulated to found), and that it is only through experience that these forms must be given,—it is nonetheless always possible and permissible, from the moment we are justified in supposing a principle of finality in nature, to relate them, *if experience shows us purposive forms in its productions*, to the same foundation as that on which the former (the purposiveness of nature in general) can rest" (*FI,* Ak. XX, p.218, my emphasis).
42 "But that things in nature reciprocally serve as means to ends, and that their very possibility is sufficiently intelligible only through this kind of causality, is something for which we have no reason in the general idea of nature as a logical set of sense objects. In the previous case [aesthetics], the representation of things could also be thought of a priori, because it is in us, as suitable and useful to the inner agreement of our power to know; but how purposes, which are not ours, and which do not belong to nature either (which we do not consider as an intelligent being) can or must constitute a particular species of causality, or at least a very particular lawfulness of it, this is what we *cannot presume a priori with any foundation*" (*CJ,* §61, p.359, my emphasis). Remember that "the general idea of nature as a logical set of sense objects" rests, as we have seen, on the transcendental presupposition of the reflective power of judgment.
43 "The concept of a thing as a natural purpose is certainly an empirically conditioned concept, i.e., only possible under certain conditions given in experience, which however is not to be abstracted from these, but is a concept only possible according to a principle of reason in the judgment about the object" (§74, p.396).
44 This phrase has also been picked up by Zuckert (2007), who, among recent commentators, confers on it its crucial importance. Connecting it with the notion of the "unity of the diverse," she writes: "purposiveness may be understood, I suggest, to be a "lawfulness of the contingent," an order that holds among contingent (diverse) parts, and unifies them, explains why they belong together, for reasons" (p.84).
45 The improbability compared to natural laws is a recurring theme in the *Critique of the Power of Judgment* itself: "the chance of their convergence seems so infinitely great

that it would be just as well if there were no natural laws at all" (§63). In other words, production by the mere interplay of natural laws, without any concept that would determine their a priori convergence, is so improbable that, if it did indeed occur, all the order shown in nature by the natural laws themselves—these universal laws posited by the understanding—could be no more than chance, which implicitly calls into question the whole Transcendental Analytic.

Here we return to the major motif of *The Only Possible Argument. . .,* according to which general natural laws by themselves yield order; hence: if a particular order can be due to chance, then so can the order of the general laws of nature. So, when reflection, faced with the infinite improbability of a chance—i.e., non-technical—production of a regular shape such as a regular hexagon in sand, concludes that a reasonable being intervened and traced it out according to a concept, it is thinking in a way that guarantees the validity of the universal laws of nature constituted by the understanding. In this sense, there is always a profound solidarity between the elaboration of the concept of purposiveness on the basis of contingency and the critical conception of the ordering of nature in general by the lawfulness of the understanding.

46 For the normative interpretation of Kant's biological purposiveness see Ginsborg (2006, 2015), Huneman (2014c). In her very strong account of Kant's idea of teleology, Ginsborg writes that "The conception of normativity bound up with this notion of judgement is in turn required, I argue, to make sense of Kant's commitment to the possibility of natural teleology. To regard organisms and their parts in teleological terms is to regard them as exemplifying normative constraints, that is, to take their structure and functioning as manifesting ways in which they *should* or *ought to* be and behave" (2015, 16). This conception means that the same normativity constitutes the meaning of the presupposition of the purposiveness of nature that the power of judging requires: "we must presuppose that nature ought to be, should be, or is meant to be judged by us in the ways in which we do in fact judge it" (Ginsborg 2018, p.77). As a consequence she "argues for a unitary notion of purposiveness as normative lawfulness, where the relevant notion of normativity is distinct from—and 'thinner' than—the notion of rational normativity associated with the will and practical reason. (. . .) the normative lawfulness which constitutes purposiveness is the same normativity that I associate (. . .) with the faculty of judgement in general" (2015, p.21). In Ginsborg's interpretation, the reflectivity of judging explicates a normativity that is intrinsic to experience itself, as explained in her essay on experience in Ginsborg (2015).

47 Today's reader cannot help but be struck by the fact that what is at stake in the Kantian investigation of teleology is clearly the fact that functional attribution *explains something* (which mechanistic explanation basically does not). The contemporary debate in the philosophy of biology about the concept of function has revolved around the so-called "etiological" theory of function, which, beginning with Larry Wright's paper (Wright 1973), has developed the intuition that the concept of function is irreducibly explanatory in biology. Among the authors, McLaughlin (2001) has explicitly defended a Kantian-inspired position on the question, on the margins of classical etiological theory. See Chapter 10.

48 See now analyses in Zuckert (2007) and Ginsborg (2015).

49 Operations that the Amphibology precisely called reflection, and the identification of a "transcendental topic" (A 268/B 324).

50 "(Reflective aesthetic judgments) claim necessity and say, not that everyone judges this way—in which case their explanation would be the task of empirical psychology—but that everyone ought to judge this way, which is to say that they have an a priori principle" (*CJ*, p.238).

51 Ginsborg (2015) has extensively developed this reading of Kant, where ought-to defines the dimension of the reflective judgment.

52 "Finality can also be purposeless, insofar as we do not posit the cause of this form in a will; but the explanation of this possibility can only be conceivable to us insofar as we derive it from a will" (*FI*, §10, Ak. XX, p.220). This "explanation" should fall within the scope of the determining faculty of judgment; but at this point, Kant does not yet attempt to articulate it with the reflecting faculty of judgment in the consideration of natural purposes.

53 "The concept of final causes in nature, which sets teleological judgment about nature apart from judgment according to universal, mechanical laws, is a concept that belongs to the faculty of judgment alone, and not to the understanding or reason. In other words, although we could also use the concept of nature's purpose in an objective sense, that of *nature's intentions*, such a use, which is already a matter for reason, has absolutely no basis in experience; it is true that experience can bring purposes to light, but it has no way of proving that they are at the same time intentions" (*FI*, IX, Ak. XX, p.234).

54 *Critique of the Power of Judgment* thus from the outset demultiplies the concept of purpose, just as *Critique of Pure Reason* intended to demultiply the concept of the a priori (analytic/synthetic, conceptual/sensible; see Grondin 1989, p.49), which allowed us to re-examine the problem of a priori knowledge and, in particular, of metaphysics. Each time, through this demultiplication, a new problem is constituted: here, that of the possibility of a priori synthetic judgments, there, that of the apprehension of natural purposes. Finally, each time, thanks to this new problem, a continuity is broken: here, the Leibnizian continuity between theology and physics (which no longer needs to be demonstrated), there, the continuity between theology and the spectacle of life (arguments from design, common since the Stoics, etc.).

Part 3

Kant's theory of "organism" and its (biological and metaphysical) implications

> In this way the idea of a *law* in the case of organic being is altogether lost. The law wants to grasp and express the antithesis as inert aspects, and in them the determinateness which is their relation to one another. The *inner,* to which the manifested universality belongs, and the *outer,* to which belong the parts of the inert shape, were supposed to constitute the corresponding aspects of the law, but as thus held apart, they lose their organic significance; and what lies at the base of the idea of law is precisely this, that each of its two aspects should have an independent, indifferent subsistence of its own, the relation of the aspects being shared between them as a twofold determinateness corresponding to that relation. The fact is that each aspect of the organism is in its own self just this: to be a simple universality in which all determinations are dissolved, and to be the movement of this process.
>
> G.W.F. Hegel. *Phenomenology of the Spirit*. §278.

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9 Kant's account of the organism in the *Critique of the Power of Judgment*

The *Critique of Teleological Judgement* is often read by philosophers of biology as an analytics of biology. This is not inadequate, and my take here is intended to provide the metaphysical background and the scientific context into which such analytics becomes a necessary endeavor.

Kant proposed a revised concept of purposiveness, multidimensional, decoupled from the connotation of utility, and explicitly based on a specific connection between contingency and necessity or lawfulness (Chapter 8). On these grounds, the analytics of teleological judgment therefore asked the question "What must an object look like that can be recognized as a natural purpose?," and answered that it should be an organism. I will now explicate this answer, by which what we saw of the constitution of this concept throughout independent distinct threads of thought (Leibnizian amendments of mechanism, epigenesist developmental theory, natural history of species and adaptation, physiology of the animal economy) is finally joining the result of Kant's evolving account of purposiveness in the *Critique of the Power of Judgment.*

9.1 Purposive causality

Kant begins with the case, already mentioned, of a hexagon traced in the sand, which I attribute to the hand of a human being. The case of the perception of our hexagon was thus a typical experience of purposiveness, because it leads us to speak of objective finality, by inviting us to posit its geometric concept at the foundation of the production of this figure. And a concept at the root of a production is precisely the definition of the attribution of purpose. Analogously, if we recall the example of the eye, the idea of an effect—i.e., vision—stands at the root of causality:[1] this is precisely the judgment we ought to make in the case of forms of contingent regularity with respect to the universal laws of nature.[2]

This purposiveness is therefore described as apprehended in an experience where the causality of an object is completely unintelligible unless a concept is posited at the principle of its *production*. Thus, the analysis of such finality, *unlike formal purposiveness* (beauty or mathematical figures), calls on the

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category of natural *causality*.[3] Purposiveness requires us to think through the variety of causalities. Hence, when zooming in on material objective purposiveness, one should add the notion of *causality* to the pair of modal concepts, necessity/contingency, analyzed above. I will now explain how Kant analyzes this purposiveness in causal terms, putting the notion of objective purposiveness in connection with the traditional metaphysical notion of "final cause," inherited from Aristotelism and later explained away by mechanistic philosophy, starting from Descartes. Leibniz indeed defended an equivalence of "efficient" and "final" causes (*Discourse on Metaphysics*, and see Chapter 1), but the third *Critique* proposes a very different conception of their relation. Kant therein developed an analysis of "natural purpose" in terms of causal series, as I now present it.

Usually, when I search for the events that led to the production of a natural object or form, I constitute what Kant calls a "descending" series of causation, in the sense that the relation of dependence always "descends" from cause to effect. This causal relation is conceived by the understanding and satisfies the three "Analogies of Experience," according to the Transcendental Analytic. But we can also conceive of an inverse, "ascending," relationship, where the effect induces a causal dependence: this is precisely what happens when we encounter an object that we judge to have an objective material purpose, since in this case, a concept is conceived at the root of its production—the concept of some effect of the object itself. In other words, the representation of the effect is the cause of the cause of the effect.[4] The example of this connection is obviously human activity: "in what is practical (i.e., in art) we easily find similar connections, as for example the house is the cause of the money collected for rent, but conversely also the representation of this possible income was the cause of the building of the house. Such a causal connection is called a connection through final causes (*nexus finalis)*" (§65, p.372).

Thus, a product of nature, if it is to be represented as a natural purpose, must be admit of a *double reading*: one according to ascending causality, the other according to descending causality. But it should be noted that the latter causality links objects, while the former, ascending causality, links objects and representations, since the effect can only as its representation be the cause of its cause. Hence, "perhaps the first connections could more aptly be called the connection of real causes, and the second the connection of ideal causes" (§65, p.372). The "natural purpose" thus intersects real and ideal causalities.

This last argument responds to the fact that there exists indeed a way for an object to be both cause and effect, a way which is even excessively widespread, since it is precisely *reciprocal action*, which constitutes one of the Analogies of Experience in the Transcendental Analytic. As such, it is the *nexus mundus*, the link that holds together nature as a whole, which constitutes the form of a nature. The weight of my cup on the table is both the cause and the effect of the table's reaction. But there is nothing final about this. So, purposiveness arises precisely when the causality of objects is duplicated by an ***ideal*** causality in the opposite direction. However, this raises an obvious problem: the category of

causality, which links the objects of experience, cannot be applied immediately, without precautions, to the relationship between a representation and an object. Two difficulties then arise: the first is ***ideal causality in itself***, since, by articulating representation and object, it departs from the ordinary use of the category of causality as prescribed by the a priori synthetic principles of understanding; the second is the ***articulation of this ideal causation with real causality***. The first question will lead us to an analytics of the organism, which we are now entering, and the second to the dialectic of teleological reflective judgment and its methodology, which will be tackled in Chapters 10 and 12.

9.2 Whole and parts: the design criterion

If ideal causality is the index of finality, then we have new notions with which to think about purposiveness: *the whole and the parts*. For, if the representation of the effect determines the cause, then all the elements of the thing that the cause produces must be specified in advance within that representation. In other words, to say that a thing is a natural purpose is to say that within it, the parts are all determined by the representation of the whole. Such was *technique* in its opposition to *mechanical*: a scheme projected in advance. In contrast, descending causality, as it occurs in nature, is such that the parts precede the whole, since the sum of the parts causes the whole; this is indeed what Kant calls "mechanism."

An important epistemological distinction should be made here. Causation is a relation between events, such that the cause-event produces the effect-event, occurring after the cause-event. Time provides the scheme for causation, so that the causal relation envelops a relation of succession, the cause preceding the effect. Kant admits that the succession can be almost instantaneous, but in his Second Analogy, he distinguished the "order of time" from the "course of time," and indicated that the *order* of time, if not the *course* of time, is always unidirectional: the smoke may appear almost at the same time as the fire, but never before it.

Mechanism is only an explanatory mode of causation, and it is defined by a reference to parts and wholes. Thus, it is secondary with respect to causation, which is the basic ontological connection, and which belongs to the essence of nature (i.e., a phenomenon and not some "thing in itself," of course). Explaining by mechanism precisely means explaining by starting from the parts and going to the wholes. It is causal, in the sense that the parts cause the whole, even though this "causation" relation may be instantaneous; yet in the order of time, the part comes first.

Mechanism is therefore an explanatory strategy; it adds to the notion of causation a mereological apprehension of the world, and therefore concerns systems that are made up of parts, and not only events, as in the case of the Second Analogy, which was formulated as a relation to be presupposed between two events. We are therefore facing not only nature as such, which is constituted by a priori principles such as the ones exposed in the Analogies of Experience regarding

permanence, causation, and reciprocal action, but nature as likely to be ordered and structured, with which the faculty of reflective judgment is concerned.

By extension, "mechanism" may mean the object of a mechanistic explanation, and Kant may talk about mechanistic causation. But we should remember that "mechanism" is in a sense less constitutive than "causation": in a world where everything obeys the principle of causation (the Second Analogy in the first *Critique*) but no parts exist, or in a world constituted of one event and its consequences, mechanism as explanation would have no place.

While causality in the broad sense, as we see it in the *Critique of Pure Reason,* univocally determines only a relation in time (before-after), mechanism is a subspecies of causality, because it adds a univocal determination to a relation of space (parts-all), as McLaughlin points out (1990, p.154). In this sense, the antinomy of *mechanism* and teleology formulated in the Dialectic of the "Critique of the Teleological Power of Judgment" *does* not repeat the antinomy of *causality* and freedom in the Dialectic of the *Critique of Pure Reason.*[5]

Thus, time in mechanism becomes less important than in causation as such. Or at least, the *course* of time becomes irrelevant here, since parts and wholes might be contemporaneous, even though from the viewpoint of nature, the parts come first. This distinction would support a Kantian answer to an objection that the "new mechanical philosophy" elaborated by Glennan (2017) or Craver and Darden (2013) could formulate, namely that the part-whole relation is not a *causal* but a *constitutive* relation. For Kant, because there is still an order of time, hence a before-and-after in mechanisms, such relation still pertains to causation and not to constitution (in the sense that the noun and the verb in a sentence "constitute" a sentence).

Mechanism comes into play when we intend to understand *systems*, which by definition have parts. In a nutshell, Kant ties mechanism to the nature of our understanding, which by definition is said to be "discursive"; this follows from the fact that an intellectual intuition is not available to us, namely an intuition that would give us the knowledge of the object simultaneously with the concept of that object. The discursive understanding has several characteristics deriving from this nature, most of which concern the relation between the universal and the particular, and the non-derivation of the latter from the former. One does not access the universal—namely, the concept—by having an intuition of the particular—namely, the individual thing. For instance, I cannot form the concept of a melon just by seeing a melon, I need to compare it to other fruits, some non-fruits, etc.

Conversely, one does not know the particulars—namely, all the apples and their varieties—by knowing the universal concept—namely, "apple." The discursive understanding is thereby constrained by the elementary logic, which implies that one cannot get the whole before the parts, since the parts can be intuited without the whole, while the whole cannot be there without the parts being there. This logical constraint for the understanding underlies the logic of mechanism: in an explanation, parts come first, and then wholes. The discursive

understanding is opposed to a hypothetical *intuitive understanding*, which would hold together concepts and intuition and therefore, when having a concept, would also know all its instances, and would not have to go step by step or part by part to identify a universal (e.g., a species) or a whole.

Mechanism is, therefore, another constraint on the understanding, subordinated to the principle of causation, when one tries to understand wholes. Let us note that this sense of "mechanism" is slightly different from what came before. For Leibniz or Stahl, "mechanism" named the claim that explanation should proceed by considering the laws of mechanics. The unity of mechanism and organism that Leibniz defends against Stahl is the idea that all mechanistic explanations are compatible with corresponding final explanations, while for Stahl, purposiveness was absent from mechanisms. But the distinction between efficient causes and mechanism characterizes Kant's originality with respect to Leibniz's project of unifying purposiveness and mechanism.

Notice also that Kant talks about mechanism and about "descending causation" in a very different sense from the way contemporary philosophers of science talk about downward causation and mechanism: the latter means an explanation that identifies entities, activities, and organization likely to produce the *explanandum* (Machamer et al. 2000; Glennan 2017). Even though the "entities" resemble the Kantian notion of parts, the overall notion of production and the reference to "organization" and "activities," are much more specific than the Kantian claim about parts. And in contemporary writings about emergence (e.g., Kim 1999; Sartenaer 2016; Guay and Sartenaer 2016), "downward causation" names the causality that goes from whole to parts, which is what Kant calls "ascending causation," but, unlike him, without assuming that it is ideal.

While Kantian mechanism is "descending causation," it opposes an ideal ascending causality that singularizes *purposes*. Here, the representation of the whole must *precede* the parts. "Indeed, the thing itself is a purpose and therefore is grasped under a concept or idea that should a priori determine all that is to be contained in it" (§65, p.373). Following the analysis of our perception of the regular hexagon, we find here our *first criterion of the natural purpose*: "for a thing as a natural purpose it is *first* required that the parts (according to their existence and form) are only possible through their relation to the whole" (§65, p.373). In other words, while purposiveness is the necessity (in a sense of "necessity" that still has to be completely determined) of a concept at the root of the production of the object, the sign of this concept is the fact that the parts are defined and related in a lawful way—in accordance with the notion of purposiveness exposed above—based on the idea of the whole. Thus, the parts are determined "according to their existence and form" by a concept: applied to living beings, this means that an organ, say a tooth, exists because it fits in with the animal's digestive system, which can only digest food in chopped form; and, to be able to slice, or grind, the tooth will have its form in accordance with the other teeth. The overall presupposed concept here is "surviving" in an environment, and in

turn, it defines concepts that determine the existence and relations of organs. The emerging notion here, by which we characterize such hierarchy of concepts and subconcepts, is "biological function"; however, the overarching concept (i.e., surviving), regarding the overall organism, is not itself a function.

This first criterion of natural purpose, namely the subordination of the parts to the whole, I call it "design criterion." It justifies the claim made by Kant in the title of §65 that things, as natural purposes, are organized beings, organization meaning this presupposition of the whole to make sense of the parts. A thing that satisfies this concept is indeed *designed* in the two senses of the term—it has a design, in the sense that it is built according to a plan—and it is designed, namely we consider a concept at the root of its production, which corresponds to the notion of "intention" involved in "design." Design was also a key term in natural theology and especially, shortly after Kant, in Reverend Paley's treatise; it yields the "argument from design," which innervates such theology, connecting it with physiology (Cunningham 2003), and which Darwin later dismissed by showing that natural selection can design by itself the features of plants and animals. Thus, to the three aspects of objective purposiveness established above in Chapter 8, that is: lawfulness of the contingent as such, concept at the root of the production, and improbability of the system according to the necessary laws of nature, one should add: *a specific parts-whole relation*. This fourth dimension of natural purposiveness is crucial since it involves a shift from the vernacular concept of purpose, which simply distinguishes means and ends, to the primacy of the parts-whole relationship.

Following Kant's conception, which sets aside the means-ends relation and focuses on parts-wholes relation, we see that some things that satisfy the design criterion involve both ascending and descending causality. Namely: the assembling of parts is intelligible through a mechanistic explanation; yet the determining relation going from the concept of the whole to the parts is an ascending causality, since it is obviously an ideal causation, the "whole" existing first as a concept, such as the concept of chewing food (in my above example of the teeth). Thinking of an ordinary machine, this dual causation clearly obtains: a mechanism produced it by assembling parts, which can be themselves assembled by another mechanism, while a mechanism in the Kantian sense, namely, an explanation, can elucidate such fabrication.[6] Inversely, the ideal causation goes from the idea of the designer of the machine to the parts.

In the case of natural things such as animals or plants, whose "internal structure" is deemed purposive, as we saw, such a designer cannot be asserted as existing by the natural scientist. Hence, the analysis of purposiveness is incomplete here: the design criterion is not sufficient to define a *natural* purpose, because the products of human technology satisfy it just as well. A watch, for example, is only made possible by the idea of the totality of its mechanism; each cog has a shape and a location determined by this totality, itself subordinate to an end, that of marking the hours. Our example of the regular hexagon was also a technical

creation, a human production; from it, we could not derive a criterion that would allow us to distinguish between natural and artificial–technical purpose. The principle of low chances, the inadequacy of natural laws for the complete determination of an object, and the derived principle of the pre-eminence of the idea of the whole, which were the key of purposiveness as analyzed above, are not sufficient to distinguish human technique from natural purpose. Kant must therefore provide a second criterion, which will be decisive.

9.3 The second criterion: self-production

Let us read Kant's text, now indicating the second criterion of the natural purpose in §65:

> But if a thing as a natural product is to contain within itself and in its internal possibility a relation to ends, i.e., to be possible simply as a natural purpose and without the causality of the concepts of a rational being external to it, it is required, *secondly,* that the parts of this thing combine together in the unity of a whole, that they are reciprocally in relation to one another as cause and effect of their form. Only in this way is it possible for the idea of the whole, reciprocally, to determine the form and combination of all the parts: not as a cause—since this would be a product of art—but as a ground [or principle] for knowledge (*Erkenntnisgrund*) of the systematic unity of the connection of all the manifold contained in a given matter for someone who judges it.
>
> Thus, for a body that is to be judged as a natural purpose in itself and according to its internal possibility, it is required that its parts produce (*hervorbringen*) one another together, both in their form and in their combination, reciprocally, and that, through this causality, a whole is produced, whose concept (in a being that would possess the causality according to concepts appropriate for such a product) conversely, could in turn be judged as the cause of this whole according to a principle. Consequently the connection of efficient causes could be judged at the same time connection according to final causes.
>
> (*CJ*, §65, Ak. V, p.373)

Thus, in a natural purpose, the parts are determined by the whole, and are determined by one another "according to their form and connection." If we had a technical purpose, the idea of the whole would fully determine each of the parts independently of each other: for example, I can make each of my watch parts separately. But in a natural purpose, the idea of the whole does not intervene as a real representation in the mind of an agent executing a project, so that this idea of the whole cannot, as in technology, directly determine each of the parts, hence the parts must determine one another, given that no other causal determination comes from the outside. This is why Kant writes that it is only in this way that the idea of the whole can determine the parts, and determine them according to the

mode of a natural purpose, in other words, not as an external effective cause. In human technique (or art), the idea of the whole is the cause of the parts, since the parts are constructed according to it, such idea yielding a blueprint; in a natural purpose, the whole and the parts are already given, and the role of the idea of the whole consists in being the "principle of knowledge" (*Erkenntnisgrund*) of the very systematicity of this whole. The "idea of the whole" that exists in the mind of the designer, with respect to a machine, corresponds to an "idea of the whole" which lies in the mind of the cognitive agent, with respect to a natural purpose. For this to happen, the parts must first reciprocally determine one another: thus, in a carnivore's mouth, the role of the idea of the animal's totality as a principle of knowledge of this animal manifests in the following: if it has teeth to cut its prey, it will also have teeth to crush it, so that the presence of incisors will entail the presence of molars.

However, at this level, the parts are organs that reciprocally confer one another a determination; this is still not enough, because it could be objected that the same applies to technical instruments. In a watch, all the cogs are certainly made separately, and the cause of each is the idea of the whole; but at the same time, each is made to match its neighbors to the millimeter, so that we can still maintain that according to form and connections the cogs are the cause of one another. So, we need to go further to clarify the notion of natural purpose; we have not yet drawn all the consequences of the distinction between the idea of the whole taken as the effective cause of the parts in technology, and the idea of the whole taken as the principle of knowledge for judging natural purposes.

There are actually two senses in which parts can cause others: a weak sense of "dependence" where one is the *raison d'être* of the other, and a strong sense of "production" where one brings the other into existence. These two senses match two meanings of the concept of causation, which have been distinguished after the theories of David Lewis (2000) and Wesley Salmon (1984)—namely, cause as a "difference-making" (often realized by counterfactual dependence), and cause as a "bringing about" production process (often signaled by the existence of a conserved quantity within the process, as Wesley Salmon made it clear) (Hall 2004).

This notion of "bringing about," in this case *hervorbringen*, enables us to make a definitive distinction between the technical purpose, where occurs a counterfactual dependence between parts and the natural purpose. "In a watch (. . .), says Kant, certainly one part exists for another, but it is not through this other part that it exists" (*CJ*, §65, p.374). The text therefore continues as follows:

> In such a product of nature, every part, just as it exists only through (*durch*) all the others, is also thought of as existing *in view of* (*um . . . willen*) *the* other *parts and the whole,* i.e., as *an instrument (organ)* [we have the dependence causation, here; it applies to kangaroos as well as watches]; this, however, is insufficient (for it could also be an instrument of art, and thus only be

represented as possible as an end in general); rather, the part is thought of as an organ *producing* the other parts (and consequently each part as producing the others reciprocally).

Indeed, if the parts determine one another when the idea of the whole is a principle of knowledge (and not an effective cause, as in human technique), then it must be said that, in this case, the parts must form one another, produce one another, since the idea of the whole is not externally efficient. This differs from the case of the watch, where the cogs are all made by the craftsman. In a word: when a purpose is encountered (according to the design criterion), and when there is no human designer, then, since the "idea of the whole" according to which the parts determine one another as to their form and connection is only a principle of knowledge, the bringing about through which the parts come to be should be done by the parts themselves, within the system. The notion of an idea of the whole being there as a principle of knowledge (in a natural purpose) conditions the ascription of a capacity for self-production to the parts themselves—or, as we would like to say now, to the cells. The "idea of the whole," therefore, plays the role of a template, or a norm for part building, even though it has no existence independent of the cognitive agent. This means that without the presupposition of the idea of the whole, no system can be seen as a natural purpose—a claim that Breitenbach (2009a) interpreted as the idea that this presupposition is what allows us to make the experience of organisms as organisms and not as sets of physical particles.[7]

The productivity of the parts thus makes the difference between natural purposes and technical purposes. This productivity is characterized as reciprocal: parts create parts, which create them. In other words, we have here a double circular causality: between parts creating parts; and between the parts mechanically making the whole and the whole in turn causing the parts as a template does, through a dependence–causation relation which yields, from the part of the parts, a bring-about causation relation. The causation proper to natural purposes is therefore more complex than the causation in a technical product, which only features a circular relationship between the causation-as-production going from parts to whole and the causation-as-dependence going from the idea of the whole to the parts.

But fundamentally, this difference is related to the difference between *the idea of the whole as a cause in human technique* and the idea of the whole as a *principle of knowledge for the object judged as a natural purpose*. This brings us back to the reflective position of teleological judgment, teleological judgment being, by definition, a reflective judgment, which, as such, requires a regulative principle. The Kantian analysis is thus similar to the emphasis on vital productive forces in the singularization of biological science, as I have shown, where Wolff's *vis essentialis* was the epistemological correlate of the continuity of a productive process.

In this way such analysis differs from Kant's position in the "Appendix to the Transcendental Dialectic," where finality was language, and where in the living being the parts were ends and means for each other, as one might have said in a Galenic model of the organism, but where at the same time no criterion of demarcation between machine and organism was truly elucidated. Here, thanks to the productivity of the living organism, one can shed a light on this difference, allowing us to fill out the concept of natural purpose that the analysis of the simply reflective faculty of judgment had uncovered.

Thus, epistemologically, the Kantian position implies the transformation initiated by Caspar Wolff. First of all, Wolff had indeed established an authentic theory of epigenesis, in which the internal productivity of living organisms is posited as the basis and support of the theory, like a primitive notion, and unlike Maupertuisan or Buffonian theories in which this productivity was to be explained by analogical theories (Chapter 4). Mechanism, in fact, as Kant says in §71, does not explain the *Erzeugung (*production) of organized beings, at least as far as our faculty of knowledge is concerned.

Second, the theoretical judgment on the specificity of the living world is based on a position that is precisely that of Wolffian science. I had already suggested that Caspar Wolff inaugurated a non-Newtonian approach to living phenomena, in that it suggested that their intelligibility consisted in the ordered reconstitution of a history by means of description. In the Kantian analysis, we have seen that only the presupposition of the idea of the whole as a principle of knowledge (*Erkenntnisgrund*) of systematicity—and not as an actual cause, like the blueprint of the external technical agent—makes it possible to distinguish natural from technical purposes, and to specify under which conditions an empirical object can be judged as a natural purpose. But such a presupposition precisely characterizes simply reflective judgment, insofar as it does not apply the category of causality constitutively as the physical sciences do, or as human technology does when it uses it to carry out its projects. In the terms of the preface to the *Metaphysical Foundations of Natural Science,* teleology does not pertain to a science of nature, *Naturwissenschaft*, since this one should be a priori and mathematical, in a completely Newtonian manner, but to a *Naturlehre,* a doctrine of nature.[8] Sloan (2006) insisted on this distinction, which endows biology with a status that is not exactly science, even though it is undeniably a knowledge (since its judgment has an objective meaning, unlike aesthetics). In this sense, even though he does not share Zammito's verdict that Kant's teleology is alien to the progress of biology (Zammito 2018), he still sees this *Lehre/Wissenschaft* difference as an indication that biology is not for Kant a genuine science, against Lenoir's interpretation.[9]

I call the second criterion of natural purpose "epigenesis criterion." The reflective judgment with its regulative status—namely, the involvement of the presupposition of an idea of the whole as a principle of cognition within the judgment about some systems—involves such an epigenesis criterion. This

conceptual connection constitutes the heart of the novelty of Kant's account. The theoretical position from which he formulates this criterion for distinguishing the living within nature generally is non-Newtonian, since it rests on a reflective, non-determining judgment; Wolffian embryology occupies that epistemic space. The analyses of Kant's scientific reflections on the teleology of the living (Chapter 6), showing the support these doctrines receive from the epistemic possibility opened up by Caspar Wolff, illuminate this correspondence at the level of the history of Kant's thought. The key point here is the parallel between the embryogenetic "vital force" that correlates with Wolff's epistemological position, and the productivity, *Zeugung*, of living beings, which in Kantian analysis derives from the merely reflective character of the judgment concerning natural purposes.[10]

The *Critique of the Power of Judgment* thus connects the *concept of organism* and the *reflective position*: one cannot exist without the other, because in order to apprehend something as a natural purpose, the "idea of the whole" must be a mere principle of knowledge—which is entailed by the reflective character of such a judgment—and, from then on, such an object manifests within itself a specific productivity according to which the parts produce one another at the same time as this production is retro-determined by the whole.[11]

Wolffian embryology indicates an apprehension of the intrinsic relationship between the parts of the living being that is precisely that which the requisites of the idea of the whole as *Erkenntnisgrund* featured as characteristic of the organism: the parts must produce one another, in a reciprocity subordinate to the unity of the whole. At every moment of the organism, the parts maintain both compatibility and production relationships; the latter then lead to other stages in the organism's development, which may be incompatible with the preceding stages. The essential point is that organicity is constituted by the conjunction of *these two types of relationship between parts*: inter-determination and production (reflecting the two families of concepts of causation: difference-making and production, see above). By distinguishing between compatibility/incompatibility relations (hence, interdetermination) and production relations, Wolff had previously freed up the space of embryology, as we saw, by doing away with the requirement that all stages in the development of the living body be compatible (hence the break with the discussions on invisible entities in the embryo, where Haller then intervened; see Chapter 4).

The two closely related notions of bringing about (*hervorbringen*) and production (*Zeugung, herzeugen*) characterize the epigenesis criterion, which captures the naturalness of natural purposes. Kant had explored them in a phenomenological analysis of the organism, using the example of a tree, just before he developed these two criteria for natural purpose. I will look at this phenomenology of organic production in more detail before completing my analysis of the two criteria, and the key claim that natural purposes are organisms.

9.4 Phenomenology of the tree and biological productivity

The tree is an example of these natural purposes mentioned when the "First Introduction" talked of "internal structure of animals and plants" as an example of nature's technique. The §64 offers an *avant la lettre* phenomenological description of the tree that details its productive power, along three dimensions: the tree *reproduces as a species*, *produces itself* as an individual, and *its parts mutually* produce one another. With this notion of "production," *Zeugung*, Kant puts forward *productivity*, which has been usually considered a characteristic of living beings (since they re-p*roduce*), and which, against mechanism, acquired a new meaning and vivacity, thanks to the vitalists on the one hand, and the generalization of the use of the notion of "vital force" on the other. Indeed, in Germany after 1760, the *vital force* was one of the characteristics that appeared in literature contemporaneous with the third *Critique.* Thus, according to Leskes, *Anfängsgründe der Naturgeschichte (*1784, 2nd ed.), the fluid parts of an organism move "from a force of its own internal to the organized body," and this is how it is said to be alive; and before him, Beckmann, *Anfängsgründe der Naturhistorie* (1767), wrote that "living or organic" bodies "grow thanks to their own internal constitution." Alongside this dimension of spontaneous growth (*wachstum*), related to the type of organization (also noted in T. Bergmann, *Physikalische Beschreibung der erdkugel* (1780, 2nd ed.), the other point highlighted in these texts is precisely the singularity of organic composition, emphasized by Erxleben (*Anfängsgründe der Naturgeshcichte*, 1768, pp.4ff), and subsequently by other authors who relied on his treatise: "when the parts of a body are bound together in such a way, that the kind of constitution (*Zusammensetzung*) has as its purpose (*Absicht*) a certain movement of the fluid parts within it, then that body is called an organ, and the body constructed from such organs, we call an organism. Hence, a body cannot live without being organized."[12]

As an individual, the tree grows—but this growth is to be distinguished from any "growth according to mechanical laws" (§64): here Kant has taken up one of the achievements of the time, initiated by Bourguet, and considered as a breakthrough by the vitalists, which consisted in the distinction between growth by augmentation and growth by intussusception.[13] This enabled him to contrast the mechanical laws (again, here: general laws of nature) posited by the understanding (taken together with the empirical laws of nature which are based on them)[14] with the growth of plants and living beings, which then appears as "production," *Zeugung*, thus related to "generation," *Erzeugung*, according to the species.

Unlike mineral accretion, intussusception is typically a non-mechanistic process, since the result does not derive from the simple sum of added parts. Productivity (*Zeugung, Erzeugung*) is therefore the name of the type of becoming that distinguishes living beings from other natural beings.[15] This kind of becoming is irreducible to that of natural beings governed by mechanism, and thus indicates

some spontaneity, in the sense that the mere addition of parts is not sufficient to account for the process. Accretion, in other terms, requires additive or linear functions; thus, the growth of organisms fails any additive or linear modeling, as we would say in modern mathematical words. For Kant, the plant itself, producing both its own species and its own substance, does so by means that are irreducible to the ordinary physics and chemistry of natural processes,[16] which supposedly proceed linearly.

Considering now its parts, the tree attests this specific *power to produce*, in a complex manner that reflects the duality (dependence/production) of the second criterion of purposiveness. Kant notes first: "Part of this creature also produces (*erzeugt*) itself, so that the preservation of one part depends on the preservation of another part, and vice versa" (*CJ*, §64, p.372), which is a circular relation of dependence. He then adds:

> The eye of a tree leaf, entwined on the branch of another tree, gives birth on a foreign foot to a plant of its own species, likewise the graft on another tree. This is why we can consider each branch, each leaf of the same tree as simply grafted or budded onto it, i.e., as a tree existing for itself, which simply attaches itself to another tree and feeds like a parasite.
>
> (*CJ*, §64, p.372)

Interestingly, here, the vital production does not come with an enhanced sense of individuality: parts can be taken as individuals themselves. This uncouples Kant's view from the ancient idea that ties life and souls. Actually, Kant's object here is less life than organisms (as made clear Chapter 7); and in order to neutralize the preconceptions of organisms that might derive from ideas of animality and life, he chose his phenomenology of organisms the tree rather than an animal as example.

Describing the existence of a tree shifts organic productivity to the level of parts, thereby updating Bordeu's vitalist schema of the organism as an agglutination of elementary living organisms, even though Kant is not resuscitating this view, since it would sound too mechanistic. For a modern reader, this productivity of the parts that make up the whole evokes cell theory, since each cell comes from a cell, as the second axiom of the theory formulates it. Then the text goes on by pinpointing a causal circularity that involves both dimensions of causation: "The leaves are, it is true, products of the tree, but they in turn preserve it; indeed, repeated stripping of the leaves would kill the tree, and its growth depends on the action of the leaves on the trunk" (*CJ*, §64, p.371). Kant ends this description by focusing on a key property of the living, namely what we call self-maintenance, of which self-repair is a major instance. The latter is often spectacular if one thinks of crayfish, but is present at all levels of life, as modern biologists know, since even DNA is self-repairing—think for instance of theories explaining the

evolution of sexual reproduction by appealing to the necessity of self-repairing DNA (e.g., Bernstein et al. 1987):

> I will just mention in passing some of the properties of these creatures, although they are among the most admirable of organized creatures: the self-repair (*Selbsthilfe*) of nature in these creatures on the occasion of injury, where the lack of one part, necessary for the conservation of neighboring parts, is compensated for by the other parts;—the monstrosities or deformities in growth arising from the fact that certain parts, due to deficiencies or obstacles, form in a completely new way, in order to conserve what exists, and thus produce an anomalous creature.
>
> (*CJ*, §64, p.372)

In a tree, self-production in a patterned way—namely, the production respects a form—instantiates exactly the notion of "concept at the root of production," which the concept of purpose encompasses, and this occurs at the two levels of the individual and the parts. But it is also to be found above the individual level, since the species also produces itself through producing individuals. Actually, this was the second point made by Kant, when he said that the tree "reproduces itself as a species—in which, on the one hand, it is continually brought about as the effect of itself, and on the other hand, acting as its own cause and often bringing about itself, it thereby continually preserves itself as a species" (§64, p.371). The constancy of form that guides the production of parts—leaves resemble leaves—and of the tree, which grows in an approximately self-similar way, thanks to the intussusception, also characterizes the existence of the species as a continued series of specifically similar individuals. And these three processes are completely cohesive; self-production takes place at three levels, which can be articulated as follows: "The self-production of the parts is the fundamental condition for the self-production of the individual, just as the latter is the fundamental condition for the self-production of the species."[17]

This phenomenology of arborescence had a strong appeal for the nascent Romantic movement, as demonstrated by Herder's extensive use of the tree metaphor in *Auch eine Philosophie der Geschichte,* which provided a framework for political organicism. However, in Kant's case, we do not yet have a model for thinking about certain phenomena, but a description, or modeling, of the plant taken as a fact. Through it, we rediscover what, at every previous point in the analysis, was characteristic of the organism, that is, *the circularity of cause and effect*: according to its species, the tree is "produced by itself, on the one hand as an effect and on the other as a cause." The species of tree—for example, the oak—produces new individuals through a succession of ancestors, while these individuals, in turn, reproduce and thus sustain the species as a whole. At the level of the individual organism, the tree forms itself, since its substance is both cause and effect of its own organization. Finally, the parts of the tree—such as the leaves—are themselves reciprocally cause and effect of the whole: they exist

for the sake of the tree and at the same time contribute to its production and maintenance.

Thus, at all three levels of the tree—species, individual, parts—the *circularity* of cause and effect signals the specificity of organisms, as I emphasized earlier, pointing out a double circularity in the causal structure analysed by Kant. Long before him, Robert Whytt's vitalist analyses had indicated this circularity as decisive for understanding involuntary muscle contraction, insofar as it rules out the mechanistic hypothesis:

> The heart is therefore the cause of the circulation of blood and the secretion of spirits, but without the impulse of spirits the heart would not beat. These two driving causes, therefore, form a true circle, and each is reciprocally the cause of the other. *These two causes, therefore, truly act in a circle, and may be considered mutually as cause and effect*.[18]

Later, Bichat would make this a fundamental element of the intelligibility of the living world, since he states in a note to *Recherches physiologiques sur la vie et la mort* that problems in physiology are "a *circle* in which something must always be assumed, unless it is subsequently proved," just as it "is essential to the sequence of questions which have circulation as their object that it is impossible for the solution of one to bring about, as a necessary consequence, that of all the others."[19] Yet it is precisely this circularity that allows Kant a double reading of causality—ascending and descending—, and thus characterizes the tree as a material objective purpose,[20] according to the taxonomy of purposes drawn in the previous chapter.

To wrap up the Kantian account of organisms, let us summarize the extent to which this analysis echoes the transformations studied in my approach to the life sciences at the time:

- *Productivity* refers to the emergence, in writings by Buffon and the Montpellier vitalists, and later in Wolff's and Blumenbach's embryology, of the theme of the specificity of vital forces. We had already seen that the theory of generation proposed by Kant in his essays on races was only made possible by Wolff (Chapter 6); I had also shown that Wolff indicated a new use for the vital force, which took Buffon's and the vitalists' schemes a step further, by indicating the possibility of a new theory of epigenesis (Chapter 4). In developing his analysis of the tree, Kant implements Wolff's transformation of embryology. It goes hand in hand with the motif of self-repair; it culminates in the formulation of the epigenesis criterion for natural purposes (§65).
- The idea that the parts are themselves individuals behaving like the whole harks back to the vitalist schema of the animal economy as a swarm of organs living their own lives (Chapter 2). As with the vitalists, Kant must then posit a circularity of whole and parts, whereby the dispersal of parts as individuals living their own lives—a perceptible risk when the above-quoted sentence (§64, p.372) speaks of "parasites"—is re-enclosed within a harmony at the

service of the common purpose, which is the conservation of the whole. Philosophically, this motive traces back to Leibniz's understanding of nestedness as a key aspect of the organism (Chapter 1), which he extended toward the idea of infinite nestedness. Kant's remark on potential "parasites," in this context, strikes me as the acknowledgment of the diachronic reversibility of groups and individuals, which is at the core of the evolutionary understanding of individuality, along the terms of the "Major transitions in individuality" program (Maynard Smith and Szathmary 1995), that I mentioned alongside with Leibnizian nestedness (Chapter 1).

9.5 Organization and self-organization

Since the last chapter, I went through the subtleties of Kant's notion of natural purposiveness, itself stemming from a complex theoretical itinerary that began with the 1763 acknowledgment of the coexistence of two kinds of order in natural systems. The "lawfulness of the contingent as such" defines purposiveness; it means that objective purposes are such that they cannot be represented without a concept at the root of their production. Such a concept sketches the overall scheme of the object, hence the characteristic of a purpose is the subordination of the parts to the idea of the whole; this makes it inaccessible—or not completely exhaustible—by a mechanistic explanation, which is what our discursive understanding does in science. But if the purpose has to be natural, then the "idea of the whole" at its root is necessarily a "principle for knowledge" and not for fabrication. This yields the epigenesis criterion, according to which parts cause themselves in accordance with this "idea of the whole "presupposed by the theoretician. As a consequence, the judgment considering an organism, that is, ascribing functions to its parts or characterizing embryogenetic steps in a process aimed at the adult type, by its essence reflects on its conditions of enunciation; it is thereby a *reflective* judgment, and natural purposiveness is necessarily a regulative principle for this judgment.

The linchpin of this analysis is the notion of *Erkenntnisgrund*, which ties the *reflective* character of the judgment of natural purposes to the *epigenetic* character of the object under judgement.[21] Kant would then emphasize this fundamental role of the reflective character of the judgment in the constitution of a concept such as that of being organized as *self-organizing*, for which the objects falling under it can be considered as natural purposes.[22]

Here is the key text, which completes the §65 I quoted above:

> In such a product of nature, every part, just as it exists only through (*durch*) all the others, is also thought of as existing *in view of* (*um . . . willen*) *the* other *parts and the whole,* i.e., as *an instrument (organ)*; this, however, is insufficient (for it could also be an instrument of art, and thus only be represented as possible rather in general); rather, the part is thought of as an organ

> *producing* the other parts (and consequently each part as producing the others reciprocally), which cannot be any instrument of art, but only an instrument of nature, which provides the matter for all instruments (and even for those of art). Only then and for this reason can such a product, as an *organized and self-organizing* being, be called a *natural purpose.*
>
> (*CJ*, §65, pp.373–374)

This text reminds us of the two criteria: design and epigenesis. Then, the proposition: "which cannot be any instrument of art, but only an instrument of nature" refers to the difference outlined above between accretion—which is the only kind of fabrication we can do, by adding parts to parts (in a way transparent to a mechanistic explanation going from parts to wholes)—and intussusception, with its *non-additive* workings that are opaque to mechanistic explanation.

At this point, considering the phrase "organized and self-organizing beings," one should remember the continued use of the reference to Kant in theoretical biology and especially in the evolutionary theory of development (or Evo-Devo) since the 1980s. An evo-devo biologist and a philosopher of biology, Scott Gilbert and Sahotra Sarkar, wrote in a paper entitled "Embracing Complexity" (2000), cited in the introduction above, that the framework of the developmentalist view of biology was Kantian. I will focus on this claim in the next chapters, but my current analysis of Kant's account of the organism should already help figure out what goes on with this recurrent Kantian reference. I indicated that cell theory, which Kant could not know, easily instantiates the notion of the production of the parts and the whole by the parts. Let us notice that Theodor Schwann, one of the founders of this theory, came from the lab and teaching of Johannes Müller, a physiologist who, in the 19th century, perpetuated some of the Kantian views regarding the autonomy of organisms. Schwann, like some other scientists of his time, namely Emil Dubois-Reymond and Justus Liebig, rebelled against the Kantian notion of an overarching whole to be presupposed in the research. According to the narrative by Tim Lenoir, they hid the possibly Kantian legacy they inherited, and committed to a strong materialism and mechanicism, which contrasted with the Kantian views of both their teachers and some of their contemporaries involved in morphology like Gegenbaur or Richard Owen (Lenoir 1982; Rehbock 1983). And even more generally, in this quoted paragraph, Kant touches upon two major issues that popped up in the late 20th-century philosophy of science and physics:

(1) First, non-linear dynamics is a body of knowledge that started in the early 20th century with Henri Poincaré and intends to take seriously the non-linear terms in differential equations, which are often neglected when solving them. This view of knowledge allows one to decouple prediction and determinism, and therefore, introduce novel perspectives for the theories of explanation. Roughly speaking, taking into account non-linear terms means that the

system can be very sensitive to initial conditions, which makes prediction almost impossible after some time, since the smallest margin of error can still lead to a huge range of possible final states (Huneman 2012).

To some extent many of the major mathematical frameworks for making sense of development and life, beginning in the early 20th century, focused on non-additivity and non-linearity—for instance René Thom's theories of morphogenesis, Henri Atlan's theories of "order from noise (Atlan 2011)," and Stuart Kauffmann's views on self-organization in Boolean networks (see Chapter 11 on these theories). Mathematics of non-linearity supports thus the claim by Gilbert and Sarkar (2000); it is even more obvious when looking at German morphology and developmental theories in the 19th century, which were explicitly related to Kant. In the next chapters, I will emphasize conceptual affinities between the Kantian account of organisms and some of the mathematics that would be developed in the 20th century.

(2) In philosophy of science, a key word accompanied this mathematics, namely "emergence." Insisting that the parts are not such that you can *derive* from them the whole, whatever the meaning of "derive" (deducing, predicting, inferring, etc.), founds the claim that some systems are at least epistemologically emergent (Humphreys 2016; Sartenaer 2016). Emergence is still a hotly debated topic, philosophers and scientists being divided between those who see it as an illusion, following the seminal papers by Jaegwon Kim and his many causal exclusion arguments (e.g., Kim 1999) and those who admit some emergence (beginning with the influential paper by Fodor on the autonomy of special sciences, Fodor 1974). The latter are, in turn, divided between those who mostly consider a priori arguments coming from the philosophy of mind (e.g., Chalmers, Silberstein, Dennett), and those who see sciences like physics or biology as the fields where this question is the most interesting and pressing (e.g., Bedau and Humphreys 2008; Bedau 1997; Humphreys 2008, 2016; Huneman 2012; Guay and Sartenaer 2016). Among this latter group, William Wimsatt wrote an important paper that distinguished two kinds of systems: *aggregative* and *emergent* (Wimsatt 1997). Kant's discussions on technique, mechanics, and purpose make sense precisely here: his distinction between aggregation and technique (Chapter 8) corresponds exactly to Wimsatt's distinction between aggregative systems, in which properties of parts are combined additively, like mass, and emergent systems, in which the addition cannot account for the result of the combination of properties of parts.

Accounting for these topics would require several philosophy books; however my aim here is to show that Kant's arguments about the various relations between wholes and parts, mechanicism, technique, the aggregates, and the difference between accretion and intussusception—all things completely related under the modes exposed above—pre-date the territory on which the scientific

formalization of non-linear relations in complex systems on the one hand, and the philosophical debates on epistemic emergence on the other hand, would take place. This contextualization explains why nowadays, in the field of biology and philosophy, Kant's reflections in the third *Critique* §65 are often cited.

However, I am not claiming that the contemporary landscapes of non-linear dynamics, developmental biology, and emergence are Kantian. And the reason is that one crucial concept in the Kantian argument got lost in translation, namely, the reflective judgment and the regulative principles.

As I recalled, historians discuss how Kant's notion of organism, with its concept of purposiveness, has been taken up by German biologists, yet without admitting the distinction Kant deemed crucial between regulative and constitutive principles. Historians diverge on the exact moment when this distinction was abandoned, and Richards (2000) has pointed out that, even from the outset, the apparent convergence between Kant's and Blumenbach's views on purposiveness—as evidenced by passages in which Blumenbach introduced Kantian terms such as *Zweckmäßigkeit* in later editions of his *Handbuch der Naturgeschichte*—was only superficial: their agendas were already distinct. Zammito (2018) offers good arguments to think that the development of German biology did not take Kant's view of *Naturwissenschaft* on board, in which purpose can only be something in our mind and not in nature. I will refine this account in the next chapter. In any case, the conceptual territory in which Kant intends to reflect on the changes occurring in the way scientists explain vital phenomena partly defines the space within which some of our own concepts about life are situated.

Let me quote the last sentence of the excerpt again: "Only then and for this reason can such a product, as an *organized and self-organizing* being, be called a *natural purpose*." Historians may wonder about Kant coining the word *selbstorganisierende*—self-organizing—, a word promised to so many fascinating developments; the widely read book by Ilya Prigogine and Isabelle Stengers (*La nouvelle alliance,* 1990) indeed made self-organization fashionable in the 1980s, and together with the "chaos theory" (the other, sexier, name of non-linear dynamics) it came to define a crowded conceptual landscape in the 1980s.

But Kant's reasoning is very clear and slightly different. Natural purposes are only natural to the extent that parts produce parts in accordance with an idea of the whole; this production yields not only all the parts, but also their relations and forms—therefore, the organization of the system comes from within, brought about by the parts, themselves produced by parts, with everything occurring according to the double causal circularity exposed above. Thus, organization comes from the system itself, which appears self-organized, even though the template of the system, according to which it self-organizes, is the necessary presupposition of the scientist. Self-organization is required by the fulfillment of the epigenesis criterion. For this reason, natural purposes are self-organized, and, in turn, only a self-organized being can be called a natural purpose, while to be

organized means to fulfill the design criterion, which merely indicates a purpose *generaliter*.

Thus, when Stuart Kauffmann, who developed one of the most influential theories of self-organization of biological systems (Kauffmann 1993), claims that self-organization was originally a Kantian concept, he is totally right. The only nuance I'd add is that the whole notion, for Kant, is tied to this "idea of a whole" as *Erkenntnisgrund*, and therefore, to the difference between reflective and determining judgment, i.e., to the regulative principles, while this disappears in Kauffman's formulation. One might discuss the reasons for this disappearance, and, in particular, point out the huge difference between the mathematics that Kauffman used and the view of mathematized science carried on by Kant, which is massively about Newtonian differential equations. (This difference will be addressed in Chapter 10.)

To sum up, organisms as self-organized beings confer objective reality to the concept of natural purpose, in the sense that it can only be applied to such objects, which satisfy the design criterion (the pre-eminence of the totality) and the epigenesis criterion (bringing about of the parts through one another). But such objects can only be perceived in their specificity (i.e., self-organization) if we place ourselves at the level of simply reflective judgment, insofar as such judgment takes the idea of a systematic whole—in which the parts are organs for one another—as the regulative principle of its reflection and not as constitutive of knowledge. Teleology is not a law of nature; it is not any more a given that we could see.[23] Because of their behavior, some objects that we experience force us to use the reflective teleological judgment, in the light of which they appear as self-organized. Then, "X falls under the concept of natural purposiveness" means that X fulfills the phenomenology of the tree exposed in §64, which, in a word, means that X is self-organized.

One crucial thing should be emphasized here: the two criteria (design/epigenesis) refer to an "idea of the whole" as *Erkenntnisgrund*, and it is the *same* idea, namely an articulated whole in which parts have *functions* relative to one another. The unity of the two dimensions or criteria of natural purposiveness is an essential attribute of Kant's account, and this should be remembered to understand the fate of this account later on (in Chapter 11).

Because of this unity of the "idea of the whole," such an account, in a nutshell, ties the *productivity* of the living (epigenesis criterion) to the constancy of the *form of* the living (design), based on the idea of a regulative principle. I showed above how Leibniz insisted on the constancy of the form of the living matter, in relation to the matter passing beneath it, and how he had to forge the theory of *vinculum substantiale*, in which living matter is the only real compound substance. More generally, the constancy of the *form of* the living has long been a reason for resisting the reduction of knowledge of biology to physics. To such an extent, the Leibnizian-Malebranchian theory of the pre-existence of germs can be interpreted as the formulation of this observation of the irreducibility of

form (as constant across the lifetimes of individuals and quasi-eternal across the species) in such a way as to be made compatible with the physicists' knowledge. But the emergence of the notion of vital force at the end of the 18th century, correlative to vitalism and vital properties (see Chapters 2 and 4), pointed in another direction, according to which life stands out from nature through its specific *productivity*. Caspar Wolff then indicated that this demarcation was to be taken as an epistemological rather than ontological requirement, which constituted the true meaning of the *vis essentialis* of life (Chapters 4 and 6).

Now, we understand that the Kantian analysis unites these two dimensions—form and productivity—by asserting the reflective character of teleological judgment, which philosophically translates Wolff's transformation of embryology. In a nutshell, since the teleological judgment is *reflective*, the *idea of the whole* outlining the parts, which constitutes the dimension of constancy of form, ought to be thought of as an *Erkenntnisgrund* by means of which the parts should ultimately determine and produce one another. This constitutes the dimension of productivity of the living. Kant's uncovering of the "simply reflective" unifies two dimensions of the contemporary affirmation of the epistemological specificity of the organisms, namely, the *robustness of form* and the *intrinsic productivity*. "Self-organization" becomes the novel concept allowing *Naturforscher* to coherently think of dimensions of the living that were separately conceived of through the ongoing examination of mechanicism in the 18th century (beginning with Leibniz and Stahl).

From here too, Kant can claim to unify the two types of explanation of vital phenomena: one that explains any genesis, and another that affirms within it the constancy of form; that is, mechanism and teleology. This movement, better explained in the next chapter, made the Kantian intervention in the field of the constitution of biology very relevant. It is, of course, the ground of the possibility of developing from this account a "teleomechanist" school, as Lenoir put it in *The strategy of life*, which includes Von Baer, Reil, Müller, and others.[24]

By "teleomechanism," Lenoir expresses the idea that biologists should first assume an idea of the whole as the principle of the development of an organism and the functioning of its parts, and then undertake a mechanistic research program. Concretely, this means that seeing an animal, the biologist should first assume that parts are determined by the whole; therefore, to use one of the key words expressing what teleology is, that they have *functions*. And then, the biologist should inquire, by observation, experimentally, or through comparative methods, into the ways a part carries out its function. Breitenbach puts this idea as follows: "By asking for the purpose of a biological trait, for example, we can thus direct our attention to the causal-mechanical processes that determine the trait's causal role within the organic body. The teleological analogy can thus guide research into natural processes to be explained by mechanical laws" (2018, p.247).[25]

Clearly, on the one hand, the unity of the global form of the organism determining the parts, and on the other hand, its productive power, allowing for

self-organization, should be taken as the conditions for teleomechanism. What do the parts in an organism is constrained by the "idea of the whole," but it is produced by other parts, and given that an explanation by definition is mechanistic since it goes from the parts to the whole, reason requires us to always explain through the laws of nature what is done by the parts.

Yet there are two reasons why this "teleomechanism" account cannot be complete. First, as it is clear now, the very definition of the parts as organs already presupposed the transcendental regulative principle of purposiveness, which is not derived from nature. Second, the "instruments of nature" produce results in a way that cannot completely be explained mechanistically, because of their reliance on intussusception. This notion of "instruments of nature" and its justification in Kant's account appear important as a way to characterize the reflective role of the critique within the many theoretical elaborations about life undertaken at the time, as I will explain now.

9.6 The biological forces and the technical analogy revisited

9.6.1 Justifying strange forces in nature

From this last viewpoint, the *Critique of the Power of Judgment* actually offers a deduction and thus a discriminating legitimization of these new forces, chemical and above all organic, by means of which we have seen that scientists of the time were attempting to understand many essentially biological phenomena. Indeed, the notion of "formative force" proposed at the end of §65 enables Kant to distinguish, as a consequence of his analyses, the self-organization of organized beings from the organization of machines, because this difference is expressed in terms of forces. He writes:

> Thus an organized being is not simply a machine, for the machine possesses only a *motive force*; but the organized being possesses in itself a *formative force (bildende Kraft*) which it communicates to materials that do not possess it (it organizes them), thus a propagating formative force, which cannot be explained by the faculty of movement (mechanism) alone.
>
> (Ak. V., p.374)

The machine indeed has a *motive* force: given a certain impulse, it will be able to move certain objects in a determined way, but keeping its proper parts fixed; in turn, the organism has a *formative* force, because it shapes its own parts and, throughout the circular relationship that unites them to each other and the whole, makes them into organs. Granted, the formative force is not empirically observed, but posited as correlative to the type of self-production of the organized being, which itself arises from the requirements of reflective judgment: in this sense, unlike his contemporaries speculating on animals and crystals or

plants, and in parallel with the physical concepts in the *Metaphysical Foundations of Natural Science*, Kant undertook in the third *Critique* a *deduction* of the formative force, namely, a justification of its objective validity through an analysis of biological judgment.

The distinctive feature of his analysis is that it does not propose a doctrine of vital forces, but rather grounds the possibility of such a doctrine on concepts that are necessarily constituted in reflective judgment. Insofar as we perceive in organisms something other than the mere movement subordinated to the law of inertia that characterizes brute nature, we can articulate and conceive it only as a formative force in a simply reflective judgment (an aspect that epistemologically required the transformation initiated by Wolff). From this point on, we can think of the activity of living things in a specific way, within the framework of an autonomous science, since the notion of "propagation" succintly indicates the singular relationships of living things with their environment. The motive force is communicated according to the laws of motion transmission; it cannot affect a body that does not already possess it, at least potentially (for us, the notion of potential energy; previously, "dead force"). This is the whole point of Newtonian dynamics. But the paradox of the living world is that bodies that do not possess any formative force, such as water or food absorbed by plants or animals, can (through nutrition) become organic matter and acquire this force.[26] This cannot be explained by the laws of motion, because it does not fit the model of the transmission of motion.

Reill (1998) linked the proliferation of forces in the chemical and biological fields from 1750 to the emergence of doubts about the generality of the mechanistic model; these forces constituted a problem for the Kantian conception of science, and in a sense their absolute exclusion in a rigorist (a priori, mathematized and Newtonian) model in the *Metaphysical Foundations of Natural Science* limited the scope of any criticist conception of science. With this analysis of teleological judgment in biology, Kant has thus now succeeded in understanding both the scientific legitimacy of these concepts of force, and in finding criteria for restricting their use (they are, as Larson (1979) puts it, "regulative forces"), in a manner analogous to the deduction of Newtonian forces in the *Metaphysical Foundations of Natural Science.*

Thus, the third *Critique*'s account of organisms inherits the vitalist schema of the animal economy, as well as the emphasis on vital productivity found in Buffon, Maupertuis, Diderot, Wolff, and Blumenbach, and it is fully immersed in the broader effort through which post-Newtonian scientists sought for forces of many kinds. This is epistemically straightforward, since the legacy of Newton's success consisted in the assimilation between "explaining" and "identifying a force." In addition, as Gaukroger (2010) made clear, the general post-Cartesian move also recognized the limits of mechanicism, and "sensibility" became one of the explanatory mottos, shared beyond the circle of the Montpellier vitalists or the Haller disciples. The project of Kant in the third *Critique* appears, therefore, as completely timely and in phase with the contemporaries.

But at the same time, it was completely novel, because it tied Kant's sophisticated concept of organism to the reflective position of judgment. Organic productivity appeared *as specific only with respect to the very requirements of the position of reflective judgment*. Unlike the authors just cited, the *Critique of the Power of Judgment* does not really propose any doctrine of the organism, or any "biological philosophy," as we would say today; it merely states the epistemological conditions implied by the concept of the organism as it emerges thanks to the few transformations analyzed in previous chapters, productivity being its primary characteristic.

This is not to say that this enterprise is understandable in abstraction from the theoretical context of the post-Newtonian search for novel explanatory forces, the successive disruptions of the soul–body paradigm of life, and then the post-Leibnizian ruptures with mechanicism regarding life. For instance, Wolff's transformation of embryology (see Chapter 4) meant, in Kantian terms, breaking up with the determining judgment in order to think the vital force in embryogenesis as manifesting the productivity specific to the organism. (I indeed argued that Wolff's epistemically induced *vis essentialis* provided Kant with a clue to the connection between "merely reflective" knowledge of the living and the irreducibility of its specific productivity to any other type of natural fact.)

In this sense, to say that there will be "no Newton of the blade of grass"—as Kant famously said regarding the mechanistic understanding of organism[27]—is not to say that life is infinitely complicated or unintelligible, as one often interprets it: it is to say that it should be conceived of according to a type of intelligibility other than that of gravitation.[28] To this extent, Kant follows Caspar Wolff rather than Buffon, Maupertuis, or even the vitalists and Bichat, who kept in mind the model of the Newtonian method. Newton is as much the key reference for the science of nature in the first *Critique* as he is the contrast point for the epistemology of organized beings in the third *Critique*. Thus, just as a correspondence has been long recognized between Newtonian laws and the principles of Transcendental Analytic, so too, and on another level, there is a profound solidarity between the Wolffian shift in embryology, reconstituted here, and Kant's shift between *Critique of Pure Reason* and *Critique of the Faculty of Judgment*, that is, from "reason" to the "reflective faculty of judgment," in order to analyze the concept of purposiveness.

9.6.2 Reformulating the technical analogy

How did Kant conceive of explanations involving the internal productivity of living organisms? While self-organization and formative force are the notions that allow us to circumscribe the object "organism," which alone confers objective reality to the concept of natural purpose, their emergence nonetheless implied a reworking of the conception of "natural technique" that Kant had renovated in order to think about the teleology of the living.

Indeed, from the moment when the organism appeared as an object providing objective reality to the concept of natural purpose, the analogy between technique and natural purpose has been repeatedly extended. For in every human technique, the instruments are given; no technique would itself make its instruments, nor the instruments to make these instruments, and so on; the matter of these instruments is always given. As an organism, nature brings this matter out of itself, so that the analogy between the two techniques seems difficult to maintain: at best, as we read in §66, it will be a distant analogy. Let us clarify this view by commenting on a few passages where it is expressed.

Already in §64, any "art" remained "infinitely remote" from the way in which the plant produces its own substance. In §65, after listing the criteria of the natural purpose in the text commented on at length here (in §3 and 5), Kant notes:

> Too little is said of nature and its faculty in organized products, when we call it *an analogon of art*; we then imagine the artist (a rational being) outside of it. Rather, it organizes itself and this in each species (*Spezies*) of its organized products according to a single exemplar as a whole, albeit with the appropriate modifications, which are required by conservation (of organization) according to circumstances.[29] (. . .) Strictly speaking, the organization of nature has *nothing in common with any causality known to us* [my emphasis].[30] The beauty of nature can rightly be called an analogon of art, because it is attributed to objects only in relation to reflection on their *external intuition*, i.e., only because of the shape of their surface. But *internal natural perfection*, that is possessed by things that are only possible as *natural purposes* and for this reason are called organized beings, cannot be explained and thought of by any analogy with any physical power known to us, i.e., a natural power, and since we ourselves belong to nature in the broadest sense, it cannot even be according to an analogy exactly proportionate to human art.[31]

Let us begin by commenting on the last two sentences of this text: the absence of an analogon for the organism contrasts with the analogy between natural beauty and art, just as depth contrasts with form. Indeed, we know that beauty is a formal purpose, affecting the form of objects alone, whereas *in the case of natural purposes, production and existence are at stake.* Human art, however, arranges surfaces: through pressure and impact, it does not create the inside of matter. It can therefore provide a paradigm for thinking about formal purpose, but by no means for thinking about a purpose that would go so far as to constitute what is inside bodies and their parts.

The distinction made here seems precisely the one by which Buffon attempted to define the fundamental forces of his physics of the living (Chapter 4). While gravitation acts on surfaces, the forces by which the inner molds act are penetrating; they are analogous to gravitation, but act in depth. For Kant, however, this Buffonian analogy cannot even hold, precisely because the vocabulary of

the driving force, borrowed from physics, and that of human technique, which employs this force to shape surfaces, are unsuitable here. It is true that technique operates within bodies, yet ultimately these bodies are delimited by surfaces and constitute its ultimate elements, into which it cannot penetrate. Thus no penetrating force is at work in human technique; to speak of penetrating forces in Buffon's sense would, strictly speaking, leave us without any analogue, at least in the domain of human art. The distinction between surface and depth, far from allowing an analogy justifying the thought of a physics of the living, as Buffon wanted, in fact marks the impossibility of such an analogy, and the necessity of confining it to the domain of aesthetics.

The natural organizing process makes use of formative forces that go right down to the very core of matter. As the first sentence of the text indicates, the formative force is immanent to what it forms, whereas art is the combination of an external agent and the driving forces it applies. Leading to the concept of formative forces, the search for the object that would fall under the concept of "natural purpose" has thus altered the technical analogy, with which Kant began the rehabilitation of purposiveness in order to conceive of the teleology of the living seen as other than mere language. Hence, this analogy becomes a "remote analogy," which means that it is caught up in a complex argumentation that I will sketch now.[32]

Human technique is always intentional: an intention gives rise to a project that is realized in its execution. Intention, as we have seen, is irrelevant to the *natural purpose*, insofar as it is the principle of the reflective power of judgment alone. This result, added to what I have just said about the impossibility of expressing formative forces in metaphors focused on human technique, would seem to absolutely disqualify the language of a supreme designer of the living, as it looms behind any classical teleology of life. But Kant ultimately rejects such a dismissal, because in the technical metaphor, he has already *neutralized* everything that could make the domain of the living suited to the technical theology of the artisanal understanding, so the lexicon of intentions becomes theoretically innocuous. Kant's analysis of the concept of purposiveness as a principle of the reflective power of judgment has finally neutralized any intentionality taken in the proper sense of the term:

> In order to remain exactly within its limits, physics entirely disregards the question of whether natural purposes are *intentional or not*, as this would be interfering with a different task (that of metaphysics). It is enough that, according to natural laws, which we can only conceive under the idea of purpose as principle, there are objects which are only thus *susceptible of explanation*, and which are only *knowable* according to their internal form, and only internally, in this way. So as not to be suspected of including in our principles of knowledge something that is not at all within the purview of physics, i.e., a supernatural cause, we certainly speak in the teleology of nature as if finality were intentional

> in nature, but in such a way as to attribute this intention also to nature, i.e., to matter: by this we mean to show *(since no misunderstanding is possible in this respect, as no one would dream of attributing to inanimate matter an intention in the proper sense of the term*), that this word here designates only a principle of the reflective faculty of judging, not a principle of the determining faculty of judging, and that it must not introduce a particular principle of causality, but only add, for the use of reason, another method of investigation than that which conforms to mechanical laws, in order to make up for the latter's inadequacy in the empirical investigation of all the particular laws of nature.
>
> (§68, p.383, my emphasis)

The analogy, here, between organization and technique (human technique = art) is not exactly broken. In 1763, by moving from cosmological proof through order to the level of pure possibilities, God's relationship to the world could no longer be called technical (that was what I called the "radical proof" of God's existence). Here, the meaning of the word "technique" has changed, so that we can continue to use it. The model of technical activity is the only one that allows us to think of the pre-eminence of the whole over the parts, the determination of the parts from the whole: thus, we designate in the process of organization "a kind of causality of nature, following an analogy with our causality in the technical use of reason, in order to have before our eyes the rule according to which certain products of nature must be studied" (§68, p.383), this rule being what has been called the "Idea of the whole" which functions as a "principle of knowledge." At the same time, however, the formative force and the self-organizing internal character of the organism break this analogy: "We only grasp and understand perfectly what we can do ourselves and execute according to concepts. But organization as an internal end of nature infinitely exceeds all the power of a similar presentation by art" (§68, p.383). Nevertheless, we can still speak in this way because Kant showed that such an analogy was immediately neutralized as soon as we spoke of nature's intentions. For by attributing a finality to nature, i.e., "to matter," which is by definition deprived of intention since it is inert, *we neutralize what we are saying at the very moment we say it*, showing it to be devoid of ontological meaning. By using such language, we are merely *signaling the change of register* in the discourse on natural causality, from determining judgment to merely reflective judgment.

Kant has separated natural and artificial–technical ends in such a way as to create a chasm between the two, a chasm named "formative force." At the same time, he can continue to use a human analogy, that of a technical understanding, or rather, he can reintroduce this expression, because after he analyzed the organism as a natural purpose, it has been *emptied of its ontological meaning* and no longer risks misleading us into a theology related to biology. On the contrary, such an analogy indicates the *splendid isolation of biological discourse*, which, with this very expression of "intentional nature" separating it from pure

physics, finds itself distanced from theology by the vast gulf between technique and organicity, due to the neutralization of its technical-intentional meaning. In other words, because we cannot think of purposiveness in any other way than technically in order to think of natural purposes, the technical metaphor must be *disclaimed* in our very formulation. Thus, in §75, Kant can write, without the risk of becoming theological: "according to the particular constitution of my faculties of knowledge, I cannot judge the possibility of these things (organisms) otherwise than by conceiving for them a cause that acts by intention, consequently a being that is a producer *by analogy* with the *causality of another understanding*" in the sense of a craftman's causality, i.e., an intentional-technical causality.[33]

9.7 Summing up a conceptual trajectory

Remember that in the *Critique of Pure Reason*, teleology was ontologically synonymous with mechanism, as it was only a heuristic for mechanistic explanations (Chapter 5); at the same time, it was understood as an instrumental relationship from means to end. In the third C*ritique*, teleology envelops a "technique" (a concept derived from *The Only Possible Argument . . .*) newly, *artistically* defined: no longer primarily a matter of means-ends relationship, instrumentality and utility, but understood above all by the pre-eminence of the "idea of the whole" as *Erkenntnisgrund*.[34] It is therefore no longer a matter of the instrumental aim of reason (what we might call technological reason, which Kant distinguishes from practical reason), but of the reflective power of judgment. Between the "Appendix to the Transcendental Dialectic" and *Critique of the Power of Judgment*, Kant moved from instrumental purposiveness, equivalent to mechanism in the explanations it can provide (Chapter 5), toward purposiveness as "technique," opposed in general to "mechanics."

But this "technique" in a new sense retains the artistic dimension of human technical activity, i.e., the pre-eminence of the idea of the whole, rather than its instrumental-utilitarian dimension (i.e., means to an end), which can perfectly well enter the sphere of the "mechanical" application of laws. In §63, the third *Critique* had rejected relative or external finality, i.e., utility for other organisms, from any claim to be the meaning of the concept of purposiveness, one of the main arguments being the arbitrariness of utility attributions.[35]

Ordinarily, the comparison between an animal and a machine can be quite heuristic, but stumbles on one double issue: the machine has a *designer*, who intended to create it; and it has been made for some goal, therefore it tends to serve something else, it is *useful*. Organisms have, of course, no designer, as authors have constantly argued since Descartes formulated a theoretical mechanicism; and organisms are not intended to serve any purpose external to themselves. This is the limit of the machine analogy and, therefore, of the technical language regarding animals and plants. Granted, someone could say that an

animal has the goal: "surviving," and actually, this is completely accepted in some sectors of biology, even though the true meaning of it is discussed;[36] yet nobody would construct a machine whose goal would be to remain there. At least, Jean Tinguely's weird machines—some of them exposed next to the Centre d'Art Contemporain Georges Pompidou in Paris—could be said to have this goal, but they have no utility, and precisely, they are supposed to be works of art.

As a consequence, §63 indicated that the true meaning of purposiveness can only be *intrinsic purposiveness*, namely, purposiveness proper to a system such as an organism independently of other things. Thus, only the parts can be thought of as purposive, to the extent that the system itself is an intrinsic purpose. But human technique makes machines; thus, this is not the proper paradigm for such intrinsic purposiveness; things coming from human art but with no utility, namely works of art, are a better paradigm to make sense of this intrinsic purposiveness. The shift from the logic of means-end (not at all eliminated, of course—see next chapter) to the logic of parts-whole, as a key Kantian claim, accompanies the transition from utility-bound technique to works of art as the paradigm of purposiveness. Initially counterintuitive, it makes sense as soon as we realize that a kangaroo, as well as a Van Eyck painting, has no utility, even though it cannot be conceived of as a chancy assemblage of colors or pieces . . . .

From *The Only Possible Argument. . .* to *Critique of the Power of Judgment*, the Kantian path thus reflected the difficulties of the concepts of order and finality found in Leibniz's first thematizing of purposiveness, reinterpreting the major transformations that made the organism (animal economy and power of development, see Chapters 1–4) into the unavoidable scheme through which the living is perceived as an object of science.

Notes

1 "Experience leads our faculty of judgement to the concept of an objective and material purposiveness, that is, to the concept of an end of nature, but only when there is a relation of the cause to the effect to be judged, which we can understand as lawful only insofar as we find ourselves capable of subsuming the idea of the effect under the causality of its cause as the underlying condition of the possibility of the former" (§63, p.366).
2 "As reason must in every form of a natural product know the necessity of it, if it wishes to perceive the conditions connected with its production, and as it cannot however admit this necessity in this given form, the *contingency* of the form in relation to all the empirical laws of nature in relation to reason, is a principle for admitting a causality for this object only as if it were possible only through reason; reason is the faculty of acting according to purposes (a will), and the object that is represented as possible only by this faculty would also be represented as possible only as a purpose" (§64, p.370).
3 "As in pure mathematics there can be no question of the existence, but only of the possibility of things, i.e., of an intuition corresponding to their concept and not of

cause and effect, consequently any finality we notice there must be considered merely as formal and never as a natural purpose" (§63 p.367 n.1).

4 "However, it is also possible to conceive of a causal connection according to a rational principle (of ends) which, considered as a series, would present a relation of dependence in a descending as well as ascending sense; and in this connection the thing which is designated as effect nevertheless deserves upwards the name of cause of the thing whose effect it is" (§65, p.372).

5 As Körner points out, teleology is "in no way tied to a temporal condition"—so that the concept of "natural purpose" has no schema (1990, p.204).

6 The displacement of the notion of purposiveness from the utility lexicon (means-ends) to the mereological lexicon (parts-wholes) introduces a novel question about purposiveness, namely the notion of mechanicism (remember Leibniz: the question is about final *causes* vs. efficient causes, not *mechanism*). In philosophy of science, we inherited this conceptual shift.

7 More recently, in the same spirit she argued that "teleological laws characterize our reflection on organisms, but they are not constitutive of nature itself" (2018, p.243).

8 As summarized by Van den Berg (2014) Kant's claim is the following: "Kant's claim that any proper natural science must contain mathematics is infamous. . . This argument is based on the premise that proper natural sciences require a 'pure part lying at the basis of the empirical part' and that they are based on 'a priori cognition of natural things'. Mathematics is interpreted as a science that, through providing mathematical constructions, provides a priori cognition of the possibility of determinate natural things" (38).

9 Breitenbach connects such a view with Kant's essential distinction between constitutive and regulative: "On these accounts, since the principles particular to our conception of organisms are purely regulative, they are unable to permit knowledge of biological phenomena, let alone of biological laws" (2018, p.240). Yet she herself "disagrees with the further claim, however, that for Kant "biology could never be a science at all" (Zammito 2012, p.22)." She concludes that "far from falling out of nature and the domain of the natural sciences, as some readers have concluded, there can be a genuine science of organic phenomena and of the laws that govern them." I concur with her verdict, and the rest of this section provides further arguments.

10 Steigerwald (2002) supports a very similar interpretation, according to which the specific epistemology of Wolff's work is reflected by the concepts of regulative principle and natural purpose in the third *Critique*.

11 Ginsborg (2004) pointed out that the inexplicability of organisms is not due to the fact that they are not machines, since they satisfy the first criterion exactly as machines do: it is rather due to a type of production. If "mechanism" is the kind of intelligibility opposed to that of the organism, then she comes to discuss McLaughlin's interpretation of "mechanism" as an explanation that goes from the parts to the whole, as this basic meaning is too imprecise, its teleological opposite enveloping more than the organism.

12 See Adickes (1924, pp.479ff.) on all these authors.

13 Gehler, in a text contemporary with Kant's third *Critique*, takes up this difference between animal bodies that feed on non-homogeneous parts by transforming them "through the organic constitution of their bodies" and mineral bodies that grow by adding homogeneous parts (quoted by Adickes, 1924, II, p.481). Bourguet, however, is not the first to talk about intussusception, and the usual reference to his writings—the *Lettres philosophiques sur la formation des sels et des crystaux et sur la Génération & le Mechanisme Organique des Plantes et des Animaux* (1729)—is wrong, as Bognon-Küss and Demarest (2020) demonstrated. See also on Bourguet, Duchesneau (2018, chapter II), and Chapter 4.

14 All these laws give rise to an understanding of a descending series of causality, which Kant on other occasions calls *explanation* (*Erklärung*) according to which growth proceeds. Notice that this use of *Erklärung* fueled later the debate on *Erklärung* versus *Verstehen*, namely the opposition between explaining and understanding that would from Dilthey onward, frame the epistemological question of the specificity of humanities/human sciences vis-à-vis natural sciences.
15 Wahsner (1993, p.12) rightly points out that only this second criterion enables Kant to avoid deeming masses linked by the law of gravitation—the planetary system—to be organisms, whereas the first criterion alone, the circular relationship of whole and parts, would lead to such a conclusion.
16 "The plant forms (*bildet*) itself, thanks to a substance which in its composition is its own product (. . .). We see in the dissociation and recomposition of the faculty of dissociation and formation (*Scheidung- und Bildungsvermögen*) in this kind of natural being, that all art (*Kunst*) remains infinitely distant from it, if it attempts to reconstitute these products of the vegetable kingdom from the products it obtains by decomposing them, or from the matter that nature provides them with for their nourishment" (§64, p.371).
17 Bommersheim (1918, p.213).
18 Canguilhem (1977, p.105). The quotation is from Whytt, *Essay on the vital and other involuntary motions of animal,* 1751, p.270.
19 Bichat (1801, II, art.6, p.228). See Huneman (2023, chapter 3) for my commentary.
20 When Larry Wright develops the characteristic of the concept of function, so fundamental in biology, which is to provide an explanation of the presence of something, he also recognizes as the intellectual structure of functional explanation a circularity of cause and consequence, which he calls "consequence etiology": "in a functional explanation, the consequences of the fact that X *is* there must be invoked to explain why X exists" (Wright 1973). This analysis forms the core of a conception of function known as the "etiological conception," on which, despite numerous nuances, a certain consensus has emerged in the philosophy of biology (Millikan, Godfrey-Smith, Neander, etc.).
21 Zumbach (1984) has insisted on this intrinsically epigenetic character of the organism according to Kant.
22 "The concept of a thing as a natural purpose in itself is not thus a concept of the understanding or reason; but it may nevertheless be a regulative concept for the reflective faculty of judgment, to guide inquiry into objects of this kind and reflect on their causality according to a remote analogy with our causality following ends in general" (§65, p.375).
23 "Since we do not actually *observe* purposes in nature as intentional purposes, but it is only in reflection on the productions of nature that we add *by thought* this concept as the guiding thread of the faculty of judging, they are not given to us by the object." (§75, p.399). On the term "intentional purpose," see §6 below.
24 This notion does, however, call for certain reservations, elaborated by Richards (2002) among others. These are indicated more extensively in Chapter 10.
25 Breitenbach sees this articulation between functional ascription and the quest for mechanisms as the locus for genuine biological laws. "Such laws could never explain the teleological character of organisms as natural purposes. Instead, they would explain the entirely natural, and hence causal, properties of those parts of nature on which we ordinarily reflect by means of the teleological analogy. In doing so, moreover, they may go some way toward explaining why biological entities and processes appear to us as suitable for reflections in accordance with the teleological analogy" (Breitenbach, 2018, p.249).

26 Hegel emphasized this point in his conception of the living, and in particular in his notion of *Triebe* (*Philosophy of Nature,* §359), which is a "tendency to suppress" the exterior experienced as otherness and negation of self. In her reading of these pages, Bognon-Küss (forthcoming) sees an argument in favor of the essential role of nutrition as the true process manifesting the formative force, and therefore, as the key to Kantian self-organization; the birth of animal and then organic chemistry at the same time, likely to reproduce the operations of homogenizing matter into the organisms' own substance, constitutes for Bognon-Küss a major challenge for Kant's idea of these forces supposedly unfathomable by our mechanistic explanations.
27 For another interpretation of this famous phrase, see Teufel (2011).
28 I extensively analyzed the relation of this example with Kant's previous mentions of snowflakes and blades of grass in Huneman (2019a).
29 We saw how in essays on races the germ theory accounted for what must be called here an adaptation of the members of the species to circumstances.
30 Kant adds here in a note: "On the other hand, a certain connection can be illuminated by an analogy with the immediate natural purposes indicated, which, however, is more likely to be found in an idea than in reality. Thus, on the occasion of the recent transformation of a great people into a state, the term *organization* has very often been used in a very appropriate way (*sehr schicklich*) for the institution of magistracies, etc., and even of the entire body of the State. For in such a whole, each member must not only be a means, but also at the same time an end, and while it contributes to the possibility of the whole, it must in turn, as regards its place and function, be determined by the idea of the whole." Here, the analogy works in the opposite direction: an ideal phenomenon like the State is illuminated by organization as a natural phenomenon; but while the analogy here is correct, this organization in turn has no adequate analogical referent. In a word: it would be an overstatement to see this note from *Critique of the Power of Judgment* as the source for a movement of political thought that goes far beyond Kant. Nevertheless, Kant was right to deem the metaphor "appropriate" in the very text in which he reflects on the modern concept of organism, for the following reason: in this note, Kant establishes the irrelevance of technical analogy to describe the organization of organisms. The organicist metaphor in politics, whether in Herder, Fichte, or Hegel, is intended to break with contractualism (in brief: Hobbes, Pufendorf, Locke, Rousseau), which makes the State an artifact produced by the legal technique of humans (i.e., the contract). If the organism is profoundly excluded from analogy with any human technique whatsoever, then it will be the ideal model to illustrate the State and the nation as entities irreducible to human technique, be it legal. By shifting, in this note, from the human technique-organism analogy, judged inadequate, to the organism-State analogy, judged adequate, and by leaving the first term without a known analog, Kant thus clearly marks the movement by which the metaphor of the organism can be deployed by breaking with contractualism.

    On organicism and technology, see Legros (1983). On the metaphors of state and society in biology, from Galen to cell theory, see Temkin (1977a); for a current view of how to think of a "society of cells" in the context of modern biology, see Birch (2017, chapter 9).
31 On the text omitted in the parenthesis, which denies that organism is "the analogon of life," see Huneman (2008b).
32 On this remote analogy, see another interpretation by Breitenbach (2018, pp.244–45), which does not contradict the present one.
33 For a different account of the key role analogy plays in the Kantian answer to the question of the possibility of a knowledge of life, see Nassar (2016).

34 The shift between means-end toward parts-whole has also been emphasized simultaneously by Zuckert (2007), e.g.: "first, Kant places emphasis not on the purpose of the object, i.e., the good it serves, the reason why it exists or why a rational agent created it, but, rather, on the kind of order a purpose constitutes among parts or properties of an object, i.e., an order of diversity and of contingency" (p.10).
35 An argument already found in OPA, see Chapter 3.
36 Many authors think that this is a rephrasing of the Darwinian idea that animals, plants, and microbes result from Darwinian selection for survival and reproduction; see, for instance, Gardner (2009).

10 Use of reflective teleology

Originary organization, milieu, and type

In this chapter, starting from the Kantian account of organisms, I will expose how it makes sense of Kant's own biological essays, and more generally relates to the ongoing embryology of the times. I will then clarify the problem of the history of nature in its relation to architectonics, which had seemed to be one of the major concerns that prevented Kant from being satisfied with the conception defended in the "Appendix to the Transcendental Dialectic." Then, I will identify the correlation between Kant's analysis of biological knowledge and the fundamental concepts of biological thought developed at that time, beginning with the notion of type. The preceding chapters of this book explained Kant's analysis of biology within the conceptual landscape of biology in the 18th century; now, I turn to its resonances in the 19th century. The next chapter will then explain how this configuration paves the way for theoretical cleavages that still constitute the ground of theoretical biology.

10.1 Originary organization, epigenesis, and the "idea of the whole"

10.1.1 The dispositions, the germs, and the organization

The neutralization of technological language to describe living matter means that it cannot be understood as a manufacturing process based on raw matter. Such a deconstruction has a *positive side*, which accounts for the possibility of an explanatory conceptuality specific to the living. This is the concept of *originary organization*, deployed in §81 of the third *Critique*. The organized being is epigenetic: the parts produce each other; at the same time, this production is not anarchic, but is governed, or at least appears to be ordered, by an "idea of the whole." Although the living being produces itself, this way of shaping itself is neither the work of an external craftsman nor the simple effect of matter being already alive. This latter option is denounced as metaphysically inadequate to the phenomenon of the living in the *Metaphysical Foundations of Natural Science* when hylozoism is rejected (see Chapter 7). Organization must therefore

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take place within matter itself, through the formative force and according to a total anticipatory scheme—the "idea of the whole" as *Erkenntnisgrund*—, without any external agent, and at the same time, without taking advantage of a latent vitality of matter. This requirement led to the concept of originary organization. Kant has already encountered it in his writings on races, under the dual name of "germs and dispositions." It is a nonfigurable, invisible organization that cannot be accounted for beyond its being necessarily postulated. It is "Originary," then, because it is at once indistinguishable from matter itself, and independent of any work of an engineer, a God, or a soul conceived on the model of a technician.

The third *Critique* derived its epistemic necessity as follows. The "idea of the whole," which is posited with any purposiveness, ought to be present, for us, within organic matter itself. At the same time, such an idea of the whole must already be organized, in the sense that within it, the parts are at the service of the whole: otherwise, we would in turn have to conceive of an idea of the whole from which it is constituted, and so on *ad infinitum*. The idea of the whole is itself originally organized; it is the principle according to which we judge the living, the organic; at the same time, it is present in the very matter of the organism, so that the formative forces, characteristic of organicity itself, can be effectively formative according to this idea. Thus, the formative forces—deduced in §65 on the basis of the concept of purposiveness—work from the originary organization of matter on. Such an originary organization cannot be visible, as it is composed of *Keime* and *Anlage*. If it were visible, we could investigate its genesis through the interplay of ordinary motive forces, and the whole criterion of the "formative force," which characterizes the object of the concept of natural purpose, would collapse.

Thus, the "idea of the whole," the *Erkenntnisgrund* of the reflexive knowledge of the living, is projected a second time into the matter of the living, in order to account for the specificity of its formative forces; then it appears as the "originary organization." From an internal Kantian viewpoint: in the writing on races, the notion of *Keime/Anlage* appeared as a necessary concept of the science of nature; now, in the third *Critique*, its legitimacy is deduced from the requirements of reflective judgment as such.

A complex explanatory structure emerges here. As *forces,* formative forces cannot be intelligible if they do not work according to some mechanism; yet, working in this way, they are unintelligible in their specificity as *formative* forces. Thus, the "idea of the whole" as *Erkenntnisgrund*, from which the formative force is deduced as characteristic of the natural purpose, must be posited as prior to the mechanism itself in the object that is a natural purpose.[1] This corresponds to the methodology Lenoir christened "teleomechanism," and it has been a working research program for embryology, at least considering Blumenbach, Pander (2003), Meckel, Serres, or Von Baer. As I said, historians of science debate the extent to which those naturalists agreed with the "regulative" status

of the originary organization, but there was a methodological consensus on the method, namely, assuming some originary organization proper to a species and then unfolding the processes through which this organization can be mechanically enacted.

Even though metaphysically disputed, the question whether the originary organization exists or stands in the eyes of the beholder—or, for a Kantian thinker, among the transcendental structures of our power of knowledge as finite rational beings—did not impact the actual developments of embryogenetic research, and the fact that it evolved from the mechanistic or epigenetic speculation of the Cartesians or of Maupertuis in the 18th century, to the elaborations of key theories such as the germ layers or the main developmental stages (gastrula, blastula, etc.), mostly intuited by Pander and then expressed most classically in Von Baer's seminal treatise *Über Entwicklungsgeschichte der Thieren* in 1828.[2]

10.1.2 Originary organization and generic preformationism

This concept of originary organization enables the articulation of a theoretical position on embryogenesis that Kant called "generic preformationism." The often discussed §81 in the third *Critique* clarifies Kant's epigenetic position on the question of generation, situating the general alternative defined by the resolution of this question.[3]

Kant distinguishes here between *occasionalism* and *praestabilism*: the former holds that God produces a new living being at every mating; the latter, that the formative power of living beings is concentrated at the origin. Occasionalism is immediately disqualified as epistemologically ruinous. Praestabilism is then divided into what we traditionally call preformationism and epigenesis, but which Kant distinguishes more precisely as two forms of preformation, one *individual*—this is our classical preformation, or pre-existence of germs: all beings are individually already formed in germ and only unfold later on—and the other *generic*.[4] It is worth noting that Kant immediately rules out absolute epigenesis, understood in the sense that there is nothing pre-existing generation, so that every living thing is embryologically constructed from scratch; indeed, in this case, we would not understand the conservation of *species* form through heredity. In other words, something always pre-exists the development, the question being what: an individual figure, or a generic entity? In the latter case, only an abstract entity can pre-exist, a set of germs, a virtuality, because otherwise we'd fall into individual preformationism. But if a general type is pre-formed at the outset, how can we understand the *varieties* that are born of the same species? Thus, in the first human being, the figures of the White, the Black, the Indian and so on would have to be present at the same time—so in the end, several individuals would be present and, for the sake of coherence, would have to be nested within one another (since if they were superimposed, we would understand nothing). Thus, generic preformation is necessarily a "*virtualiter*" pre-existence of

"final dispositions," in other words, the Kantian theory of *Keime/Anlage* as originary organization.[5]

Classical preformationist theory, or the theory of "evolution" (in the traditional sense of "germ development")[6] is criticized here in the name of sound physical method, as it was in the opuscules on races and already in *The Only Possible Argument*. . . . It concentrates hyperphysical intervention at the origin—and this is its only difference from occasionalism—but it thereby exposes itself to the following dilemma: either accumulate the protections required by the germs of future generations, so that such final provisions are not absurdly and contradictorily wasted, or let an immensely large number of germs never develop, and thus once again admit an immense and incomprehensible divine waste. Finally, Kant explains, the existence of hybrids implies endowing the male seed with a "purposive formative force," and not merely with the role of mechanically stimulating the development of a germ wholly contained within the ovum. But then, to complete the Kantian line of reasoning, this question of hybrids compels individual preformationism to add an epigenetic concept—the formative force—and preformationism ends up negating itself by becoming superfluous.

This leaves us with the epigenetic germ theory already outlined by Kant to account for the generation of living beings while respecting the concept of natural purpose under which organized beings fall, and which implies understanding in them the mechanistic development of invisible final dispositions. Here's how Kant now characterizes this theory along these lines:

> If, on the other hand, one did not immediately see the great advantage that the advocate of epigenesis possesses over the preceding one, with regard to the reasons drawn from experience as proofs of his theories, reason would nevertheless be strongly warned in favor of his explanation, because he considers nature—with regard to things that can originally be represented as possible only according to the causality of purposes [=organisms]—not simply as that which develops but as that which produces (*hervorbringend*), at least as far as reproduction is concerned, and thus, with the smallest possible use of the supernatural, he abandons everything that follows from the first beginning to nature (without determining anything about this first beginning where physics generally fails, whatever chain of causes it wants to try).

Indeed, in classical preformationism, nature is simply "that which develops," since it merely develops the germ laid down by God, and in which the living future is represented in miniature. Kant continues:

> As far as this theory of epigenesis is concerned, no one has done more than Councilor Blumenbach, both to prove it and to establish the true principles of its application, partly by limiting an excessively presumptuous use of it. He begins with organized matter, any physical explanation of these formations.

> Indeed, he rightly declares that it is irrational for brute matter to have originally formed itself according to mechanical laws, for life to have sprung from the nature of the lifeless, and for matter to have assumed the form of a self-preserving finality; however, under this inscrutable principle of an originary organization, he leaves to the mechanism of nature an indeterminable part, but at the same time impossible to ignore, which is why the faculty (*Vermögen*) of matter in an organized body (unlike the formative force (*Bildungskraft*) which generally belongs to it) is called by him a formative trend (*Bildungstrieb*) (similarly standing under the higher direction and ruling of the former [the originary organization]).
>
> (§81, p.424)

The same desire to neutralize what the third *Critique* would call hyperphysics—which is labeled here the "excessively presumptuous use of epigenesis"—was manifest from *The Only Possible Argument*. . . and even from the *Universal History and Theory of Heaven*. Epigenesis has the upper hand over preformationism on two counts: empirically, since, while Kant certainly does not name Trembley's polyp, or even Wolff's observations, it is clear that these new 18th-century facts, whose importance in the genesis of the concept of organism I identified (Chapter 4), run counter to preformationism—and a priori, since epigenesis reduces to a minimum this hyperphysics proscribed by reason. The originary organization both minimizes the intervention of the non-natural (non-mechanist) and circumscribes the greatest possible scope for mechanist interpretations, not only of germ development but also, above all, of the production of new benefits via the selection of proper germs by the environments.[7]

Even though he calls his account "generic preformationism" (in stark contrast with classical preformationism), let us pay closer attention to the way Kant finally grasped the radical novelty of the epigenetic theories of Wolff and then Blumenbach. Epigenesis, as it emerges in Harvey and then in the Cartesian treatise *De la formation du foetus*, was fundamentally a mechanistic theory. For Descartes, it was a key element in asserting the reducibility of vital phenomena to the universal laws of nature formulated by mathematical physics, in particular through the laws of fluid motion. In this sense, preformationism, as embraced by Leibniz, for example, can be seen as part of a resistance to this hegemony of mechanism, as an affirmation of the specificity of living beings. This is why, in Leibniz's case, it goes hand in hand with the vindication of a generalized dynamism, the assimilation of the essence of material substance to a force and not to extension.[8] In the post-Cartesian field of the 18th century, preformationism could therefore mean, against epigenesis, the acknowledgement of a specificity of the living being.[9]

However, the meaning of terms changed with the emergence of the notion of vital force and vitalism in the 18th century: epigenesis became the affirmation of the specificity of vital productivity, while the theory of preformation asserted the

inertia of nature in general, and of living nature in particular, and the impossibility of bringing anything new into being without God's help (which is the reason why Kant's OPA dismissed preformationism in 1763 [Chapter 3]). The assimilation of mechanism and epigenesis was broken, and epigenesis became a theory of the specific productivity of the living. Finally, Caspar Wolff best achieved this move by freeing embryological theory from the features of intelligibility required by a mechanistic physical theory (research into quantitative relationships, mathematical laws). In this way, the affirmation of a distinct regime of intelligibility proper to living beings now belonged to the side of epigenesis, in contrast to the Cartesian situation. Epigenesis became a theory that reduces and limits mechanism in the explanation of living things: this is the novelty of Wolffian–Blumenbachian epigenesis, after the conceptual shifts associated to animal economy and vital forces,[10] and for this reason Kant acknowledged Blumenbach's essential contribution to the definition of this epigenesis, i.e., to marking a turning point in its meaning since Descartes.

The strength of such modern epigenesis was that it offered the possibility of a mechanistic explanation of living phenomena, while at the same time providing an initial limitation to these explanations, and even more precisely, a guiding framework. Of course, the point here is to distinguish this epigenesis, which we might call moderate because it does not claim to go as far as the origin of organization, from a radical epigenesis, which Zammito rightly diagnoses in Herder and others, and which is the very target of Kant (i.e., the "excessively presomputuous use of epigenesis" he condemned).[11] Radical epigenesis converges with hylozoism to render science impossible: with the former, there are no longer any boundaries in nature, so we can no longer classify, hence there are no longer any possible empirical laws, as the first Introduction to the *Critique of the Faculty of Judgment* reminds us; with hylozoism, there are no universal laws of nature, because no inertia. On the contrary, moderate epigenesis preserves the mechanistic possibility of explanation, while acknowledging the inexplicable, indeterminable status of originary organization.

The difference between radical and moderate epigenesis had no name in Kant's time; that's why he called the latter "generic preformationism." Actually, the usual notion of epigenesis covered at the time three aspects in particular, which are quite distinct for us: the non-preformed embryonic formation of an individual (namely, our meaning of epigenesis), spontaneous generation, and then, by extension, the generation of one species from another. Eighteenth-century authors made the distinction poorly. As a result, many of the controversies surrounding epigenesis are often linked to this non-individual aspect of epigenesis, connected to spontaneous generation. Roe (1980) clearly showed that Haller rejected Wolff mainly because he seemed to include spontaneous generation in his epigenesis. Kant's review of Herder, which I analyzed in Chapter 6, and which expressed his horror at a blurring of boundaries in nature by an unlimited genetic force, parallels Haller's critique of Wolff, as reconstructed by Roe. Both

controversies are therefore concerned with limiting the inaugural (Wolffian) formulation of modern epigenesis, even though Wolff's later doctrine, of qualified matter (see Chapter 6), brought him closer to Kant and further away from Herder (Zammito 2002, pp.302–307).[12]

Understanding how exactly the "generic preformationism" or moderate epigenesis articulates the mechanistic explanation and the postulation of an originary organization (*Keime/Anlage*) requires reading the *Critique of the Power of Judgment* together with Blumenbach and allows us to situate such an account within the overall theoretical landscape of late 18th-century biology. The faculty of organized matter that distinguishes it in its own right, says §81, is the *Bildungstrieb*—a word coined by Blumenbach—, the "formative trend." This *Trieb*, we are told by Kant, is governed by the originary organization; in other words, it forms the animal only by developing what its matter is already disposed to. Finally, the "formative force," *Bildungskraft*, which Kant says belongs to bodies in general—where we must understand "organized bodies" to avoid a blatant contradiction with §65—is subordinated to *Bildungstrieb* in the sense that it is an indeterminate force for forming living things, and thus belongs, identical to itself, to all organized bodies, unlike the *Bildungstrieb*, which, controlled by the originary organization, is differentiated according to species, producing fins in sea lions and antennae in ants. In order to understand Kant's relatively obscure text, we need to think of *Bildungstrieb* as a specific actualization of *Bildungskraft* by the originary organization of a particular species.[13] What the formative force accomplishes, step by step, proceeds mechanically, but the order of activation of the germs is not mechanical, and is instead determined by the formative tendency.

10.1.3 Moderate epigeneticism in context

While the *Bildungstrieb* in this text, explicitly Blumenbachian, is distinguished from *Bildungskraft* to the extent that it is specifically determined, the latter gestures toward the Wolffian *vis essentialis*, which Blumenbach distinguished from his own *Bildungstrieb* for exactly the same reasons. In this three-term construction, Kant reveals the necessary interdependence of germs/dispositions and force, in order to think of living beings in terms of their specificity, and in particular, their self-preservation, according to the individual and the species. Certainly, the formative force would suffice for conservation according to the individual, but the formative *trend* (directed by germs) is needed for conservation according to the species. Ultimately, there are no germs without a formative trend to give rise to developmental mechanisms. Kant's concept of *Bildungstrieb* is grounded in the theory of germs—the non-figurable originary organization—which itself stems, as we have seen, from the requirements of merely reflective judgment. In this way, Kant grasps one of the novelties of post-Wolffian embryology, namely the status of the force of development, that *vis essentialis* whose very nature, as I have

shown (Chapter 4), is the flipside of embryology's cognitive stance, the support for the requirement of continuity that makes its historical descriptions possible.

In this context, Blumenbach was already indebted to Wolff for the possibility of his embryology, even though Kant rather refers to Blumenbach. The major convergence between the philosopher and the naturalist concerns the boundary between the living and the non-living, as acknowledged in the text I quoted above—something less easily found in Caspar Wolff. Blumenbach, in §9 of his *Handbuch der Naturgeschichte*, also distinguished between the "plastic force" that produces crystallizations in raw matter, for example, and the generative force of organized beings, which "can give the seminal substance susceptible of various organizations forms just as varied as these [various living] functions; only these forms are always modified in accordance with a purpose (*Zweckmässig*)." Generative plasticity is essentially not crystallization, even though both seem to shape constant, recurring forms. This claim distinguishes Blumenbach from any of his contemporaries who saw crystallization as the paradigm of a vital formative force, and Kant praised Blumenbach exactly for this insight, in his *Lectures on Metaphysics*. Blumenbach, he said therein, definitely destroyed the "great chain of beings," which would have supported hylozoism, since the continuity between brute and living matter would allow for physical systems behaving lively (Ak. XXIII), and, in the other way round, also supported radical epigeneticism, since any non-living system could produce life, making therefore the science of nature impossible.

Blumenbach sounded indeed very Kantian: for him, "purpose" thus distinguished the mineral from the organized—this term fundamentally meaning here functionality, namely, parts of the animal ought to do something unlike parts of a crystals, hence the difference in their formative forces, and the requirement that functions should be posited originally in the animal. Then Blumenbach went on to say that the machine itself differs from living beings in that it lacks the growth force and its derivative, the reproductive force,[14] through which living beings repair their wounds or simply regenerate their skin and various materials. This exactly corresponds to the third feature of organized beings according to the phenomenology of the tree proposed by Kant in the §64 of the third *Critique*. Organisms display functionality and reproductive force, while crystals only have the latter and machines the former.

According to Blumenbach, living beings are ontologically distinct from inert matter in terms of functionality, and from machines in terms of explanatory principles. As the following passage indicates, "the idea of organized bodies" is an "idea that necessarily carries with it that of an end, of a goal."[15] This sixth edition, here quoted, had indeed benefited from Blumenbach's reading of the third *Critique*, which made him aware of the importance of purposiveness in his own conceptions.

Yet, the convergence between Blumenbach and Kant on the dismissal of the chain of being is not so straightforward. Their perspectives were different: while

Blumenbach argued that two forces, mineral and biological, namely crystallization and *Bildungstrieb,* are essentially different, the Kantian boundary between brute matter and organized beings is *epistemic*: the possibility of understanding some systems, such as "the internal structure of animal and plants," requires a presupposition absent from the physics, and therefore, their two kinds of intelligibility are heterogeneous. Of course, this is enunciated in the context of Kant's transcendental idealism, namely, the the claim that the things in themselves are not accessible to us and therefore cannot warrant any judgment on their essence.

Thus, the same boundary is seen by Blumenbach from an ontological viewpoint and by Kant from an epistemological viewpoint. It seems, therefore, that the connection between Kant and Blumenbach is partially rhetorical, as the authors are not working on the same level. Kant, for his part, seeks to understand what the concept of tendency (*Trieb*) is and why it is justified, but not to explain things through it. Contrary to what has been thought, and contrary to Lenoir's thesis, it is basically impossible for a philosophical theory, whose concerns are essentially metaphysical, to answer a question concerning a specific natural process, even though this alliance between Kantianism and some naturalists proved fruitful in the subsequent development of German biology.[16] However, rhetorically, the support of the major German philosopher at the time was an asset for Blumenbach's views, while reciprocally, for Kant, showing a convergence with a leading contemporary naturalist appeared as a significant theoretical support for his views. Thus, the "creative misunderstanding" diagnosed by Richards (2000) regarding the Blumenbach-Kant relation also uncovers an alignment of interests.

10.1.4 Originary organization and a general account of purpose

Purpose, as conceived by Kant as an epistemically justified concept—a necessary concept, if we are to think about biological reality—can be subdivided into three guises: the idea of function (e.g., breathing), adaptation (e.g., a bear's fur), or the goal-directed activity (e.g., hunting). As an originary organization, teleology primarily designates a type "targeted" by development, namely, a design of parts and wholes likely to exist in a given environment because the proper germs and dispositions have been activated. The fact that these are the proper dispositions is explained by the purposive nature of the originary organization, which guides the building of an organism according to its species type, and allows us to ask proper questions about the mechanisms that bring about this type in an individual.

Such a type is, as Kant explained in his essays on races, adapted to its milieu. The idea of adaptation then articulates all the dimensions of teleology: *originary organization,* considered in reflective judgment, is made up of dispositions that are *adaptations* to the organism's future environment; and adaptations, in turn, define proper *functions*:[17] the aerial environment for instance implies fulfilling the function of flight; finally, these proper functions are realized by physiological

mechanisms directed toward precise goals (flapping the wings, etc.). These interdependent dimensions defining the "natural purpose" then enable us to answer two questions specific to the biological field, namely, the *embryological* and *physiological* questions:

1 Why does embryogenic development take place with such an orientation? (It aims at the species type delineated in the originary organization, and by conforming to it, the adult organism will be viable, since the adult type activates the proper dispositions in its milieu.)
2 Why is this part of an organism there? What is it doing there? (This is the question of the functional norm: what are the body parts supposed to do?).

From here, we can see how the principle of teleologically considering the living takes on a new meaning. Kant formulated it in §66 under the guise of traditional teleology: everything in the organism is both end and means, "nothing is useless" (p.376). Now, the theory of originary organization enables him to reformulate it: "the principle of teleology: never to judge as devoid of purpose in an organized being that which is preserved in its reproduction" (§80, p.420). Here, the teleology practiced by physiology, i.e., the traditional language of the instrument-organ, employed in §66 where Kant extends teleology to everything in an animal,[18] is *clearly subordinated to the consideration of reproduction as both production of oneself and heritable transmission*. Physiology can rely on teleology because embryology is itself teleological—i.e., implies a theory of germs, without which the organic production (*Zeugung)* would be unintelligible; for this sole reason, certain organs are primarily to be considered as instantiating final dispositions, i.e., said to have a *function*. It be clearer that the teleology of the organism for physiology, far from being rooted in an artificial–technical vision of the organism—the organism as a machine according to Galen and Descartes[19]—is anchored in the recognition of self-organization as both the specific difference of the living and the source of its own intelligibility.

Kant thus revives the traditional means-ends lexicon in the formulation of teleology (especially in physiology: Galen wrote about the "usefulness" of organs), but this formulation is clearly secondary and derivative to the original characterization in terms of whole and parts.[20] *The necessity proper to physiological teleology* (i.e., such and such a part must do such and such an action, the wing must fly, etc.) *is conditional upon the existence of originary organizations,*[21] an existence which pertains to reflective judgment (and is therefore never an absolute existence). An organism living on its own, à la Davidson's or Millikan's *Swampam*, without instantiating a species, a variety, etc., would have no "organs," as it would not be possible to identify the truly final parts by the criteria of generation/production: the lineage, belonging to a species, and therefore the intergenerational continuity of reproduction, plays a kind of engineer's role for a

machine, namely, it justifies applying categories of purposiveness (the engineer is supposed to have planned, designed, etc.).

Another consequence follows: physiology is no longer subordinate to anatomy, is no longer the "animated anatomy" of which Haller spoke, when he based his deduction of organ functions on anatomy, using the teleological artificial–technical maxim "everything in the animal is a means." Physiology here is constituted *under the constraint of embryogenesis;* even if its practice is relatively autonomous, its possibility is founded on the correlation among originary organization, adaptation and function at the very heart of reflective judgment, rather than simply on the regulative principles of reason (as in the first *Critique*, see Chapter 5).

With the concept of originary organization, deduced from the concept of natural purpose as the *projection of* the idea of the whole—the *Erkenntnisgrund* of the reflective judgment—onto the matter of the object of this judgment, Kant was able to articulate the reflective dimension and the determining dimension of the judgment. For, on the one hand, originary organization is a requirement of the concept of natural purpose and, beyond that, of the reflective judgment, because it posits in the object of this judgment the "idea of the whole" that is its principle, and in such a way that it cannot be derived from efficient causes. (Otherwise, the simply reflective judgment would be absorbed into a determining judgment that would mechanically explain the organization.)

However, on the other hand, from this unquestionable position of an originary organization, we can attribute to living beings a mechanistic explanation in terms of development: this is what the essays on races do, when they consider the action of circumstances in the production of varieties. The determining judgment, applying the category of causality according to the universal mechanistic laws of nature in general, can only take living organism as its object when the pattern of its organization, according to which its formative force works (in a way that is unintelligible to the determining judgment and the mechanistic laws),[22] is posited as a fact. Such a fact no longer needs to be dealt with, and only produces effects through causes subject to mechanistic lawfulness, namely, motive forces. In short, the concept of originary organization makes it possible *to isolate* that aspect of the formative force that belongs specifically to reflective judgment so that it avoids the determining judgment and the mechanical laws sought and applied through it. In this way, the living provides a foothold to the determining judgment.

This is why Kant places such a concept of originary organization at the heart of his "Methodology of teleological judgment," i.e., his attempt to show how, in actual knowledge of living beings, the mechanism of nature and the teleology specific to living beings are reconciled. To this extent, the clarification of the status of "originary organization" in an analysis of teleology enables Kant to take up his views on the question of the generation of living beings that he set out

theoretically in the essays on races, and whose coherence with the critical system he exposed (§81). Such a coherence grounds the teleomechanist methodology, whose legacy has been traced by Lenoir and others, and is sketched above. But this move also enables him, as we shall see next, to shed new light on the question of the history of nature (§80).

10.2 The history of nature

10.2.1 Kant's novel views on the archaeology of nature

The theory of originary organization as elaborated here sounds reminiscent of the genetic epistemology of *The Only Possible Argument. . .* and *Universal History and Theory of Heaven*: the guiding idea consists in explaining an order by deriving it, over time, from the course of nature, governed by the positing of simple laws—in this case, germs, but the epistemic gesture remains the same. The impossibility of a discourse on origin, demonstrated in the Antinomies of Pure Reason, does not translate into a renunciation of genetic epistemology, but into the assignment of a special status to origin: its correlation to the simply reflective judgment.[23] When we forget this status and reduce originary organization as a regulative principle to the level of the constitutive,[24] we run the risk of the Herderian attempt that Kant criticized, that of an unlimited genealogy of the living through radical epigenesis.

Throughout the years Kant evoked this risk at length, because it represents an exemplary misunderstanding of the subtle articulation of mechanism and teleology that he defended, hence, a temptation to which he could bring us closer, while at the same time the notion of a history of nature was involved within the idea of architectonics presented in the *Critique of Pure Reason* (see Chapter 5).

In the §80, Kant envisaged a hypothesis of mechanical generation of all species, formulated in these terms: "explore, through comparative anatomy, the great creation of organized natures, in order to see whether there is not in them something akin to a system according to the very principle of generation; so that we would not need to remain at the mere principle of judgment (which gives no enlightenment for the understanding of their production)." The idea is clearly to overcome the reflective judgment, therefore to produce a physical theory based on determining judgment. This is called an "archaeology of nature" and its justification appears in this sentence:

> The concordance of so many animal species in a common scheme, which seems to lie not only at the foundation of their skeleton, but also of the arrangement of the other parts, where an admirable simplicity of plan has been capable, by lengthening this part and shortening that, by enveloping this part and developing that one, of producing such a great diversity of species.

The reasoning considered by Kant is fivefold:

1 Comparing various species' skeletons.
2 Imagining simple transitions from one to another.
3 Inferring from the possibility and generality of these transitions a common template, or blueprint, or plan, on which animals have been built.
4 Asserting that these transitions occurred in history, through an actual mechanism. (Possible mechanisms for these transitions are conceivable since the process of activating one latent germ and disposition, after a migration to a new environment, explains the occurrence of varieties. The same reasoning could explain the emergence of species, and, by generalizing it, the emergence of all the forms of animals).
5 By jumping to the terminus, *a quo* of the process, all those forms could have proceeded from plain brute nature.

As Kant says, concluding this move:

> This analogy of forms, inasmuch as despite all differences they seem to have been produced in accordance with a common original type (*Urbild*), reinforces the conjecture of a real kinship (*wirkliche Verwandtschaft*) of them in production from a common original mother (*Protomutter*), by the fact that animal species approach one another by degrees, from those in which the principle of purposes seems best established, namely humans, to the polyp; from there to the mosses and lichens; and finally the lowest degree known to us in nature, raw matter.
>
> (§80, p.418)

Steps 1–3 are not imagined by Kant; they were discussed commonly across the zoologists, especially since Petrus Camper, cited by Kant about anatomy, Felix Vicq d'Azyr and before them by Buffon and Diderot (as I will explain below) engaged in such comparison-based speculations. But what Kant rejects in this text is step 4, and especially step 5.

The analogy between species observed in natural history, aided by comparative anatomy, thus gives rise to the idea of a system of nature in which species would produce one another, and in which the boundary that *nature's technique* established between organisms and raw matter would then dissipate, nature's technique resolving itself into a process identical to that of the mechanics of crystallization. "From this and from its forces, according to mechanical laws (similar to those according to which it acts in crystallizations) seems to come all the technique of nature, which is so incomprehensible to us in organized beings, that we believe we need another principle to conceive of it" (§80, p.419). This sentence is ambiguous, but one meaning is that this theory, "similar" to a crystallization theory, provides a mechanistic explanation of the "technique of

nature," which is, when we consider organisms one by one, epistemically irreducible.[25] Thus, this view jeopardizes the major claim made in the third *Critique*, regarding the regulative character of the purposiveness in nature and therefore its non-derivability.

The key term, here, is *Verwandtschaft,* an affinity between species whose necessity was required initially by the hypothetical reason (in the Appendix to the Transcendental Dialectic) and then by the reflective power of judgment (see Chapter 8), and the *Ur-Bild,* which assumes the reality of an originary organization, for all life on Earth and not only for one species considered from the viewpoint of generation. This "archaeology of nature" provides a picture of the biosphere as emerging from raw matter, and, moreover, as a sequence of forms that seem more and more adapted to their milieu. But this progress slows down, and finally, the generation of species produces "specific species" separate from one another (hence, unlikely to hybridize), yielding the current biological diversity, which is here to stay:

> The archaeologist of nature is therefore allowed to bring this great family of creatures (for this is how it must be represented if this so-called universal kinship is to have any foundation) out of the traces that remain from nature's earliest revolutions, according to all its known or supposed mechanisms. From the Earth, which was just emerging from its chaotic state (rather like a large animal), it can first give birth to creatures of a less purposive form, and from these in turn it can give birth to others which are formed in a manner more appropriate to their place of reproduction and their reciprocal relationships; until the matrix itself freezes, ossifies and limits its offspring to specific species, which will no longer degenerate, and diversity remains as it was at the end of the operation of this fruitful formative force.

But Kant then goes on to show that this program is, in fact, unfeasible, as he writes in an often-commented paragraph:

> To this end, however, [the archaeologist] *must endow this universal mother with an organization that is purposive* in relation to all these creatures, for otherwise the purposive form of the productions of the animal and vegetable kingdoms is no longer conceivable in its possibility. But then he has only pushed back the principle of explanation (*Erklärungsgrund*) further, and cannot claim to have made the production (*Erzeugung*) of these two kingdoms independent of the condition of final causes.
>
> (§80, pp.419–420, my emphasis)

The text quoted legitimizes an "archaeology of nature," and the whole wording reminds the modern reader of the transformist idea: overall kinship, families of species, "species appropriate to their place." But this feeling should be resisted,

since Kant dismisses transformism in all current forms.[26] In his terms, this text refutes the possibility of deriving any *technique of nature* from the *mechanism of nature*. But the resemblances and analogies between species, the difficulty of drawing firm boundaries between varieties, the possibility of supposing a template (*Ur-Bild*) of which they are modifications—all of this nevertheless legitimately invites the project of an archaeology of nature, as an inquiry about the past organic conditions of the current biological forms. However, says Kant, this archaeology does not go all the way back to inorganic nature, because it is always necessary to postulate an originary organization at the foundation of the first formation from which all the others derive. The whole *Critique of the Power of Judgment* has shown that without such an assumption, the very possibility of producing organisms, namely, objects which by essence fall under the concept of natural purpose because we cannot apprehend them otherwise, is inconceivable.

However, this text invites us to conceive of the *Ur-Bild* as a type revealed by comparative anatomy. Granted, teleology implies that there is at least one type, at least one originary organization—i.e., one that cannot be derived from mechanism—otherwise biology disappears. But then, it raises the *empirical* question of how *many* types are actually necessary: archaeology of nature finds here its rational locus in addressing this question.

Compared to his earlier critique of Herder, Kant thus goes further in admitting the validity of an archaeology of nature. As long as the originary organization is safeguarded in its impenetrability to the determining judgment, we can practice this archaeology, for ultimately, we are protected from the risk of everything arising from anything at all. Let us not forget that Kant's resistance to Herder was less biological than metaphysical: now, in the *Critique of the Power of Judgment*, the order of nature was guaranteed, not by reason, but by the presupposition of the reflective faculty of judgment; insofar as biology itself is constructed in the field delimited by this faculty, we have no reason to fear that it violate the order of nature, and thus undermine the preservation of species differences. The initial presupposition of the reflective faculty of judgment can ensure us a priori that, even if there were only one originary organization at the outset, it would specify its germs and dispositions in such a way as to give rise to differentiable and classifiable varieties and species. The hierarchy of species would necessarily be respected. Hence, theories speculating on the transition from one variety to another, and then on the transformations of species, need not be judged metaphysically, but simply evaluated scientifically: Kant can afford to be here far more liberal with Herder than he had been ten years earlier.

In a footnote, he proceeds with such assessment in two stages: *logically*, the theory previously defended by Herder, namely, the theory of an archaeology of nature going back to a single original type, is correct; it is a "bold adventure of reason" to which scientists, at this stage of their knowledge of life, are irresistibly driven. Since it connects the living to the living, Kant ascribes it to what he calls "*generatio univoca*," and it is rationally acceptable, unlike spontaneous generation, labeled "*generatio equivoca*," which overcomes the sphere

of organized beings. The latter faces the knock-out argument of the need for an originary organization, just recalled in this §80. As to the former, it can be divided into ordinary within-species generation (which "produces a product that is in its organization itself homogeneous with that which has generated it"), and a transformation that he labels *generatio heteronyma*. Empirically, such generation seems however difficult to accept, as there exists no direct corroboration. This argument is rather new, and would have been convincing at the time: "as far as our empirical knowledge of nature extends," we have never encountered an individual giving birth to another one of a different species (§80, p.420). Kant had indeed nothing a priori against the derivation of species from one another, and at the same time, he did not believe in it, because we have never observed a fish beget a frog. The essential frontier to preserve was that between the living and the inert, a boundary threatened by hylozoism and radical epigenesis: a restricted archaeology, respecting its limits, is valid, even if empirically false for the moment. One immediately thinks of Darwin here, and sees the Darwinian move as a way to bypass Kant's rather naive objection to *generatio univoca heteronyma:* considering very long timescales and population-level processes extends the range of plausible empirical processes through which a species begets another species. But a hypothetical Darwinian could still be Kantian here, provided she admits the epistemic boundary between the first living being and brute matter.

While Kant himself does not believe in the evolution of species, this is not a priori rejected by the critique of teleology. Blumenbach himself, in connection with a sentence about the supposed chain of beings presupposed by the fact that organic bodies beget one another, points out that in his *Beiträge zur Naturgeschichte* he had "advanced facts which make it more than probable that even in the present creation new species of organized bodies are born which are, as it were, created after the fact."[27] The theory of generation and restricted transformism defended in §80 of the *Critique of the Power of Judgment* matches this view from Blumenbach (just before Kant's acknowledgment of Blumenbach's contribution in §81, regarding theories of generation). This is undoubtedly why Blumenbach's heirs, such as Tiedemann, would accept the idea that species could descend from one another—not, of course, in a Darwinian mode, but in a way that allowed for change and progress between original types of organization. This doctrine, as Richards shows in *The Meaning of Evolution*, was shared by 19th-century German biologists, with varying degrees of nuance and reticence, as exemplified by Von Baer.

10.2.2 Archaeology and architectonics

Such an idea of the archaeology of nature sheds new light on the transcendental problem of architectonics exposed Chapter 5. Indeed, if an archaeology of organized beings is conceivable, linking all species to the same originary organization through a derivation that can be thought of in mechanistic terms, then

nature would have to divide itself into genera, species, subspecies, and varieties, through the course of history. As soon as the simply reflective judgment constitutes the concept of natural purpose, and organisms exist, then in order to think about them, we must have recourse to an originary organization, hence, we are allowed to postulate an archaeology of nature. As a result, the beings of nature can be classified into genera, species, etc., because they are all related (*Verwandschäfte*) in the sense of *real derivation.*

The concept of originary organization as a requirement for simply reflective judgment thus connects the two problems of the third *Critique* concerning nature, namely the unity of the empirical laws of nature, and the organisms as natural purposes. Just as the reflective faculty of judgment can conceive of a living being in terms of *final development*, and thus know a criterion for being able to think of *a part* of an organism *as a means* (see above §1.3), it can also be assured a priori that, for any given organized being, it will be able to *classify it in a species* or form a new empirical concept for it in terms of genus and species.

Genus now means *the unity of an originary organization*. This was one of the achievements of the essays on races, taken up by the third *Critique*; classifying, forming empirical concepts, are, for organized nature, operations that are not abstract, not purely taxonomic and arbitrary, but that concern the material and historical depth of organized bodies, since it is ultimately a question of comparing originary organizations and their developments.[28] Though reflective, the simply reflective power of judgment does not perform a purely arbitrary act of classification. Its exercise is deeply correlated with the concept of an organism as an animal economy with its own functional depth, and quite distinct from the animal according to ancient natural history, namely, a visible surface made of sign-characters to be classified.

In the third *Critique*, the privileged character of the *vital* metaphor to express the architectonics of reason (see Chapter 5) found the means to justify itself: it is expressed in the language of organic vitality, because organized nature can indeed be thought of as an archaeology, in other words as *the historical development of an architectonics*.[29] The *systematics* of organized nature (genus/species relationship) is thinkable as *historicity*: this implies that architectonics itself, as it appeared obscurely in *Critique of Pure Reason* without yet being legitimized, must be understood as historical. The first *Critique* had no answer to the question it triggered: "how can the organism exemplify architectonics?". Yet, the third *Critique* proposes the following answer:[30] in order to be conceived, the animal requires this originary organization, which at the same time allows the archaeology of living nature as a system of genera and species, i.e., as architectonics. In this sense, the systematicity of reason, as historical (i.e., as developing), is and must be expressed in biological language. The transcendental history of nature, whose form I sketched above from the 1775–77 essays on races, is thus possible against the backdrop of the structure of simply reflective judgment.

We see, then, that the analysis of the teleological judgment concerning living beings is not an appendix to critical philosophy; it is not a chapter of applied criticism or philosophy of biology in which Kant draws inspiration from Blumenbach. Much more profoundly than that, it elucidates the status of reflective notions (such as "architectonic" or "system") by which critical philosophy analyzes reason itself, and it legitimizes their use.

A longstanding consequence of those reflections is a rearticulation of the conceptual landscape of disciplines in biology. As to natural history, whose activity in shaping empirical concepts was the paradigm for the problem of the unity of empirical laws posed by the introduction to the third *Critique*, it has just received a new interpretation in terms of kinship through originary organizations: i.e., while "identify" and "classify" remain its two operations, they are no longer to be thought of as a quest for common visible characteristics, but as identifications of real kinships at the level of originary organizations, i.e., investigations of germ identities and differences. This change in meaning distinguishes the natural history of organized beings from the general, previously undifferentiated natural history of the three kingdoms.

The mentions of comparative anatomy and *Ur-Bild* in §80 bear witness to this new articulation, which changed the meaning of natural history for Kant's contemporaries. His search for analogies and resemblances in the inner organization of living beings is framed in terms of a profound unity of the living world, to be conceived of in terms of originary organizations developed in history. The Kantian concept of organism thus echoes precisely the notions of "type" and "plan" as developed by comparative anatomy for half a century, from Buffon to Geoffroy Saint-Hilaire, going through Vicq d'Azyr, Goethe, and Cuvier. I will now ask what the presence of "type" in the Kantian text indicates in retrospect, namely, the correlation between the concept of "natural purpose" forged by the third *Critique* and this fundamental dimension of the schema of the organism, the "type," soon to become central in comparative anatomy.

I begin by considering Goethe's notion of type, since he explicitly confessed that with Herder they finally undertook this "bold adventure of reason" that Kant invokes against Herder in his meditation on the archeology of nature. The way they undertook it carries important teachings for whoever studies the epistemological history of biology.

10.3 The type and its antecedents (from Buffon to Goethe)

> He seeks to fashion a conception of nature that owes nothing either to Newton or to God—at least, not to the God of the religions. He rejects the notion of creation, discerning in the evolution of organisms its irrefutable refutation. Yet, on the other hand, he refuses to explain life by the sole play of physico-chemical forces. In this respect, his ideas are not so very far from our own. We possess, it is true, the advantage of countless facts brought to light since his time. But the idea we are able to form of life

> has gained only this: to express itself in more exact contradictions, and in enigmas at once more numerous and more intricate.
>
> Paul Valéry. *A discourse in the honour of Goethe*.

The theories of Wolff and Buffon, discussed in Chapter 6, focus on the species as a framework for variations. Conversely, once we think of varieties as variations on the same theme, and once the species refers to something other than the visible forms given in experience, we can construct an abstract form, hidden in nature, which would function as the theme of all these variations; and from several of these forms, we can construct a new one by the same method. This is the idea of the animal "type," the *Ur-Bild* named in §80. As it is shared by several species, Kant refers to it in terms of comparison. "Type" is then a crucial aspect of development, and Kant sees it as transcendental, insofar as this is the status of originary organization.

10.3.1 Prototypes of the prototype

The prehistory of the general animal type refers back to Buffon, who in his *Histoire naturelle de l'âne* writes: "we will note that although all these beings exist solitarily, and although all vary by differences graduated to infinity, there exists at the same time *a primitive and general design* which can be followed very far, and whose degradations are much slower than the figures and other apparent relationships."[31] Diderot too gives the example of quadrupeds, in which functions are found in all species, with a few organ transformations—but, even if he has been widely read, like Buffon, he relied on Daubenton's descriptions in the *Histoire naturelle* (Tome IV. *Description du cheval*). But he goes on to generalize to the entire animal kingdom, in a way similar to Kant's description of the archaeology of nature: "would you not think that there was only one first animal, the prototype of all animals, whose nature only ever lengthened, shortened, transformed, multiplied or obliterated certain organs?" (Diderot 1753, 565) Diderot then goes on to speak of the "successive metamorphoses of the envelope of the *prototype*," which thus reaches all levels of the chain of beings "by insensible degrees" and can thus "populate the confines of the two kingdoms with uncertain, ambiguous beings, stripped for most of the forms, qualities and functions of the one, and clothed with the forms, qualities and functions of the other." The text in §80 of the third *Critique* figured out the same sketch of the animal type through steps 1–3 of Kant's reasoning above: lengthen it here, shorten it there, and you get the different animals; Kant's *Ur-Bild* and Diderot's *prototype* are kindred notions.

Rather than a pre-Lamarckian theory of temporal transformations of a single rudimentary element, Diderot suggested that Nature produces many variants of a hypothetical form at once—a quasi-simultaneous multiplication of "variations

on a theme", these being continuously linked together by an infinite number of intermediaries. This is confirmed by the rest of Diderot's text: the prototype is "a hypothesis essential to the progress of experimental physics, to that of rational philosophy, to the discovery of the explanation of phenomena that depend on organization." With this hypothesis, we can guess, by comparing two animals, what in one is invisible, assuming that it is a hidden version of what is present in the other. In this way (and unlike Buffon's account), the prototype is simultaneously a clue for the search for the hidden and the outcome of the investigation, i.e., the form that the philosopher reconstructs by juxtaposing the visible parts that the prototype discloses across its variants. But Diderot gives no method for constructing the prototype, which has the status of an unworkable hypothesis. Diderot's thinking here resembles Kant's archaeology of nature in its untenability: the dream of an organization that is the mother of all others, but the absence of methodological principles for establishing derivation.

10.3.2 Goethe and the "adventure of reason"

Type thinking, as used in early biology, essentially refers back to Goethe, who elevated the vague hypotheses of Buffon and Diderot to the status of theoretical constructs. Nevertheless, for Goethe, causal *explanatory hypotheses* were less important than *knowledge of forms*; hence, the gap between his theory of type and speculations on generation. On this basis, drawing on his work on metamorphosis of plants in 1790 and on his discovery of the human intermaxillary bone (1786), Goethe formulated a concept of type which, in its most precise formulation, initiates a certain trend in biology—common to zoologist Geoffroy Saint-Hilaire and *Naturphilosophie*—which emphasized the idea of unity of plan.[32]

The history of the concept of type, after its first sketches by Buffon and Diderot, and the critical examination of the archaeology of nature in the third *Critique*, finds a landmark in the natural history writings of Goethe, namely the *Metamorphosis of plants*, about botany and the numerous essays on morphology that Goethe published in a journal he launched himself. The notion of type was crucial in Kant's *Critique*, since, as I just showed, from the viewpoint of the history of nature, it realizes the "idea of the whole" that Kant ascribes to reflective judgment as a transcendental presupposition. This instance of the whole derives from a first instance of it, namely the notion of "originary organization," which renders embryological description possible since it is posited as a norm and a goal for development. The *Ur-Bild* functions as a synthesis of many originary organizations from many species, recovered by comparison and imaginative morphological transformations (as explained in steps 1–3 of Kant's reasoning above). The type may support a restricted history of—in practice, a history of the derivation of varieties from a given species, via adaptive mechanisms.

Goethe's writings were important because they took seriously this idea of a type, expanded the process of deriving it—in a way akin to Kant's five steps reasoning—and played a seminal role for the comparative anatomy in German settings called "transcendental morphology" (Sloan 2007; Rehbock 1983) as well as for Geoffroy Saint-Hilaire's influential *Philosophie anatomique* (1828). As Rupik (2024, p.34) recently said, "Especially in German-speaking lands, Goethe has consistently functioned as the patron saint of a more holistic way of thinking about and approaching biology, invoked and emulated by those familiar with his scientific works to ward off biological perspectives that were too narrow, reductive, or mechanized." I need to consider those writings because they explicitly position themselves vis-à-vis Kant's third *Critique* and reflections about type in the above-studied paragraph 80. And overall, Goethe is very concerned about situating his own views with respect to Kant's, given that Kant's ideas of the science of nature played a normative role for many German thinkers.

For Goethe, the science of the living was, first and foremost, *morphology*, and it is only through this that it can grasp the living as living. In his 1795 "Outlines for a general introduction to comparative anatomy," he noted that "anatomy is to organized bodies what chemistry is to inorganic bodies" (174), but by this word, he no longer meant anatomy that dissects man or animal, but anatomy that can uncover the essential form from which an animal or plant is built. This anatomy is comparative anatomy. In nature, everything is influenced by everything else, so that the usual distinctions between "cause and effect, disease and symptom, act and character" are of little use. Thus, instead of tracing connections between cause and effect according to laws, science aims to grasp what remains constant amid the variation of shapes.[33] This point of constancy is not a natural law, but an *organic type*.

Goethe put into practice the idea of morphology as comparative anatomy first in his 1790 *Metamorphosis of Plants*, a text whose impact on later botanists (such as his future disciple Voigt) was late but significant enough for Goethe to praise it in his 1831 *History of My Botanical Studies*.[34] To study metamorphosis, he postulated a "force of nature that gathers several leaves around an axis" (§34); then he showed that, rather than creating a new organ with the calyx, it "gathers and modifies a new organ already known" (§38)—the *leaf*. "We have carefully observed the evolution of this force by which the gradual metamorphosis of the same organ (the leaf) takes place," he wrote in a summary (§84). The leaf is the sepals, as we can see by gathering them and bringing them together on a single axis (§32); by another transformation, it becomes the style (§72). From cotyledons to seed, passing through the leaf, flowering—calyx—corolla, stamens, style, and fruit, the same leaf-organ appears transformed. Such is the metamorphosis of annual plants: the use of the leaf to produce all plant organs through regulated modifications, and thus, to capture—starting with one single plant—the modifications to it that allow passage from one plant species to another, since this organ-generator, the leaf, is present in every plant. The notion

of metamorphosis is so crucial that recently Rupik (2024) used this term to name a "metamorphic organicism" alternative to the neo-Darwinian mechanistic biology supposedly hegemonic today, which he tries to reconstitute:

> Within a metamorphic organicism, form derives from transformation, *morphe* from metamorphosis. This is not to say that the 20th-century organicists didn't ground their work in a similar intuition, but only to emphasize the fact that turn-of-the-19th-century organicism already articulated organismal life as processual, morphology as dynamic, and biological systems as patterned yet open. Metamorphic organicism is a philosophy of biology which recognizes the developmental and adaptive activity of organisms to be (ultimately ineliminable) features of the territory it seeks to map and understand.
>
> (p.49)

For Goethe, to know plants means "establish the laws of transformation by which nature can produce the most different forms by modifying one and the same organ" (§3), namely the leaf. But this fundamental leaf is not to be misunderstood. Goethe speaks of a "transcendental concept" of the leaf, to indicate that the leaf in question is the ordinary leaf we see, but grasped as capable of transformation; it is not a particular leaf that becomes a calyx, corolla, etc.; but each of these plant forms is understood as a regulated modification of the *leaf form*, even if it is not necessarily derived from leaf matter. Hence the conclusion that there really is no "general term" supporting the transformation process: if the calyx is a contracted leaf, we can just as easily describe the same process starting from the calyx and claim that the leaf is an expanded calyx. What is matters is the identity of a form that can be called transcendental, because its lawful transformations allow us to account for all the plant's organs. As I will explain later, one sees that this fundamental leaf shares the transcendental status of the originary organization in Kant's account of organisms.

These laws of transformation involve "principles of expansion and contraction, compression and anastomosis," which, when applied "like algebraic formulas" (§102), enable us to grasp the metamorphoses of each plant genus. In this sense, and bearing in mind the transcendental dimension of the leaf concept, Goethe can write: "The same organ, which has developed as a leaf on the stem and taken on very varied forms, now *contracts* to give the calyx, *expands* again to form a petal, *contracts* again in the sexual organs to spread out one last time in the fruit" (§115, my emphasis). So, in addition to the identity of the support—the transcendental leaf—the identity also concerns the operations performed upon it at several levels of the process, namely *expansion* and *contraction*. Since each of them is applied iteratively at different levels, they give rise to different manifestations.

Hence, the idea of an *Urpflanze*, the original plant, which is both the starting point of a transformation process across the whole set of plants, and the most

general type of the plant, manifesting on itself those principles of metamorphosis from which the plant has built itself.[35] Goethe notes that the plant's growth is "a manifestation of its vital force" (§113), and this on two levels: that of growth, which produces stems and leaves, and that of reproduction, which produces flowers and fruit. But these two dimensions reflect the two fundamental operations of metamorphosis: extension and contraction, since the budding plant expands and the flowering plant concentrates, i.e., rises (§113). The plant type as expressing vital force involves an idea of epigenesis, which in this field is deployed under the heading of "metamorphosis." The *Ur-Pflanze* plays the same role as the *Ur-Bild* in Kant's idea of archeology of nature: a transcendental idea of the whole which allows for making sense of a sequence of forms, as a sequence of transformations of the transcendental leaf. A major difference is however the nature of the succession. For Goethe, the processes of metamorphosis are not to be mechanically explained, while the "archeologist of nature," according to Kant, intends to provide such a mechanistic explanation of the series of species forms: I will address this difference directly in the next paragraph, concerning morphology.

The *Metamorphosis of Plants* focuses on the "manifestations" of vital forces. "Without claiming to discover the primary generative springs of nature's actions, [we have] focused our attention on the manifestation of the forces by which the plant gradually transforms the same organ" (§84). The sequences of the leaf according to Goethe resonate with the sequence of embryogenetic stages that Caspar Wolff ascribed as an object to nascent embryology (Chapter 4). While Goethe's view sounds more phenomenological and less explanatory than Wolff's theory of epigenesis, this difference fades if we consider the construction of the concepts and the methods by which the two discourses build their object.

First, the concept of life force. In Goethe's case, it constitutes an epistemological requirement, much as in Wolff's. There is a force, he writes, "that gathers leaves around an axis," that can even "render these gathered and modified leaves more unrecognizable; it then binds them together sometimes totally, sometimes partially, and welds them by their sides" (§36). Here, the genetic force is, as it were, the flip side of the continuity of phenomena, guaranteed by the identity of the leaf as the medium of the process. Since the leaf is the same at each of its moments, a force is required to account for its transformation from one moment to the next. While the leaf's identity makes the process of metamorphosis conceivable, the postulation of a force guarantees the continuity of this process. Goethe's need to conceive of a force as specific to the vital order thus seems to be based on the same configuration as Wolff's. Indeed, Wolff was the one who, before Goethe, had the idea of considering the identity of the leaf throughout plant growth. Goethe quotes a passage from *Theorie der Generation*, where Wolff writes: "In the whole plant, whose parts at first sight differ so extraordinarily from one another, we see, when we weigh everything up, nothing but the

leaves and the stem, of which the root is a part." The possibility of this Wolffian anticipation undoubtedly rests on the affinity of the Wolffian epigenesis device with Goethean metamorphosis, which is established by the requirement of a force as the support of the continuity of the process.[36] But Goethe is not satisfied with Wolff's description, for the naturalist has not entirely grasped the force at work here: "In the course of the plant's transformation, he [Wolff] observed that the same organ constantly contracted and shrank, but he did not see that this reduction alternated with an expansion. He saw that the volume was decreasing, and did not notice that the organ was simultaneously becoming thinner; thus, he mistakenly attributed to atrophy this march towards perfection" ("Preliminary work for a morphology of plants," 171). Thus, Wolff ascribed to the exhaustion of the force of growth the responsibility for a phenomenon that stemmed from the dual nature of this force, a nature that he had not been able to sufficiently intuit.

We can verify the conceptual proximity between Goethe and Caspar Wolff by focusing on the metamorphosis of the leaf. Goethe recognizes the correlation between the vital forces as such and the need for continuity in vital phenomena, seeing in this force of expansion and contraction the link between what is or appears isolated.[37] In the final analysis, therefore, the force in question has no name; it is the guarantee of the possibility of describing a continuity and coherence of a specific order, irreducible to the continuities found in physical processes. This is why, unlike Newtonian forces, this force, like Wolff's *vis essentialis*, cannot be identified with a mathematical law governing its manifestation. And yet, laws are sought for it, but laws which, as Goethe attempts to state, are mostly a framework for a description: formal laws rather than laws governing causality. For instance, Goethe thus identifies three qualitative laws, the first according to which each knot has the power to develop, extend and engender another knot, the second according to which the succession of knots changes as they develop, the third according to which when the calyx forms, the different parts develop simultaneously.[38]

Provisionally, I will explain how his views adhere to (1) and depart from (2) the Kantian framework.

1 These three laws clearly have the status of regulative principles, since they are not constitutive of the phenomena, but describe the behavior of a transcendental leaf that plays the epistemic role of Kantian transcendental presuppositions of teleology.[39] Precisely because they are not a matter of physical necessity, the formal laws that Goethe draws out are typically regulative principles in Kant's sense: the prerequisites for any grasp of the plant type and its realization in the various plants.

In an essay for his *Metamorphosis*, he offers as a corollary to the transcendental concept of the leaf the infinite power of reproduction of the *plant*, i.e.,

ultimately the model of the tree that Kant analyzed in detail in §64 of the third *Critique*.

> In the first essay, I endeavored to show that the different parts of the plant are born of an organ that is absolutely the same, which, although basically always the same, is modified and transformed by progression. This axiom rests on another principle, namely that a plant has the power to multiply infinitely by continuing to produce completely similar parts: I can thus cut a willow branch, plant it, cut off the next shoot, replant it, and continue indefinitely.[40]
>
> (*Metamorphosis*, "Second Essay, 1790," p.191)

As with Kant, this model then finds its meaning in the acknowledgment of self-production as a distinctive character of the organic, insofar as it organizes itself from each part, the privileged locus of this organization being the knot. This is also why the Goethean *type* is clearly a regulative concept, self-production and the regulative character of biological principles being related in Kantian thought.[41] The vegetal type imposes its normativity on the vision and description of plants. Thus, Goethe distinguishes between "perfect" and "imperfect" plants according to whether the buds and seeds are distinct in the former, but not in the latter (§92).[42]

2 Yet Kant's conception was "teleomechanist"; therefore, under the presupposition of an idea of the whole, a mechanistic explanatory program (for instance, of the formation of a specific necessary embryogenetic stage) had total legitimacy. Goethe, instead, does not think processes in terms of mechanistic laws. The processes at stake with the transcendental leaf are *ideal transformations*, therefore, the question of subordinating a mechanistic research program to the supposition of an originary organization makes no sense here. The transformation between stages of the leaf and therefore stages of the overall plant is *ideal*—the *UrPflanze* pertains to these ideal, mathematical transformations and does not mean to be explained in mechanistic terms. *UrPflanze* is therefore not the *Urbild* considered by Kant. This will be confirmed by an examination of Goethe's zoology.

10.3.3 Urbild*, morphology, and the solution to the adventure of reason*

The Goethean concept of type first concerned the transformation of a plant.[43] For animals—vertebrates—Goethe repeated the requirement of a type. Just as the leaf was the support of this structure for plants, so the bone will be for animals. "It is therefore a question of describing how nature shows itself to be variable and how it is constant in the formation of bones."[44] This resulting invariant, the type, is created from observation of the parts common to all species, and thus enables us both to "describe isolated species according to type," and to "track

the modification of the same organ in the main genera."[45] This second aspect of the type makes it possible to establish a law of transformation that links species. Thanks to it, we can easily identify the parts of an unknown species.[46]

Hence, in his 1786 memoir, Goethe proved the existence in humans of the intermaxillary bone, the last vertebra present in monkeys, the existence of which had been denied over the centuries by Vesalius, Eustachius, Peter Camper, and Blumenbach.[47] By scrutinizing the relationships of each bone with its neighbors, namely, the junction lines of the vertebrae, Goethe was able to show that in the human skeleton the pattern of junction lines is analogous to that of the apes. From this, he deduced that the intermaxillary bone does exist, but in a hidden form, as it is virtually absorbed into the preceding vertebra. Here, the second law of compensation comes into play: an organ may be virtually invisible due to the overdevelopment of the others, yet its presence is nevertheless required by the type. The regulative effect of this law led Goethe to identify the intermaxillary bone of man. In this way, he deploys the same mode of intelligibility in his botany and his zoology. This animal type, constructed through the comparison different vertebrates, enables us to classify animals according to their differences from it; it sets a norm for all vertebrates, a norm realized in enables us to understand them all.[48] In addition, this bone plays a role in the philosophy of nature since it shows that humans and other primates are built on the same template; it provides an argument for the monist view of nature that Goethe defended throughout his writings. The German poet was ultimately a Spinozist, in the sense that Spinoza's motto was "man is not an empire within an empire."

From this, Goethe elaborated the "vertebral theory of the skull," which he published in 1820 and which is the analogue for animals of the theory of the leaf as the support of metamorphoses for plants: the mammalian skull is composed, in fact, of nine vertebrae that continue the spine:

> three for the posterior part, enclosing the cerebral treasure and the terminations of life, divided into tenuous branches that extend to the surface and the interior of the organism; three vertebrae form the anterior part, which opens in the presence of the outside world (. . .) the last three are not yet accepted: they are the palatine bone, the upper jaw and the intermaxillary bone.

This theory, taken up by Oken—a major reference for *Naturphilosopher* and Richard Owen—and others, had the double advantage of unifying plant and animal, through understanding the animal as the transformed repetition of a single element.[49] The type is constructed through systematic transformations of the vertebra, and the different species through standard transformations of the type. Hence, the harmony existing both among species and within each animal.[50] The type is therefore *ideal* in the sense of a law of species construction.

Both the *UrPflanze* and the original animal type or *Urbild* are patterns reconstructed by comparisons; both appear as transcendental, namely, as allowing by

their transformations the possibility of an understanding of the focal phenomena. In 1795, Goethe indeed visited the Botanical Garden in Naples and had the intuition of the *UrPflanze*. He recalls that at this time with Herder they discussed Kant's "archeology of nature," and added that, starting from his revelation, they could launch the "bold adventure of reason" that Kant had proscribed.

At first glance, one sees here the ambition toward generality, which asserts a progression from the simplest to more complex species, starting from raw matter. Herder had such a view, which was strongly rejected by Kant several times, as we saw. But Goethe's idea does not stop here. The whole point of his analysis lies in the shift from a mechanistic understanding of explanation, which requires, as Kant does, a mereologically based account of the processes at stake, toward a formal understanding of explanation, which leaves mechanisms out of touch and focuses on the ideal transformations of form.[51]

From this viewpoint, the general deployment of the biological kingdom based on nature does not stumble over the lack of any direct evidence of "heteronymic univocal generation," since we do not need any actual production of a form by another to conceive of the general transformation process. It is like the leaf that turns calyx and pistil: all those transformations support the actuality of the plants, but are not actual mechanistic operations.

Granted, I emphasized the affinity between Kant's regulative principles and Goethe's transcendental leaf ((1) in §3.2). But where Kant subordinates a classical mechanistic explanatory program to the originary organization, and therefore stumbles over the lack of available evidence (for *generatio univoca heteronyma*) and the epistemic boundary between raw matter and organized beings, Goethe allows himself the transcendental leaf, then the *UrPflanze* and the *Urbild* as transcendental figures whose metamorphoses have to be traced back geometrically, and even from the raw matter if needed. From the perspective of a non-mechanistic explanation the distinction between raw and organized matter is not relevant any more.

As a consequence, Goethe's teleology is not teleomechanism. The mechanistic explanatory project is now left aside, in favor of another kind of explanatory program, purely geometrical or topological. With Nassar (2014), one should also emphasize that, conceived of by Goethe, this program relies on the power of imagination, and therefore calls for the Goethean identity between knowledge and art, biology and poetry:

> The organism, however, does not develop as separate parts, but as a whole. In order to grasp the organism, then, one must not perceive its parts in isolation, but see how they are connected to one another—that is, grasp the relations between the parts and the transitions from one part to the next. It is only through the imagination that one can discern these transitions and thus discern how each part is a modification of the one preceding it.
>
> (p.62)

Importantly, the notion of purpose is no longer distinguished from mechanicism as an explanation, rather, the break with the means-end connotation of purposiveness advanced by Kant is even carried further. To be a purpose, indeed, does not mean more than to be conditioned in one's life by a proper environment that matches with the organism itself:

> The *fish is made in view of the water* seems to me to make much less sense than *the fish is in and by the water*; for this second sentence expresses much more precisely what was only implied in the first: namely, that the existence of the creature we call fish is only possible under the condition of an ambient element we call water, and this not in order to live in it, but also in order to form itself in it.
>
> ("Toward a general comparative theory," in Goethe (1995), pp.54–55)

There is no more "teleology" in the vernacular sense of the term and I would here agree with Rupik (2024) stating that "understanding nature as active productivity—not a passive product—frees Goethe of the need to tie plants' forms and functions to the trellis of a divine system of ends, and allows him to consider possibilities for nature beyond the walls of Teleology" (p.53).[52]

The consideration of Goethe's morphology and botany here served two purposes: to introduce the last element that is required to get the proper modern concept of organism, namely the *type* and all kindred notions; to initiate a reading of the life sciences immediately affected by the Kantian account. Goethe is interesting since at the same time he acknowledged the importance of the *Critique of the Power of Judgment* taken as a whole—for the esthetics was important for him since poetry and science coalesce—and he was among the first to bypass the limitations imposed by the careful Transcendental Analytic of biological judgment.

In the next chapter, I will sketch what the post-Kantian history of the Kantian account of organisms could achieve in terms of scientific research programs, and argue that the major approaches to the living, "formalist" and "functionalist," have their place within this story. Yet they cannot be straightforwardly reconciled, and both now have their roots in Kant's account, while none of them can explain the whole of the living by itself. The next chapter will consider this duality, and the way the Kantian account splits into two kinds of theories, both of them offering a valuable perspective on "life itself" (as Rosen (2000) used to call it) and the organisms.

Notes

1 "In order, therefore, that the scientist may not work in vain, he must, in the judgment of things, whose concept as natural purposes is undoubtedly founded (organized beings) always put at the principle an originary organization, which uses this very

mechanism to produce other organized forms or to develop its own into new forms (which, however, always result from this purpose and are in accordance with it)" (*CJ* §80, p.418). In this alternative, the first member, "to produce other organized forms," means precisely the production of varieties as explained in the opuscules on races.

2 On Pander, see Schmitt's introduction to Pander (2003), on Meckel and Serres, see Canguilhem et al. (1962); on an important overall interpretation of the German school of embryology, see Zammito (2018).

3 Huneman (2006b) deals with this question in detail.

4 Indeed, "this last system [epigenesis] may also be called generic preformation because the producing faculty of begetting beings, hence their specific form, was preformed *virtualiter* according to the final internal dispositions that had fallen to their race" (423).

5 On the generic preformationist, see Fisher (2007).

6 See Richards (1992); evolution meant originally the process of unfolding a germ, and was attached to preformation. Richards explains the singular historical trajectory through which this word came to name the Darwinian evolution of species, which is completely different (absence of preformation, and population rather than individual level).

7 See Chapter 6, on the difference between Kantian germ theory and preformationism.

8 To this extent, Leibnizian preformationism has a different meaning from the Malebranchian pre-existence of germs, from whom Leibniz nevertheless borrows it; for the Malebranchian world still retains Cartesian inertia, all power in it is concentrated in God, and this is the meaning of occasionalism: no substance can do anything without God's help. In Leibniz, on the other hand, this same theory relates to his rejection of Cartesian inertia, in an affirmation of the power of substances to act that is very close to Spinoza and his theory of *conatus*. In this way, Leibnizian preformation is in tune with the idea of substance as monad, according to which it draws everything from its own fund. It is the dimension of passivity of the living being that gives meaning to the theory of the pre-existence of germs in Malebranchism; but transposed to Leibniz, it takes on a different tone because another dimension is emphasised, according to which the living substance already possesses within itself all that it can produce. On Leibniz, dynamism and degeneration see Guéroult (1967), Duchesneau (2010, 2018), Smith (2011), Nachtomy (2011).

9 About this field, see chapters 1–4 in Smith (2006); Gaukroger (2010); Roger (1963).

10 Chapters 2 and 4.

11 On radical epigenesis and Herder as Kant's targets, see Zammito (2007). On Herder's view of development, see now Rupik (2024) and Nassar (2022).

12 Zammito sees in Herder, for Kant, a figure of the hylozoism he denounces in the *Metaphysical Foundations of Natural Science*, i.e., the attribution of life to matter that ultimately erases all ontological boundaries in the universe. Here, he draws a sharp distinction between Wolffian and Blumenbach epigenesis, attributing to the former a more radical epigeneticism that is limitless, whereas that of the latter is contained within certain originary forms like that of Kant; hence, by imagining an unlimited plasticity, Herder is closer to Wolff. Blumenbach was initially a preformist: on this point see Lenoir (1980) and Duchesneau (2018, chapter 9).

13 Steigerwald's recent analyses of the *Bildungstrieb* provide additional understanding here. Especially, she shows how its status changes through Blumenbach's various publications, and moves from an experimentally induced phenomenon toward a concept in a theory of vital forces, which became Blumenbach's legacy: "As this drive became conceived as a power and was compared to other vital powers, shifting attention from experimental demonstrations of phenomena to conceptions of their cause,

the Bildungstrieb became reified. It was the Bildungstrieb as an actual power, rather than the experiments manifesting a drive to self-organization, that many physiologists and naturalists read in Blumenbach's texts in the early 1790s" (2019, p.92).

14 *Handbuch der Naturgeschichte*, §19.

15 *Handbuch der Naturgeschichte*, §8.

16 Richards (2000) talked of a *creative misunderstanding*, which seems a good category for understanding what played out between these authors. His analysis is compatible with Jardine's, indicating how the "scene of inquiry" shifted between Kant and the *Naturphilosopher*, via small shifts that each time accredited questions initially outside the framework set by Kant (Jardine 1991, chapter 1). Lenoir (1982) wanted to distinguish the biologists influenced by Kant, the "vital-materialists" with their teleomechanism, from *Naturphilosopher* such as Oken or Schelling, who were working at the same time. Unfortunately, the distinction seems too clear-cut: all of these authors reflected on the same Kantian texts, all of them distorted them to fit their own concerns, and despite Lenoir's opinion, all of them agreed to use mechanistic explanatory schemes and empirical investigations when considering a problem of physiology or embryology. Steigerwald (2019) exposes the sophisticated intervention techniques used by *Naturphilosopher* such as Ritter, Humboldt, and Schelling to address some of these problems (muscle contraction, functioning of nerves, etc.). Richards (2000) offered a synthetic and integrated picture of the two tendencies that Lenoir wanted to artificially oppose. Jahn (1994) had outlined the institutional context of Romantic biology, which enabled this fruitful reception of the theories of Kant and Blumenbach.

17 Ruth Millikan developed a theory of "proper functions" in the context of a selectionist account of biological functions. I will address the theories of functions seen from the Kantian viewpoint in the next chapter. I proposed a revised etiological theory of functions in Huneman (2013b, 2023d).

18 "It is well known that those who dissect plants and animals, in order to study their structure and to be able to grasp for what reasons and with what end in view such parts were given to them, and why also such an arrangement and such a connection of these parts and precisely of this internal form, admit as absolutely necessary this maxim: "in such a creature nothing is useless," and they give to this maxim the same value as to the principle of the general science of nature: "nothing happens by chance"" (§66, p.376).

19 Lewens (2004) offers a systematic investigation of the idea that an organism is analogous to a complex and functional artefact. This scheme has been fueled, after Darwin, by the Darwinian idea of natural selection as a source of design, which underpinned the naturalist etiological understanding of functions (e.g., Millikan 1984). It includes the methodology of functional ascription called "reverse engineering," which considers a trait of an organism in order to reconstitute the environmental demands that were the original reason for which it has been selected.

20 In the initial categories of *The Only Possible Argument. . .*, Kant thinks of the System as the original meaning of purposiveness (wholes and parts), and derives from it purposiveness as Technique (utility of parts, etc.). Now is he finally drawing all the consequences of the primacy of the System over Technique that had already been advanced in 1763. This is the essential continuity of Kant's work on the themes examined here.

21 This point overturns simplistic readings of Kant that make him the proponent of a purely pragmatic vision of finality—namely, "we look at organs as if they were made for such-and-such a use, because it helps us understand." Such an interpretation, while not completely false, misses the subtlety of Kantian reasoning, which justifies teleology through considerations of the intrinsic productivity of living things.

22 That is, the principles of the Transcendantal Analytics and the laws of *Metaphysical Foundations of Natural Science.*
23 This, as Larson (1979) and Richards (2002) have shown, is the fate of Kantian doctrines—but as the regulative/constitutive distinction was misinterpreted from the outset, the consequences of its weakening were not as dramatic and visible as Kant thought.
24 Basically, this is yet another mistake made by the proponents of the antithesis of the second Antinomy: from the regulative principle requiring that regressive chains of conditioning always continue, they wrongly deduce the constitutive principle that the chains were indeed infinite.
25 On the paradigm of crystallization at the time, see also Duchesneau (2018), and Steigerwald (2019) (cited in Chapter 6).
26 For an examination of the relation between Kant's views and evolutionary ideas, see now Cohen (2020).
27 *Handbuch der Naturgeschichte*, I, sect. 1, §2.
28 Of course, the reflective status of the judgment prevents us from confusing the concreteness of this operation (the term here contrasts it with the abstraction, the very artificiality, of Linnaean natural history, whose criticism by Buffon was endorsed in the 1775–77 essays on races) with that of physics, which actually constrains the developing forces.
29 One can compare this systematizing of the organism question and the architectonics question, throughout the notion of transcendental history, to the thoughtful and detailed account of the epigenesis of reason pursued by Mensch (2013).
30 On this question of the parallelism between biological language and the description of reason, the shortcoming of analyses dealing with the question of the "epigenesis of concepts" (e.g., Ingensiep 1994) is to confine themselves to this occurrence in the Transcendental Analytic without taking into account that this language runs through the entire second edition of the *Critique of Pure Reason*, in particular the Methodology of Pure Reason and the passage on the Architectonic. Our question here aims to shed light on the entirety of this usage, and in this sense, it seems to us that it requires attention to Kant's entire career, right up to the third *Critique.* Mensch (2013) provided another, exhaustive and systematic, investigation of this biological language applied to reason.
31 HN, IV, p.135 (my emphasis). Diderot follows Buffon in writing: "Nature seems to have taken pleasure in varying the same mechanism in an infinite number of different ways. It abandons one kind of production only after having multiplied its individuals in every possible way" (*Pensées sur l'interprétation de la nature* (1753), §12, in Diderot (1994), p.565).
32 On the genesis of Goethe's biological thought, its intersection with *Naturphilosophie* and, in particular, with Schelling's later thought, one can first read Richards (2002), who does justice to an overly clear-cut opposition between true science (embryology, anatomy) and speculation (by the Schellingians, above all), in which Goethe would find himself unclassifiable. Against, in particular, Sherrington's interpretation (Sherrington 1949), Richards shows that Goethe is not a poet lost in natural history, transporting his creative imagination into this field, but the representative of a type of scientificity relatively important in the life sciences emerging in Germany at the beginning of the 19th century, and anxious to position itself in relation to the Kantian legacy. Concomitantly, Tantillo (2012) offers an exhaustive study of Goethe's natural science and its method.

In the wake of Richards (2002), under the label of "romantic biology" or "romantic science," many scholars have reevaluated the contributions made to biology and

natural sciences in general by philosophers and writers often bypassed by previous historians of science because of their lack of commitment to analytic methods or their plea for intuition or syntheses. As Rupik (2024) characterized it, "romantic biology reflects (a) diverse set of responses to Kant's works, and therefore presents itself again as a veritable library of maps with which one can navigate through or beyond Kant and the philosophies of science he inspired."

In recent years, three monographs have addressed Goethe's biology and philosophy of nature. Nassar's *The Romantic Absolute* (2013) focuses on the way Schelling, Novalis, and Schlegel designed a novel way of knowing such that poetry can be a pathway to knowledge; by doing so, they were instantiating some of Goethe's methodological and philosophical ideas, which he elaborated in relationship to Kant. Steigerwald's *Experimenting at the Boundaries of Life. Organic Vitality in Germany around 1800* (2019) explains how German scientists, poets and philosophers built a new philosophical image of nature and natural science by inventing instrumental approaches to vital properties, embryogenesis and biological growth; Goethe is a crucial figure in this movement, and Steigerwald traces the many connections that tied him to many protagonists of German biology. Rupik's *Remapping Biology with Goethe, Schelling, and Herder* (2024) grants Goethe's biology a crucial role, since it allows us to overcome the reductionism and the excessive mechanicism proper to some views of biology found in the early 19th century, and whose descendants can be found in the contemporary suborganismal biology. He does a legitimate and stimulating use of the view of science as maps elaborated by Winther (2020). I will not discuss these works thoroughly but will mention some convergence with this chapter.

Lastly, Amanda Jo Goldstein's *Sweet Science. Romantic Materialism and the New Logics of Life* (2017) devoted a chapter entitled "Equivocal Life: Goethe's Journals on Morphology" on Goethe's morphology, as part of a project (close to Nassar's, Steigerwald's and Rupik's) of revisiting the interplay between romanticism and science, by showing how another conception of life arose at that time.

33 "Doctrine on atmospheric states" (1821).

34 Rittersbuch (1964) provides an interesting perspective on the idea of type in biology, from Goethe to Waddington, relating it to both the scientific issues of classification and the aesthetic issues of form. References in brackets in the body of the text in this paragraph are to *Metamorphosis of Plants.*

35 On the way Goethe constructs and uses the *Urpflanze*, see Richards (2002, pp.413–494); Brady 1987; Angleraux (2023). See now for the *Urpflanze* Nassar (2013, pp.194–196).

36 Steigerwald (2019) indicated that Goethe himself undermined his own proximity with Wolff, while emphasizing the affinities with Blumenbach: "He did not recognize the similarities between Wolff's account of the role of the refinement of nutritive juices in the development of his account. He was more sympathetic toward Blumenbach's notion of a *Bildungstrieb* for combining the creative activity of formation with the material on which it acts" (p.254).

37 He writes: "The progressive modification of the plant's parts is the work of a force that I can call—but improperly—expansion and contraction. It would be better to designate it, as in algebra, with an X or a Y, because the terms expansion or contraction do not express this action in all its magnitude. It contracts and dilates, shapes, transforms, connects, separates, colors, discolors, spreads, lengthens, softens, hardens, amplifies and resorbs; and it is only when we embrace all these different effects in a single glance that we can know more concretely what I have thought to explain and bring out with these words. It does all this in portions, so smoothly and unobtrusively, that in the end it has transformed one body into another before our very eyes, without

our having seen it. Without it, man can only recognize what is isolated, precisely because it is isolated" ("Preliminary work for a morphology of plants," Goethe 1995, pp.205–206).

38 Goethe 1995, pp.206–207.

39 The relationship between Goethe and epigenesis becomes clearer when we read certain passages dedicated to Caspar Wolff.

40 *Metamorphosis, "*Second Essay, 1790," Goethe 1995, p.191.

41 On Goethe's relationship with Kant, see Richards (2007).

42 Jardine happily specifies this provenance and proximity of the Goethean type to the Kantian germ in terms of reversal: "Paradoxically, Kant's germs are real objects that cannot be seen, whereas Goethe's types are ideal objects that can be seen" (Jardine 1991, p.38).

43 The concept of *Bildung*, central to Goethean humanism, is represented here. Interest in morphology is interest in the ever-changing result of the creative process that is the *Bildung* of an organic body; and this, not being an act of external juxtaposition but a growth from a center, cannot be thought of by the analytical method—it requires the method outlined here that Goethe calls *synthetic*, and which places the Goethean *Naturforscher* in a position analogous to that of the artist or poet, insofar as her understanding transports her as intuitively to the heart of organic *Bildung*. This is why, in Goethe's view, botany and anatomy are on the same level as literature and poetry, and ultimately belong to the same intuitive-creative attitude (see Richards 2007, 2002, chapter 9, and also Nassar 2013, cited above). It follows from the identity of the operation of nature and the operation of mind in the transformation of the leaf along the metamorphosis of the plant, as pointed out above. But in insisting on the unity of art and the view of life, Goethe seems to be reintroducing the unity of the two parts of Kant's third *Critique.*

44 "Outline for a general introduction to comparative anatomy commencing with osteology," (Goethe 1995, p.118).

45 "Outline for a general introduction to comparative anatomy commencing with osteology," (Goethe 1995, p.119).

46 On Goethe's method of comparative anatomy, see Schmitt (2001, pp.495–522); and Rupik (2024, pp.133–136).

47 Sherrington (1949), however, corrects Goethe's claims of priority.

48 "What a gulf there is between the intermaxillary bones of the elephant and the tortoise, writes Goethe in a *Memoir*. And yet, a *series of intermediate forms* can be found between them. The unity that cannot be overlooked in the organization as a whole can be demonstrated here in one of the isolated parts" ("An intermediary bone is present in the maxillar jaws of man as well as in the animals," Goethe 1995, p. 116).

49 On the vertebral theory of the skull, see Balan (1979, pp.323ff). It was refuted by Thomas Huxley around 1850. On the notion of repeated parts in morphology, see Schmitt (2006a).

50 "It is because it is composed of identical parts that change insensitively, that the organic whole can present the perfect harmony we admire in it. (. . .) It is thus that by modifying similar organs, nature can create the most varied systems" ("Anatomy lessons," 1796, Goethe 1995, p.75).

51 In Huneman (2006b), I show in detail that Goethe thus changes the very idea of what an explanation is, and that such a shift enables the realization and success of his morphological program.

52 About Goethe, Rupik (2021) speaks of "ateleology."

11 The two great laws of biology and the parting of the Kantian ways

11.1 Introduction: "two great laws of biology" as two takes on the "type"

In the "Summary" that concludes chapter 6 of the *Origin of Species*, Charles Darwin raises a very general question, which involves the main alternative set by the biology of the time, and anticipates some of the major current theoretical cleavages. He mentions the "two great laws of biology." They are the "principle of conditions of existence," formulated by Georges Cuvier, and the "unity of type," then defended by Etienne Geoffroy Saint-Hilaire. Both zoologists worked in the Muséum National d'Histoire Naturelle in Paris, and they fought a notorious academic battle at this Museum in 1830, about the extension of the unity of type. This phrase means that animals are built on the same organizational plan, and Geoffroy Saint-Hilaire extended such unity even beyond the vertebrates, thus generalizing Goethe's intuition about the unity of the type "vertebrate" (studied in the previous chapter).

For Darwin in this "Summary," "the conditions of existence" are basically explained by *natural selection*, to the extent that natural selection explains the adaptations, which constitute what supports the existence of an animal; in turn, the "unity of type" means, for him, *common descent*: inheriting by descent a trait, such as the anterior extreme member of the tetrapod (my hand, the shark's fin), implies the pervasiveness of the trait across lineages and finally some unity of type.

I will not develop this discussion now, and the way Darwin answers the question of "what is the most important law? " suffices to establish that these two biologists, who were famously antagonists within the life sciences, defended principles that, for Darwin, deserved to be called "great laws." Given that it would be weird to have a myriad of *first laws*, it is plausible to think that these laws exhaust the field of biology (at least for him).

The two great laws concern the ways one has to understand the organizational plan of an animal, or in other words, this "type" that Goethe conceived of as an essential object for biology. The discipline devoted to explaining the type

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is precisely what Cuvier and Geoffroy Saint-Hilaire practiced, namely "comparative anatomy." As Auguste Comte put it in the same period, comparisons are the specific operations through which biologists can capture the facts of the living—the other operation being experimentation, and Comte wrote these words thinking of Bichat's experimental physiology, met in Chapter 2. The type of a given group emerges through comparisons—this is the core idea of comparative anatomy, and Cuvier and Geoffroy Saint-Hilaire instantiate two approaches to "comparative anatomy," namely, distinct ideas of how comparison should proceed, how anatomy relates to physiology, and what a type *is*.

Their difference traces back to a key cleavage within biology: unity of type, as Goethe's biology asserts it, pertains to a "biology of form," as E.S. Russell (1916) famously put it; in contrast, "conditions of existence" pertain to a biology of adaptation of organisms, and finally of function. This is the second pole of Russell's dichotomy between the two cardinal biological perspectives.

In this chapter, I want to show how these two principles are embedded within the science developed by Cuvier and Geoffroy, respectively. Given that their trajectory is somehow related to Kantianism, and that they discussed and interacted with some of the scientists who inherited the supposedly Kantian teleomechanist program, I will outline below those two principles and their relation to the Kantian account of organisms and natural purposiveness. This will allow me to revisit the distinction between form and function from the viewpoint of the Kantian account, and shed light upon the intrinsic theoretical cleavages that affected biology until now, and the prospects of their conciliations.

Geoffroy Saint-Hilaire's perspective comes directly from Goethe's, which (Chapter 10) initiated the "adventure of reason" and a possible interpretation of Kantianism; Cuvier, in turn, historically belonged to the circle of scientists committed to some degree to Kantian ideas. I will argue in this chapter that their two views instantiate two possible interpretations of the Kantian account, because each of them turned it into one particular understanding of its key terms. I will also argue that their parting of the ways continued to be reflected in the subsequent history of biology, and especially evolutionary biology.

11.2 Cuvier and the "principle of conditions of existence"

Historically speaking, Cuvier stands in his own right within the Kantian perspective on the organism. In presenting the notion of organism in his *Leçons d'anatomie comparée*, he writes that life is not a constant union of molecules, but a

> continual circulation from outside to inside and from inside to outside, constantly maintained and yet fixed within certain limits (. . .) [the livings are] hotbeds of energy (. . .) [the livings are] hearths into which dead substances are successively carried to combine in various ways, to hold a place and exert

> an action determined by the nature of the combinations into which they have entered

This "general movement" is the essence of life, since the parts that are separated from the whole soon die. He then explicitly refers to Kant's concept of organized being, when he defines living entities by saying that "the reason for the manner of being of each part of a living body lies in the whole."[1]

His acquaintance with Kant comes from his apprenticeship in natural history at the Caroline Academy in Stuttgart, from 1787 to 1788, where he came into contact with German biological thought. Becoming friends with Christian Pfaff, he began a written correspondence with him that persisted for years, which provides us contextual details about the connection between German biology[2] and French zoology. In 1788, Cuvier read Blumenbach's *Handbook of Natural History*, and asked Pfaff about *Physiological institutions*.[3] Moreover, Pfaff communicated to him the ideas of the comparative anatomy lessons that Kielmeyer developed there in 1791, and then, being himself a student of Kielmeyer (under the supervision of whom he did his doctorate dissertation entitled *De electricitate dicta animalis*), the latter's more complete lessons.[4] Throughout 1792, Cuvier constantly asked Pfaff to send him further fragments of Kielmeyer's lectures (on nerves, the eye, and sexual parts, for example).[5] Furthermore, before he met Pfaff in 1787, the young Cuvier had already become acquainted with Kielmeyer in 1785. The *Critique of the Power of Judgment* and Kantian germ theory had been a fundamental inspiration for Kielmeyer (see Richards 2002; Steigerwald 2019, Chapter 6), so Kantian thought may have indirectly reached Cuvier via this route.[6] Kielmeyer belonged to the school called the Göttingen School by Lenoir (1980), which developed Kant and Blumenbach's inspirations into a research program focused on embryology. Kielmeyer in his most famous and virtually unique publication, a public lecture on forces entitled *Über die Verhältnisse der organischen Kräfte* (*On the Relations of organic forces*) incorporated an essential Blumenbachian element: the universality of the reproductive force.[7] At the same time, he conceived of a certain lawfulness in vital phenomena when looking at animal series: these laws would describe across the taxonomic series the relationships among the main forces, irritability, sensibility, and reproduction.[8]

11.2.1 The organism according to Cuvier's comparative anatomy

What about Cuvier's presumably Kantian take on comparative anatomy? First and foremost, Cuvier's work represents a major renewal of the meaning of zoological classification, as Daudin and then Foucault have clearly shown.[9] Before Cuvier, classifying meant organizing a table of animals, hence the disputes over which character was best to use to classify species; with Cuvier, classifying

became revealing the kinship (in a non-genealogical sense) of organization. This transformation was accompanied by a profound change in method: Cuvier used dissection[10] and compared dissected animals. In other words, zoology shifted from the observation of similarities in external form to the search for identities within the internal structure. This deeper structure, which Vicq d'Azyr's *Discours sur l'anatomie comparée* was already aiming for, is at stake in §80 of *Critique of the Power of Judgment:* its possibility referred to the concept of an irreducible originary organization,[11] and we also remember that the "internal structure of animals and plants" represented the paradigm of a natural purpose in the "First Introduction" to the *Critique of the Power of Judgment* (Chapter 8).

But in comparative anatomy, after Vicq d'Azyr's insistence on internal organs, Cuvier conferred new weight to physiology. In the opening speech of his *Leçons d'anatomie comparée*, we find a conception of the organism that emphasizes the process dimension of life, since a "general movement" is "the essence of life." Even though this word "life" has no positive meaning, as Cuvier reminded us from the outset, and only designates the unknown nature of an essence common to certain phenomena, which we feel "must be linked" to one another, so that ultimately "we use the words *life* and *vital force* to designate exceptions, at least apparent, to the general laws (of physical bodies)."[12]

While life has no designable essence, organized bodies have "general" and "common" characteristics that make them recognizable: "origin by *generation*, growth by *nutrition*, end by true *death*."[13] In addition to these general organic functions, animals have the capacity to feel and move. Here we encounter the need to distinguish functions, as Bichat did with the notions of organic life and animal life (in his *Recherches physiologiques sur la vie et la mort*, Part I), which he defined physiologically, whereas Cuvier's division refers to comparative anatomy, i.e., to the differences to be established between species. The organic functions require a digestive system, in order to be able to feed discontinuously (in contrast with the continuous feeding of trees . . .). The "continual transfer of particles from inside to outside" that animals undergo through motricity and sensation requires organs to "re-establish the resting composition that action alters."[14] Cuvier distinguishes between *digestion* proper, which consists in preparing a homogeneous nourishing fluid from the heterogeneous food ingested, and *nutrition*, which is the absorption of this fluid. Between these two operations, other "less essential" operations happen in certain classes of animals, namely, "the absorption of chyle, the production of blood, circulation, and respiration, i.e., combination with oxygen."[15] In other words, the circulatory system is subordinate to digestion, and above all, the latter is accomplished with greater or lesser complexity of apparatus, depending upon the relevant animal class.

Notwithstanding Cuvier's later revisions of the relationship between functions, with his emphasis on the role of the nervous system in the *Règne Animal*, these

considerations led to a shift in the relationship between function and organ. The same function, *digestion*—but also other functions—can be performed by several different organ systems, depending upon the class of the animal. "Many functions can be exercised without the whole apparatus of organs devoted to them in man and animals close to man."[16] Overall, this shift resulted from the growing attention paid to animals very different from vertebrates, such as mollusks and worms, which Aristotle had already examined, but whose detailed examination, especially by Réaumur and Lamarck's *Histoire des animaux sans vertèbres*, marked a clear reorientation of the life sciences in the 18th century.

A function is therefore an operation common to several classes of organized bodies, but which requires different, more or less complicated organs to be carried out—these organs themselves having several sub-functions. Attention paid to function, therefore, implies considering several animals simultaneously, and conceiving together organic parts that are different with respect to their form.[17]

While the explanation of function is made possible by the comparison and decoupling of function and organs, the fact remains that not all organ combinations are possible, because they are all ordered by a principle. Cuvier's *Le règne animal* sees in this notion the particular principle of natural history, that of "*conditions of existence*, vulgarly called *final causes*."[18] This principle is that all organs "work towards a common goal. According to this, changes in any one of them exert an influence on all the others."[19] This "common goal" is simply the animal's existence, its survival in a given environment. Such survival, in turn, depends on being able to carry out its vital functions in their proper order, in a way that is not hindered by the environment. Consequently, Cuvier could write that the "laws which determine the *relations of their organs*, and which are of a necessity equal to that of physical or mathematical laws" are founded in the "mutual *dependence* of functions."[20] Thus, a carnivore must be able to crush its prey, i.e., it must have teeth, but it must also be able to grasp it, that is, it must have claws and be able to move relatively quickly.

Cuvier was, thereby, aware that he was giving true expression to the Aristotelian and then Leibnizian phrase "final cause": it is not a matter of thinking of the animal as the instrument of an end, but of grasping that, from the moment it exists, that is, survives in a given environment, it must fulfill the conditions of possibility of this existence, and its "internal structure," the real object of natural history,[21] is *the expression of these conditions of possibility*. In a very distant sense, the Cuvierian organism inherits more from Stahl than from Leibniz, more from the confrontation with death than from infinite organization.

11.2.2 Significance of the principle of the conditions of existence

In this respect, Cuvier's comparative anatomy fits into a space delimited by Kant's analyses in the *Critique of the Power of Judgment,* since his "principle

of conditions of existence" controls both the organization and intelligibility of living beings. Such intelligibility unfolds along two dimensions:

a) On the one hand, in the development of the *science of paleontology*, of which Cuvier was one of the first systematic exponents. We have all heard of the famous passage from the preface to *Recherches sur les ossements fossiles des quadrupèdes*, the "Discourse on the Revolutions of the Globe," where Cuvier set out his principle in the form of the "principle of correlation of forms," and showed how "whenever one has only one well-preserved end of a bone, one can, with application, and with a little deft help from analogy and effective comparison, determine all these things as surely as if one possessed the whole animal."[22] The problem arose with the fossils of quadrupeds, as those of fish and worms generally offered the mold of their whole bodies. The Cuvierian principle makes it possible to reconstruct them. The "general conditions" of the carnivorous diet require certain abilities, and "any animal disposed to this diet infallibly has them, *for its species could not have subsisted without them*" (my emphasis). The respective organic performances indeed follow on from one another: "Its jaws must be built to devour its prey; its claws to seize and tear it; its teeth to cut and divide its flesh; the whole system of its organs of movement to seize and reach it; its sense organs to see it from afar; nature must even have placed in its brain the necessary instinct to know how to hide and lay traps for its victims"; hence the anatomical consequences: "for the jaw to be able to grasp, it needs a certain shape of condyle; a certain relationship between the position of resistance and that of power with the fulcrum; a certain volume in the temporal muscles, etc.," for the animal to be able to carry off its prey, it needs a certain strength in the muscles that lift its head, resulting in a certain shape in the vertebrae where the muscles have their attachments, and in the muscles where they are inserted." And so on. Moreover, in addition to its carnivorous conditions, "there are particular ones relating to the size, the species, the stay of the prey for which the animal is disposed" ("Discours sur les Révolutions du globe" (1812), p.104). We can see, then, that with a piece of bone, if by a few good analogies the paleontologist can determine the type of diet of the animal, she will be able to reconstruct it entirely: "the nail, the scapula, the femur and all the other bones taken in isolation give the tooth, or give themselves reciprocally; and starting with each of them, he who rationally possessed the laws of animal economy could reconstitute the whole animal" (p.100).

The strength of Cuvier's principle underlying such an epistemic achievement is that it no longer invokes a purposiveness intrinsic to the animal's operations, as was the case with Stahl, or a character of the animal's functioning that would distinguish it from brute bodies, as in vitalism: the very fact that the animal exists, that its species has survived, implies the correlation of parts that we have just seen, and which is not based solely on physical laws

(even though it is constrained by them, as any existing thing). Without these correlations, which are of a different order than physical laws and yet are not actions directed toward a purpose, the animal would simply not have existed. As laws of the animal order, they enabled the "deductive computation" (Daudin 1923) by which Cuvier reconstructed the dinosaurs.

b) In the *comparative anatomy of extant animals,* the principle of the conditions of existence can also be read in the reverse way: if, in several species or genera, there is a constant relationship between two organ forms, then we can conclude that they act on each other. Thus, the presence of a large liver in animals that breathe little, and its absence in insects, whose bodies are "large lungs," suggests that the liver removes the "combustible principle" from the blood.[23] For this reason, "a thorough study of these relationships" would lead to advances in physiology.

From there on, Cuvier could take up the question of character in zoological classification, and reintroduce a method, namely, what he called the "principle of subordination of characters." "The relationships that are more constant than others are those that relate to the most important parts of the organic economy," he notes in *Tableau élémentaire de l'histoire naturelle des animaux* (1796, p.7). For example, animals with hearts have tracheae, heartless animals have gills. The most important organs are certainly hidden: the heart, liver, etc.; ancient natural history, based on visible characteristics, was thus bound to miss the essential. Shortly before Cuvier began his career, the physician and naturalist Vicq d'Azyr, in his *Discours d'anatomie comparée*, similarly distinguished between surface organs and internal organs, the latter being the secret resource of the former.[24] The problem[25] therefore is to find visible characters that indicate something about the hidden parts of the organism, because they are constantly in relation with them, since, as Vicq d'Azyr says, "these organs correspond to each other." Thus, the principle of subordination of characters is only of local value. In each class—and even in each order of mammals—different characters are used to classify.

These difficulties are reflected across Cuvier's various general presentations, in which the order of essential functions is not always the same: in the "Mémoire sur les mammifères," it is rather respiration; in the introduction to the *Leçons*, the functions of sensation and movement are prioritized, even though the text mostly relies on the primacy of the functions of circulation and respiration; in the *Règne animal*, he gives priority to the nervous system.[26]

Basically, this problem of the functional reference viewpoint stems from the new zoological approach Cuvier instituted, which focuses on "internal structure" and separates the organ from the function. For, if we look at one function, such as digestion, and then another, such as respiration, the animals classified under each of these two points of view, in an order of increasing organ complexity and differentiation will not be the same. "Naturalists, said Cuvier, have formed the

idea of a ladder of beings that would bring them all together in a single series" with "insensible nuances," yet "the organs do not all follow the same order of degradation," and "these gentle and insensible nuances" only occur "under the same combinations of the principal organs".[27] In other words, there exists an animal series only within each of the four great classes that this analysis has delimited. And Cuvier also qualifies this assertion, since although "one can descend from the cuttlefish to the oyster in much the same way as from man to the carp," nevertheless "it is not by a single line that one thus descends, in one phylum as in the other."[28] For this reason, the local value of the principle of subordination of characters is a consequence of this new classification, insofar as the absence of a single series prevents the universal existence of a hierarchy of subordinate common characters.[29]

These four classes, in which there are constant relationships between the main organs, and in which a process of degradation or simplification of the sets of organs corresponding to the main functions can indeed be detected, Cuvier calls them "phyla" or *embranchements*. Each phylum is characterized by a "composition plan," or "organization plan," which represents the invariant of these relationships, and is an application of the principle of conditions of existence.[30]

The organization plan of vertebrates, for example, is established as soon as the idea of a vertebral column exists, because the structural relationships that comparative anatomy has subsequently uncovered necessarily follow. The four phyla can be seen as four heterogeneous responses to the project of making a living being exist in an environment. Certainly, there is no community of environment between all the representatives of the same phylum; at the same time, we can say that from the moment something like a vertebrate exists, what it will have to deal with in its existence—to move around using its muscles and bones, to decode sensitive messages—will not be exactly the same as what a mollusk will face, whose conditions of movement are completely different. In this sense, with the idea of phylum comes the idea that the environment in which the animal lives is co-determined by its own structure, leading to the idea of a specificity of what we would now call, after Uexküll, the *Umwelt* of each animal, that is, the idea of *milieu*.[31]

Cuvier's comparative anatomy is thus the culmination of a movement of thought whose beginnings we had recognized in the vitalist concept of animal economy and the Buffonian concept of species (Chapters 2 and 6), a movement that led us to think of *the very essence of the organism in terms of its relationship to an environment,* which is no longer an inert surrounding, but is codetermined, for the living being it surrounds, by the structure of this being. Vitalists saw the skin as a vital center, because it was the place where, through contact with the environment, vital properties became manifest and therefore active (Chapter 2); Buffon included the kind of relationship with the environment in the concept of the animal species, and Kant's essays on races developed the subsequent notion of adaptation as transmitted in the species stem (Chapter 6, §1); with Cuvier,

the internal structure of the organism in terms of its functioning becomes itself conceivable by reference to the environment in which this structure is immersed, because it is only by being embedded within it that it takes on the meaning of the structure of a *living* being.

Cuvier's account of the type or "organization plan" focused on functions, as we saw. Comparative anatomy relied on physiology. Hence, *types* were ways of functioning, typical kinds of relations to a milieu. The functionalist requisite played a subtle role here in entailing the distribution of types, and the discontinuity between them. No unique series is indeed possible because tweaking the plan of organization of a species,—following Kant's imaginary deformations in CJ §80—by shortening this organ, elongating this other, etc., creates a deformation of other organs in order for the whole to remain integrated and able to function in its milieu. As a consequence, some localized deformations entail such large modifications of other organs that the organizational plan is no longer functional. Thus, there is no way to continuously derive, for instance, a mollusk from a mouse by tweaking and topologically deforming the organs of the mouse. Cuvier grants a single type for vertebrates, for sure, thus acceding in principle to Kant's idea of archaeology of nature (*generatio univoca heteronyma*, see Chapter 10); yet, one cannot extend the type beyond vertebrates, due to his functionalist commitment.

In this way, we can understand Cuvier's notions of type and environment, the first appearances of which we have traced. An animal type meant that each animal bears within itself its relationship with the others as variants of the same type. With the principle of conditions of existence, Cuvier introduced a new relationship: the type, seen as a *composition plan*, is marked by *the requirement to be able to exist*—that is, by the *relationship to a possible environment* in which the animal could *survive.* Here we encounter a *functional*, rather than *structural*, vision of the type. Thus, the relationship with other animals is no longer one of participation in a common type, but one of *exclusion*: the vertebrate's composition plan includes the impossibility being turned into the existence of an annelid.

Cuvier's composition plan thereby articulates a double relationship, namely, to the animal's environment and, negatively, to other types of existing plans. The relationship between species, which in the traditional natural history picture was simply one of presence or absence of particular visible characters, is now anchored in profound relations of incompatibility. Hence, the organism is doubly surrounded by negativity: first, because the principle of the conditions of existence renders its being the resolution of a *possible unviability*, and second, because its being embodies a negative relationship to *other composition plans*. However, this negative relationship is the flipside of a new intelligibility, brought about both by the principle of conditions of existence and the establishment of the four *embranchements*.[32] Cuvier's conception therefore corresponds, on another level, to the transformation that Caspar Wolff undertook regarding the question of embryogenesis: to the continuous development of organs

that were known a priori to be present, Wolff substituted—against Haller—the identification of *incompatible* embryonic configurations (Chapter 4); similarly, Cuvier no longer traces an animal series, but highlights the *incompatibilities* between types. Epistemologically speaking, this instantiates the same elevation of the negative relationship as a source of intelligibility in biological phenomena.[33]

11.2.3 Cuvier and Kant: A clarification of the final determination of the organism's schema

Cuvier indicated that his principle of correlation, derived from the principle of conditions of existence, was substituted for that of "final causes." This statement means that he replaced the idea of the living being as a machine, i.e., a set of goal-oriented tools, or, more traditionally, as a Galenic system in which organs have their own virtues, with an idea in which animal parts cannot be thought of as tasks, in other words, an idea that excludes the artisanal image of the animal.

Let us consider now in detail the logic of Cuvierian explanations. The major vital functions—breathing, digestion—(hereafter "function$_1$") certainly organize the classification of families and organs; but when we say "the function of the kidney is eliminating toxins" or "the function of hematopoietic cells is to carry oxygen" we are referring to functions of finer grain carried out by organs, traits or systems, which cannot be generalized across many species (hereafter "function$_2$"). The set of functions$_2$ allows, combined into an organism, this organism to achieve a general function$_1$ (e.g., breathing, digesting); hence, ascribing function$_2$ to organs and tissues allows the biologist to explain how a general function$_1$ is executed. These functions$_2$ of parts are then understood through the principle of correlation of parts.

In this way, Cuvier subscribed to the Kantian transformation of the concept of purposiveness, since I have shown that, in the third *Critique*, this concept becomes conceivable as a *natural purposiveness*, whose instantiations are organized beings, only on condition that *the technical-intentional model* is abandoned, and purposiveness is instead located within the *relation of parts to the whole*. But here, in Cuvier's thinking, the correlation *between organism and environment* becomes essential, because the principle of the conditions of existence subordinates the organisms to the conditions of life in their milieu. Abandoning the traditional "final causes," understood in terms of an artisanal or machine-like model, shifted purposiveness toward the correlation of whole and parts, and at the same time, with Cuvier, it brought to the fore the crucial role of the relation between the environment and the organism.

Kant wrote that in an organism, each part determines the others and the whole at the same time as it is determined by the whole, and this resurfaces in Cuvier's thinking when he explains the principle of conditions of existence as a principle of correlations, through which each part is determined by its place in the whole,

the whole itself then referring to the possibility of surviving in its environment. In other words, this totality refers to a possible *adaptation* that brings us back to the Kantian theory of originary organization, which is itself a set of adaptive germs, representing the requirements imposed by a living environment. And, while the originary organization is above all a "principle of knowledge" (Chapter 10), we also saw that Cuvier's principle of conditions of existence is a principle of intelligibility (e.g., for reconstituting past animals). There is an undeniable theoretical proximity here, one that biologists like physiologist Johannes Müller and developmental biologist Karl Ernst von Baer understood, as they embraced both the Kantian program, as defined by Lenoir as "teleomechanist," and the Cuvierian idea of zoology, dominated by the principle of conditions of existence. This latter principle constituted an operative actualization of Kant's concept of organized being.

I am not exactly describing here an actual research tradition that stems from Kant, which Lenoir has tried to do by reconstructing the "teleomechanist" school and its relevance in embryological thought up to Schwann, Bergmann, Leuckart, and the triumph of Darwinism (see Chapter 10). On a more general level, I rather wanted in this book to explain how the critical elucidation of the concept of purposiveness in the *Critique of the Power of Judgment* circumscribes the concept of organism as it was historically constituted, thanks to the emergence of the notions of type, environment and the principle of conditions of existence, particularly around comparative anatomy. After vital properties (Chapter 2), vital forces (Chapter 4), and the rearrangement of the concept of species (Chapter 6), the notion of *type*, developed throughout comparative anatomy, undoubtedly completed the organismic schema under which living phenomena were perceived.

As such, this latter element surely did not stem from the research program that Kant's writings on race and teleology sketched. But its elaboration expanded Kant's exposition of the concept of organism, and was only possible against the background of the concepts required by Kant to think about organism: the regulative character of principles, the relation between reflective judgment and self-production, the circularity of parts and whole. Granted, the Kantian analyses influenced Cuvier's thinking much less than they (along with Blumenbach) provided the lexical framework for the works of Johan Christian Reil, Kielmeyer, and others.[34] Yet they circumscribed the intellectual requirements from which Cuvier's ideas unfolded.[35]

However, the Kantian model of the determination of parts by the whole and other parts was extended during the same period beyond Cuvier's comparative anatomy. If we turn to nascent experimental physiology, we indeed find such a model in Bichat's *Recherches physiologiques sur la vie et la mort*, which takes the circularity of cause and effect as a hallmark of the epistemological specificity of the vital order (Chapter 2). Therein, in the *Recherches sur la mort*, Bichat presented an attempt to understand inter-organic functioning, deduced from the relationships of inter-organic dependence revealed by the connections that lead

to the death of one organ after another (brain, heart, and lung).[36] Here, each organ's behavior is determined by all the others, so that it enters into a series of various circular conditioning processes.

Cuvier offers one interpretation of the Kantian account: the *shape* of each part is determined by the others and, beyond that, by the organism's environment and type of life, as shown by the example of the skeleton of an extinct animal reconstituted from a single bone. At the same time, Bichat presented another side of the same coin: the *functioning* of each organ is conditioned by all the others, and, beyond that, by the perpetuation of the organism's existence. In both cases, the same specificity of the circular relationship between parts and the whole, which is characteristic of the organism and which Kant highlighted, is recognized and posited at the heart of an intelligibility of the living: reconstitution of organic forms by Cuvier, reconstitution of inter-organic conditioning based on experiments that kill one organ to observe the order of effects on the others for Bichat.[37] In both cases, then, an empirical instantiation of Kant's concept of natural purpose is posited as an operative principle capable of producing knowledge; the epistemic operations used to reach this knowledge are, on the one hand, Cuvierian comparisons, and, on the other hand, Bichatian experiments focused on death processes.[38]

In both cases, the organism as a totality refers to the alternative "existing versus not existing." How so? The "whole" that determines the parts is the animal insofar as it is capable of continuing to exist: in the case of Cuvier. The determination of the parts in their form is grounded solely in this possibility of continued existence and therefore of fulfilling its functions in the environment, in Bichat's case, the chain of interactions between organs characterizes an animal that continues to live, one that following his famous definition of life, "resists death." Transposed or, rather, extended into an operative principle, the Kantian concept of organism is thus charged with the alternative of life and death; the "totality" in question is defined against the possibility of dissolving and dying, which therefore appears as the background against which emerges the scientific knowledge that can be produced about this organism a knowledge whose epistemological specificity Kant had circumscribed, having identified the conceptual requirements of its constitution.

Kant reflected on the contemporary constitution of the concept of organism as a schema for thinking about life and making it the object of biological science. This reflection (provided one follows me until now) in turn stemmed from problems intrinsic to Leibnizian metaphysics, which arose from the moment when it was necessary to reform this metaphysics, because the organism emerged as the locus to rethink the problem of contingent order, a problem the first *Critique* had eventually not solved (Chapter 5). In so doing, Kant drew the network of presuppositions and requirements from which the constitution of this concept could be completed, first with Cuvier's comparative anatomy. Because of this network, he was also able to inspire a tradition of teleomechanist research, which put into

practice his proposals for research into germs, developmental layers, etc. As Larson, then Caneva, and above all Richards (Caneva 1990; Larson 1979; Richards 2000) argued, biologists as early as Blumenbach possibly confused the "regulative" in the Kantian sense with the "constitutive." Nevertheless, while they posited as constitutive the forces that Kant wanted to be "regulative," the fact remains that they respected the epistemological difference between types of forces, principles, and judgments, established in the *Critique of the Power of Judgment*.[39]

From the Cuvierian viewpoint, the organism now *avoids the alternative of physical necessity and supranatural design,* which Stahl still maintained, and from which the vitalists struggled to extricate it. It is indeed not directed by any purpose, but at the same time, it is not the product of a mere necessity. Its proper necessity sounds conditional: provided that an organism exists here, in such and such a milieu, it will be so and so; once a kind of life is specified, one *ipso facto* obtains knowledge of the organizational plan of this organism. Inter-organic relationships are therefore governed neither by physical necessity nor by a designer, but by a *conditional necessity*, namely, the necessity of life itself. What we have here is this "lawfulness of the contingent as such," that Kant saw as the proper meaning of purposiveness.

I explained, in commenting the §81 of the *Critique of the Power of Judgment* and the notion of "originary organization," that the *norm for development* is a necessary presupposition for the biologist and therefore constitutes a lawfulness superimposed on the physical sequences that underlie a given embryogenetic process. But Cuvier's comparative anatomy program and its formulation of the two principles instantiate *another norm*, which is the norm of surviving in a milieu, and which governs any understanding of comparing organs and ascribing function$_2$ to them, in order to reconstitute classes of organization plans and their functional organizations, that is, ways of achieving functions$_1$. The distribution of animals seems contingent, nothing allows one to deduce it from the laws of mechanics; however, as objects of knowledge, they should be thought of as lawful, the relevant law being the principle of conditions of existence.

11.2.4 Cuvier versus Goethe: acknowledging two types

However, the type is not Cuvier's proper domain, since I examined in the latter chapter Goethe's morphology and theory of the *UrPflanze*. Here, too, the regulative character of an organic totality played an epistemic role in the science of life. But Goethe's idea of type did not share the Cuvierian presuppositions relative to the primacy of functions over structures. This suggests that Cuvier's developments about the type may not be the only possible pathway from Kant's "organism" toward comparative anatomy.

The other account of the type was completed shortly after Cuvier's major achievement and Goethe's insights by another comparative anatomist who began working with him at the Muséum National d'Histoire Naturelle, Etienne Geoffroy

Saint-Hilaire (not to be confused with his son Isidore Geoffroy Saint-Hilaire, who later did seminal work in teratology). As mentioned above, the confrontation between Cuvier and Geoffroy at the Muséum in 1830 constituted for Goethe the major event of the time. I will first expose the reasons for their theoretical disagreement by reconstructing Geoffroy Saint-Hilaire's account of the biological type (§3). This will explain why Darwin saw in each of these views of comparative anatomy two "great laws of biology."

Then I will demonstrate how these two accounts philosophically derive from two distinct appropriations of Kant's idea of the regulative principle of purposiveness (§4). I will argue that this parting of the ways after the Kantian account induced theoretical consequences that survived the rise of Darwinism and are still present now.

11.3 The type: structuralism and unity, starting from Geoffroy Saint-Hilaire

11.3.1 Another take on comparative anatomy

Etienne Geoffroy Saint-Hilaire developed his theoretical account in 1818 in his *Philosophie anatomique.* The title echoed Lamarck's *Philosophie zoologique*, but signaled that comparative anatomy would be the ground of such philosophy, instead of classification *generaliter*.[40] It also relies on numerous works the naturalist did on mammals and fish, alone or at the Museum with Cuvier.

As a theoretical synthesis, the 1818 book presents first the foundational concepts and the principles that should guide the anatomical work across lineages. These are the "principle of connections," the theory of organic affinities, the theory of analogies, and the "law of balancing organs." The last three are in some way directly linked to this "principle of connections"; hence, I will now define its status and that of the derived statements, such as the theory of analogies.

Analogies between the organs of organisms have been detected since Aristotle, but Geoffroy's theory of analogies concerned, instead of the organs, the "materials of which each organ is composed."[41] This shift results from the first principle, called "principle of connections," which requires us to first consider not the shape of the organs,[42] but their position relative to other organs:

> Now it is obvious that the only generality to be applied in the species is given by the position, relations, and dependencies of the parts, that is, by what I embrace and designate under the name of *connections.* Thus, the portion of the leg, called the hand in man (which is generally understood by the word "foot"), is the fourth part of the branch of which the forelimb is composed; the terminal portion of this stem, the furthest from the center of the individual and the most susceptible to variations; the part most specially assigned to the

> communications of the being with all that surrounds it; the section, finally, which comes after the forearm.
>
> (*Philosophie anatomique* I, 1818, p.xi)

This focus applies in particular to bones: Geoffroy Saint-Hilaire began his comparisons with the skeletal system, then moved on to other systems, always starting from the vertebrate reference point. Beginning with the skeletal system and ignoring the others is, above all, a question of simplicity.[43]

Thus, "position, relationship and dependence of the parts" are, according to Geoffroy, the *connections*, which must be considered exclusively when comparing species and establishing the common type likely to encompass them. From one species to another, the shape of the bones varies, but their reciprocal position does *not* vary. Geoffroy was thus able to determine invariants, despite the changing shapes of bones through fusion, widening, sharpening, elongation, etc. The scheme of connections constitutes the object of attention for the biologist, while the apparent pattern of bones and cartilage tends to blur it and should be bypassed; the principle of connection allows us to reach a hidden level of biological reality.

The principle applies to recognizing, in the rings of annelids or the segments of insects, the same pattern of connections as between vertebrae: hence the assertion that "an animal lives inside or outside its vertebral column,"[44] and the re-establishment of a "unity of organic composition,"[45] against Cuvier. This assertion stemmed from his comparative anatomy work on insects, which was able to relate the six segments that make up the insect to the vertebrate skull (the first three insect segments "come from a dismemberment of the vertebrate skull," the next three correspond to thorax, abdomen, and coccyx).[46] Geoffroy Saint-Hilaire was thus extending a unity he had previously established across fish and mammals, but here he generalize it outside a phylum.

Moreover, the principle of connections made it possible to relate internal organs and the skeleton. For example, we can superimpose the organization of a lobster, a crustacean,[47] and that of a mammal, by making the lobster's spinal cord do a half-turn of conversion: this simple act allows us to see unity where the state of affairs suggested distinct planes. Geoffroy's principle undoes the visible form of an animal to reveal what relates it to other animals.

Granted, Cuvier already spotted identities of connections: for example, he wrote that "the connections between the bones of the skull are the same in all carnivores as in man"—and also in the lark.[48] While this attention to the skeleton indicates an orientation toward form and not only function, the principle of connections still breaks with Cuvier's program: Geoffroy no longer considers the general form of the organ, but its materials and position. The space of organisms considered through his comparative anatomy is not any more the space addressed by Cuvier: while the latter sees organs realizing a function$_1$ via

functions$_2$, the former focuses on schemes of connections that are not functional, and that can remain the same throughout deformations likely to impede the functions. For Geoffroy Saint-Hilaire, indeed, the function$_2$ of the same organ can change depending on its location in an animal, since the two concepts are not indissociable. Speaking of the history of his discipline, he argued that naturalists abandoned an initial intuitive vision of analogy in favor of an inventory of differences, and then finally scientifically arrived at a scientific approach to analogy: "Naturalists have returned to the doctrine of analogies; they are beginning to glimpse this fact of great importance to theory, that an organ varying in conformation often passes from one function to another."[49] Of course, this "analogy" defined by structural identity with functional difference corresponds to what we usually call "homology," analogy being functional identity with structural difference.[50]

Hence, while Cuvier found unity across the diversity of organs proper to different species by detaching functions from organs, Geoffroy found unity within the diversity of organic forms by shifting to the sequence of connections. But both Geoffroy and Cuvier stood at a level different from the visible form of organs accessed by the dissection of a single animal. Notwithstanding their crucial difference, their two respective principles induced an epistemic shift: the structure of the organism no longer exists at the level of the geography of organs, but at that of relations between relations—relations between various organs and the same function, or relations between distinct forms and a scheme of connections. The intelligibility of organic processes, as well as of their unity within the diversity of specific forms, is so established. For this reason, the two principles defended by two rival biologists still have a parallel use in establishing types—as modern morphologists can testify.[51]

In Kant's sense, both principles are regulative principles, expressing the concept of organism itself as a regulative idea of biological thought. Notice the dialectical move here: Cuvier's and Geoffroy's principles turned the Kantian notion of organism, understood as satisfying the two criteria of design and epigenetics (Chapter 9), into an operative epistemic scheme likely to reconstruct the organizational plans of organisms. They *operationalized* the Kantian transcendental principle. But the *cost* of this move is also clear: each of them seized only one aspect of the Kantian notion of organism. For Cuvier, function is primitive; an organism is a set of organs fulfilling coordinated functions$_2$ in the service of the functions$_1$. For Geoffroy Saint-Hilaire, the organism is above all a set of regular connections; the viewpoint on the organism is the form, not the function.

No single perspective is *the* true one, of course; both allow the biologist to discern types. They yielded exactly what Darwin said: the "two great laws of biology." Yet these laws are not like the laws of physics: in Kantian terms, they do not *constitute* nature; they merely *regulate* the judgment that a specific scientist—the biologist—elaborates.

Before examining their difference and their relationship to Kant's original formulation, I will focus on the "unity of type," this "great law" deriving from the principle of connections, and consider it in the context of post-Goethean biology. I will argue that a whole epistemic perspective has been built around this idea, supported by a specific mathematical modeling, and that, even though strongly dominated and marginalized, this tradition persisted and underlies some of the major heterodox moves in current biology.

11.3.2 Connection topology

The Geoffroyan "type" is a totality reconstructed a posteriori by us in order to describe the living creatures, and to put some order into the functional diversity of animal forms. Even more than with Goethe, the "adventure of reason" is possible without unfaithfulness to Kant, since the archaeology of nature has shifted from a mechanical strategy toward a regulative reconstruction of the invisible forms underpinning the different compositional structures of organisms.

Such a reconstruction considers connections, namely, not the parts, but the respective locations of boundaries and overlaps between parts. Mathematically speaking, it pertains to topology rather than geometry, since geometry concerns the metrics; thus, two pieces of different sizes and figures, hence geometrically distinct, could be topologically equivalent, provided that they can be continuously deformed one into the other, and that their connections with other figures remain the same. When Goethe spoke of identifying the vertebrate type, he initiated this shift in perspective, from Newtonian mechanics to topology, which led to Geoffroy Saint-Hilaire. Once the topological approach is understood, which is Geoffroy's achievement, the type extends naturally beyond the vertebrates, and comes to includes gastropods or mollusks. Hence, the claim of a unity of type.

Beyond providing the second "great law of biology," this approach, stemming from Goethe's *UrPflanze* and *UrBild,* instantiates a topological view on animal form, organization plan, and even development. The *connection scheme* is a novel epistemic object. It allows for correlations between parts in organisms that are not related to any functioning of the individual. However, relations operate on two distinct levels: (1) within the organism, as a topological map of the connections rather than a metric map of the organs or tissues; and (2) between organisms, as a set of deformations of the connection scheme that makes visible affinities between species, with the strength of an affinity corresponding to the degree of proximity between organisms. Hence, while the Cuvierian type, largely functional, as a type of existence in a set of milieux, combined an internal order of connections (that is, the correlations between parts characterizing an embranchment), and an external order through which embranchements negatively relate to one another, the Geoffroyan type articulates two kinds of order (1, 2), both of which involve positive relations.

As a consequence, Geoffroy defines another idea of similarity and identity between parts: two organisms or organs manifesting the same schema of connection are the same. This implies that my hand and the fin of a cod are the same, insofar as they instantiate the same connection scheme. Clearly, this kind of similarity realizes "homology," as we say since Owen (structural identity without functional similarity). In contrast, the similarity according to Cuvier's comparative anatomy is an *analogy*, namely, a similar function performed by two different organs.

The similarities unraveled by the Geoffroyan approach are not obviously visible ones; hence, the counterintuitive character of his assertion of the unity of plan. But Cuvier's comparative anatomy established counterintuitive similarities, too, for instance, two very distinct organs would appear the same because of the function$_2$ they fulfill. Most generally speaking, Cuvier's principle and Geoffroy's principle introduced two incompatible ways of distributing identity and difference across the living realm.

But the principle of connection introduces an important inflection in the understanding of biological type, namely the shift from *causal understanding to topology.* Goethe broke with the causal derivation of forms as envisaged by Kant in the CJ §80 (Chapter 10). His *Urbild* resulted from ideal modifications of the morphologies of all vertebrate species comparison, detection of similarities and differences, and abstraction from the latter in order to expose the former constituted Goethe's method and possibly Geoffroy's inspiration. No causation as a genuine mechanism therefore enters as *explanans* in the theory, since ideal relations are the explanatory focus. Geoffroy's novelty consisted in situating these relations, and more generally this ideality, at the level of the *connections*. The connection scheme, a novel object constituted into an explanatory target by the *Philosophie Anatomique*, instantiates this ideality that Goethe previously sought by considering skeletons or plant structures. More precisely, it constitutes a way to access the types and the common type of types, ultimately justifying the assertion of the *unity of type.* While Goethe defined the shift allowing for the adventure of reason, namely, shifting from transformation mechanisms to ideal relations, Geoffroy Saint-Hilaire, through the principle of connections, provided us with the method likely to make this shift operational, namely a topological understanding of relations.

One can hardly underestimate the importance of such a shift in biology. The biology of form, if we follow E.S. Russell (1916), found a major research pathway through this equation between connections and types. Not only was it given as a "great law," namely, the unity of animal form, but also, it would easily identify new types and new families of types, by its uncoupling from functional dimensions of the living and its focus on connections beyond visible forms. In a nutshell, typology arose with the introduction of the topological gaze in comparative anatomy.

Historians have documented this tradition, which is not the "teleomechanist" one, focused on embryology. Here, the aim is rather the reconstitution of

original types and their affinities. Under the name "transcendental morphology," a research program (*sensu* Lakatos) arose, which is accountable for major achievements—not only the definitions of homology and analogy but also a detailed understanding of major families (chordates, especially). Richard Owen, whose stature is illustrated by the fact that he was one of the biologists most respected by Darwin, elaborated an *Ur-vertebrate* in the tradition stemming from Geoffroy. This *Urbild*, admittedly, is not the *Ur-Tier*, it concerns only the family of vertebrates. However, it functions exactly as the Kantian "originary organization" does, in that it is presupposed as the template on which each organism is built, conversely, its nature is reconstructed by means of principle that I identified as regulative in the Kantian sense.

The story of Owen's *Urbild* is well known. Balan (1979) provided a major account of the form as a target for this newly constituted morphology; Rehbock (1983) explored the relations between the morphologists and the filiation that connects them to German *Naturphilosophie*. In a series of publications, Sloan (2001, 2005, 2007. . .) investigated the constellation of English biologists who inherited and elaborated the German transcendental morphology, by downplaying some *Naturphilosophische* echoes but keeping in sight the general goal of reconstructing types and deepening our understanding of the unity of type.

But this is not only food for historians of science. In fact, the marriage of typology and topology persisted well beyond the "transcendental morphology," supposedly wiped out by evolutionary theory.

If one considers the general tradition stemming from Geoffroy as a bracketing of the causal functioning of organisms in favor of an examination and appraisal of some topological structures, mostly recurring across species within one or several lineages, one realizes it persisted into our times under various guises. D'Arcy Thompson's *On Growth and Form* published in 1920, constitutes a major milestone in such a tradition. The title clearly: the object of study is form, hence functions and adaptations are secondary. And the form is understood in process, namely, as a growing form. D'Arcy Thompson revived the program set by Goethe: a science of biological forms, focusing on the process through which the form develops, grows, and reaches its final state.

D'Arcy Thompson has been widely read, even though his book is still considered far from mainstream biology, be it evolutionary or molecular biology. One might think that it is very antireductionist, focusing on the organismal form, while both molecular biology and modern evolutionary biology are centered on genes (in very different manners, indeed) (Huneman 2017b). But the topological methodology, quite remote from considerations of causal mechanisms, and mostly interested in topological constraints placed upon causal mechanisms, explains its singularity. By those constraints, one may think of laws of shifting size, which explain why an elephant with thin legs is impossible, whatever the transformation mechanisms at play. This latter example justifies the crucial attention paid by Stephen Jay Gould, the prominent evolutionary biologist, to

D'Arcy Thompson (see Gould 1977, 2002): Gould's major research topic when he began was *allometry*, which is exactly a relation between sizes within and between animals.

But D'Arcy Thompson can also be situated in a galaxy of biological figures: Nicholas Rashevsky,[52] Conrad Waddington, or Brian Hall, who rushed for mathematical topological models of organisms, leaving aside both natural selection and the minute workings of the molecules within the cell, especially genes. Some of the realizations in this tradition have been called "theoretical biology" (following Rashevsky's use). In any case, the continuity with Geoffroy Saint-Hilaire's rupture with adaptation and functions, and his focus on topology via connection schemes, as well as his aiming toward commonality across specific types that helped him reconstruct an ideal type, unifies those distinct biological projects. They seem to revolve around the idea of a specific mathematical modeling likely to discern, beyond the adaptations, the functional relations, and even the visible forms, something about the deep unity across the living, as well as the mysteries of biological individuality.

In the 1960s, the French mathematician René Thom tried to provide the relevant mathematics and be part of such a move (Thom 1974, 1980). He explicitly called for a science of form (1974) and proposed his own newly elaborated topological theory to ground this new science. Thom's mathematics is opaque to most biologists and, clearly, this direction—namely "mathematical models for morphogenesis"—did not take over the whole field of biology. But the explicit object study is the living form, and the genesis of forms across lineages, which is why Thom constantly referred to the "morphogenesis"—a concern echoing, fifty years later, d'Arcy Thompson's connection between growth and form. (I will get back to Thom in the last section.)

My point here is not, of course to reconstitute a whole episode in the history of modern biology; rather, I want to explain how Geoffroy's principle of connection, while instantiating a Kantian regulative idea, and pursuing Goethe's project of unraveling animal types, became a general approach to biological form, embodying a research program and specific formal tools that still persist today, and whose compatibility with mainstream cellular, molecular and evolutionary biology will be addressed later. But before raising any issue about such compatibility, I first need to better define and characterize this tradition, its ambitions, and its origins.

11.3.3 Connections of the principle of connections: from Goethe to Geoffroy Saint-Hilaire and generally to current developmentalism[53]

The biology of form, as characterized by E.S. Russell, featured two major milestones defined by Goethe's *Metamorphosis of Plants* and morphology, and Geoffroy's "anatomical philosophy," with its late 19th-century continuation called "transcendental morphology" (Rehbock 1983). The "vertebrate type" described

by Richard Owen, namely, the reconstitution of the original type of all vertebrates, represented a culmination of this biology of form, as well as a testimony of the communications between an original German and a later English paradigm of such a biology. Sloan (2007), for instance, focuses on the figure of Joseph Henri Greene, a British naturalist whose thought conveyed German insights in the transcendental morphology to the English-speaking readership, and ultimately Richard Owen (see Sloan's intorudction o Owen 1992; see also Corsi 2005).

Given the relevance of Owen's views for Darwin, one cannot underestimate the significance of Owen's comparative anatomy for modern biology. As a matter of fact, one could consider Darwin's hypothesis of common descent as a general inversion of Owen's Vertebrate type.[54] The evolutionary theory ultimately replaces the Vertebrate type, which expresses the commonality between all vertebrates, with the common ancestor of all vertebrates, which was real instead of an ideal reconstruction.

Today, in 2024, my account is inevitably marked by the key role of Darwinian evolution as the framework for any biological theorizing. Even though I study events in biological thought that predated Darwin and that may have persisted well after his works, the shadow of Darwinism unavoidably colors what I am reading.

Thus, Geoffroy's project of a form-centered biology, whose theoretical tool is the connection schemes and the topology, bears interesting relations to the evolutionary theory, as David Ospovat made it clear. In "Perfect adaptation and teleological adaptation" (1978), he showed the epistemological role of Geoffroy's comparative anatomy in the rise of Darwinism. He does not, as expected, focus on the unity of type, which indeed is one of the major pillars of Darwinism, and was expressed for the first time in the *Philosophie Anatomique*. He rather focuses on what he calls "imperfect adaptation." Geoffroy indeed bracketed functions and adaptations, as we have seen. An organizational plan is like a theme with variations, in music; variations are like the many adaptations to different environments, but the type, for instance, the vertebrate organizational plan, remains the same.

According to this approach, adaptation in organisms cannot always be perfect, since the adaption of a part always arises in an existing organization plan that, in turn, may not be completely adaptive; after all, some of the animals with the same plan live in very different environments, think of fish and reptiles—therefore, the plan in itself cannot always be adaptive. This difference between actual organisms and perfect adaptation, argued Ospovat (1978), is conceptually crucial. Geoffroy would surely allow Darwin to make sense of the unity of type—it is the theme underlying the variations—but also of the fact that natural selection might be the main causal factor. Why? Because selection always starts from antecedent states of organisms, therefore, it cannot perfectly adapt an organism to its environment. Under the name "tinkering," coined by François

Jacob (1980), this idea would meet great success in biology. If nature were a rational engineer, the adaptation would be perfect; yet it is not, as Geoffroy has shown, hence what brings about organisms is not an engineering plan, but rather tinkering.

This is not to say that Darwin completely followed Geoffroy. In the text mentioned when I opened this chapter, the "great law of biology" constituted by the unity of type is subordinated, for Darwin, to the Cuvierian principle of the conditions of existence. This latter one, in turn, means "natural selection." But some biologists will not follow Darwin here, even though they do not reject evolution at all (hence, they are not ID proponents). Brian Hall, for instance, contested the idea that natural selection is the root of all adaptations, which later on would be inherited by various species and transformed in their environmental context (Hall 2003).

As Amundson (2012) characterizes them, the biologists descending from Geoffroy Saint-Hilaire favor *homology* (common descent) over *adaptation* (natural selection), while the orthodox Darwinians, the ones who support the modern version of Darwinism called Modern Synthesis (Huneman and Walsh 2017; Gayon and Huneman 2019), favor adaptation over homology, hence natural selection over common descent, which is Darwin's original statement in chapter 6 of the *Origin of Species.*

Favoring homology means avoiding subordinating form to function, and therefore subscribing to the ideas defended by Goethe, Geoffroy, and this lineage of thought. As Pigliucci (2007) emphasized, the Darwinian Modern Synthesis focused on genes and their changes; it left aside "form," that is, the object study of such a lineage.

One may quarrel with this interpretation but, related to my purposes here, it makes clear why Cuvier's principle of existence and Geoffroy's principle of connection, even though both are instances of Kant's general regulative principles of reflective judgment, diverged greatly, giving rise to antinomic traditions of biological thought, one functional, the other formal.

To some extent, one could see the biology of form and the biology of functions as two distinct perspectives; the famous Necker cube helps us to understand this stance. One can see biology through the prism of form, or through the prism of function; no one is wrong, but you cannot hold both together at the same time (like the forward-looking and backward-looking cubes inscribed in the same 2D drawing of a cube).

But is it really the case? Russell (1916) clearly stated that the two biologies cannot be reconciled, but he also seemed to think that they are complementary. In this sense, to some extent, they should be articulated. Each of them would explain a side of the living. Let us briefly indicate how.

The lineage stemming from Geoffroy's principle of connection is committed to rejecting mechanistic thinking, as Goethe saw it, when he inaugurated the "adventure of reason." It is therefore strongly related to the varieties of topological

thinking in biology, whose main instances were listed above. The major question raised by those biologists is not the diversity of species, addressed through the notion of a diversity of niches, and therefore of adaptations, in accordance with the program sketched by the famous final paragraph of the *Origin of Species*.[55] Instead of the diversity of adaptations, they focus on the commonalities of forms. Why do mice, giraffes, and hippopotamuses share the same organizational plan? Granted, this is because of their common descent, but why was it not possible to deviate from the type, and, for instance, let the giraffe have many more cervical vertebrae than the mice, which would obviously be useful to them?

This question of the form touches upon development, since the developmental process means the process through which the biological form of a species is yielded at the individual level. As many biologists and philosophers today concur, beginning with Gould and Lewontin's (1979) influential paper about the "spandrels of San Marco," which coined the term *adaptationism*, the question of the evolution of development attracted a major critical charge against mainstream Darwinism. The supporters of Evo-Devo, the evolutionary theory of development (see Raff 1996), argue that development matters to evolution, especially because development is not only the expression of a genetic program (the genes being ultimately shaped by natural selection). The question of form, therefore, merges with the question of development and the commonalities of development across lineages. Asking about the "tetrapod limb," which is a commonality, and therefore, according to Goethe and Geoffroy's ideas, a *type*, means asking about the common developmental regime for producing a limb across tetrapods.[56]

The students of development, starting with Waddington (1957), and then many of the Evo-Devo scientists, including Kauffmann (1993), addressed the question of form through mathematical tools that inherit the sidestep made by Goethe and then Geoffroy, which distanced the question of form from the Cuvierian type, wholly governed by considerations of functions.

To sum up, there are at least two major research traditions because there are two biological types. And types, as indicated above, are always related to one way of understanding the transcendental regulative principle of purposiveness. In the next section, I will return to the subtle articulation between this presupposition and the two "types," the functional one (Cuvier) and the formal one (Geoffroy). This will first help us to make sense of the complete historical constitution of the concept of organism; it will also cast light on the theoretical challenges raised by the coexistence of two distinct, possibly conflicting—or not simultaneously endorsable—stances regarding the biological type.

11.4 The parting of the Kantian ways: now and then

Remember that the Cuvierian and the Geoffroyan principles are both regulative principles, in the sense of Kant. They explicate the "idea of a whole," in which the parts find the reason for their form and connections, while they

do not acquire their shape from any external agency, since they are natural. The Cuvierian principle focuses on the functional roles of parts, while the Geoffroyan principle focuses on the integrated character of the whole, and the constancy of this whole across changes of parts, from the viewpoint of its connection scheme.

When considering Kant's original formulation, the key conception here is the notion of an "idea of the whole" as the principle of knowledge, which guides both the design of the parts and their connections, and the self-production of the whole. These two dimensions were distinguished as a design principle and an epigenesis principle; they led to the two criteria of design and of self-organization, as I considered them (Chapter 9). These criteria conclude Kant's inquiry (*CJ* §65) regarding the kinds of things likely to be counted as natural purposes.

By focusing on his conception, I will explain the parting of the ways represented by Cuvier and Geoffroy, and its major consequences within the structure of subsequent biology.

11.4.1 Then: the "idea of the whole"

The design criterion requires that in a "natural purpose," parts acquire their form and their connections on the basis of the hindsight of the whole—this consideration being in the eye of the beholder, that is, as a presupposition of the cognitive agent focusing on the system. The Cuvierian principle of correlation of parts clearly instantiates this criterion, and it allows the biologist to reconstruct the whole from particular parts, so that the functioning organism appears as buildable on the basis of this whole taken as a template.

Thus, while Cuvier's biology is accurately seen as an instance of functionalist biology, it can be understood clearly as a biological program centered on one aspect of the notion of natural purpose, namely, the design criterion. No wonder then that the biologist, here, can use the model of the machine to make sense of functioning organisms, because, precisely, this criterion is also satisfied by machines.[57]

One should notice an important ambiguity there, relative to further advances. Cuvier asks how parts can fulfill functions$_1$, and these functions are supervening on the parts in the sense that, for instance, the digestive function$_1$ can be fulfilled by the intestine in vertebrates, but by osmotic absorption in other animals or even in plants (these being the functions$_2$ of organs, as indicated above). Yet, the Cuvierian reconstruction of animals based on discrete parts—be they extant animals or prehistoric, extinct ones—also insists on the fact that the organizational plans face an environment, and derive their key rule, namely "the principle of the conditions of existence," from existence in a given milieu. Thus, functioning, regarding an organism's parts, means being functional and also being *adaptive* to the environment. Hence, Cuvier's functionalism easily translates into methodological adaptationism, understood as the doctrine according to which one should

always first assume that a trait is an adaptation, before even modeling an organism (Godfrey-Smith 2001).

Actually, philosophers and biologists (Kitcher 1993; Gardner 2009) are prone to claim that natural selection is the only explanation of design (see also Huneman 2015). The design is also exactly what is reconstituted based on the principle of the conditions of existence—a proximity that Darwin understood, since, as recalled at the beginning of this chapter, he interprets this Cuvierian principle as the equivalent of natural selection. Thus, even though this principle and, on this ground, Cuvier's comparative anatomy, constitute an instance of functional biology, one can easily turn such functionalism into what is now called adaptationism. Whereas in Cuvier's science, the design was *presupposed* first as a principle and then reconstituted, Darwinism makes the design into something *actual*, observable in the field, because it proceeds from a real, and material process, namely, natural selection.

The second criterion, the epigenetic one, means that parts produce themselves in accordance with an idea of the whole. This idea of the whole is a principle of cognition, and crucially—still following Kant's analysis—, it is the same as the one involved in the design criterion. According to our second Kantian criterion, embryologists presuppose, for instance, that parts and whole produce themselves, but they are always measured against the idea of the whole. Here, the principle of reflective judgment concerns the phenomenon of development; the idea of the whole first ensures that the development aims at something, and second, allows us to say that some developmental processes may be abnormal, since they prevent the zygote from reaching its purpose.

Given that the "connection scheme" constitutes a specific whole according to which the organizational plan of an organism of a given species is deployed independently of its functioning in a given milieu, the principle of connections allows the scholar to make sense of this idea of the whole, which is inbuilt in the developmental process. Thus, such a principle, wholly devoid of any functional consideration, directly instantiates the second criterion of natural purpose, epigenesis, that is, the second aspect of the Kantian principle of purposiveness, namely self-organization.

I spent some time analyzing Cuvier and Geoffroy Saint-Hilaire, not by an extravagant respect paid to Goethe, or by a library—worm tropism, but because they supported two research traditions that today constitute the *Kampfplatz*—as Kant used to say—of modern biology (or, at least, evolutionary biology). Yet these traditions do not only consider *functions* and *form*, according to Russell's classical divide; they also elaborate upon two corresponding modern notions, crucial in the field of evolutionary studies, namely, *adaptation* and *development,* respectively. But why are they so separate, and what is at stake when researchers call for their articulation (e.g., Sansom and Brandon 2007; Gilbert et al. 1996), or insist that these two traditions are not pursuing compatible goals (e.g., Amundson 2005; Burian 1986)?

According to Kant's account, there is *one* single idea of the functioning whole as the *Erkenntnisgrund* for the two criteria he identified. These two criteria are not independent; you cannot use one and leave the other, because such an "idea of the whole" is the same notion refracted through the two criteria. Thus, the partition between the two criteria, occurring within the French comparative anatomy school in the early 19th century, clashed with Kant's account taken for itself.

But what does mean the (Kantian) unicity of the presuppositions of an "idea of the whole"? It implies that the one that stands at the level of functional design cannot be in conflict with the one that obtains in the developmentalist theory. Both *norms*—of development, and of function—should relate to the same individual. Yet there is no evidence that their pre-established harmony can still persist after the establishment of two research programs that do conflict over the extension of the animal "type," as we just saw with Cuvier's functional type and Geoffroy Saint-Hilaire's topological (formal) type. With respect to comparative anatomy, which orders the mammals, the vertebrates, the cnidarians, and all other groupings, a key question for any object of biological theorizing consists in understanding biological unity. Unity is given, for Cuvier, by the multiple realizability of functions$_1$ (i.e., general physiological functions), which are diversely realized, in various species by various organs fulfilling functions$_2$ (i.e., functions ascribed to parts). For Geoffroy Saint-Hilaire, unity rather proceeds from form (namely, connection schemes); but this means that the subordination of the analysis to function$_1$ should be deflated, because "function" means that environmental differences are relevant (since functions$_2$ support adaptations), while the unity of type bypasses or overcomes the differences in varieties of environment. Hence, the two "ideas of the whole" in Kant's sense diverge.

In Kantian terms, "natural purpose" means purposiveness as a regulative principle of reflective judgment, deployed along the two criteria. It means first that the contingent mechanisms of an organism's organs are addressed throughout a norm, namely the norm of functioning, according to which they do something that makes sense for the survival of the whole—and when they do not they are dysfunctional. It also means that even though the self-production of an organism is influenced by all extant physicochemical processes occurring in its environment, it nevertheless corresponds to an "idea of the whole," and therefore subscribes to the norm of the "adult type," according to which each step of the development can be assessed, identified and named. The Kantian account of organisms thereby involves the unity of norms of the living, i.e., the unity of the lawful aspects of this "contingent as such" represented by a plant or an animal, contingent with respect to the universal laws of mechanics.

Thus, when Cuvier proposed his version of Kant's natural purpose, he initiated a dissociation of the Kantian dual idea of the whole. And since Geoffroy Saint-Hilaire did the same with his own principle, he introduced into life sciences another version of the Kantian "idea of the whole"—one that may clash with Cuvier's.

In this perspective, the Kantian analyses may be relying on a lost past. The shift from function to adaptation, and from form to development, which characterizes the current formulation of the problem, makes even more manifest the divergence between the two readings of Kant's notion of organism respectively introduced by Cuvier and Geoffroy.

Yet something theoretically significant should be noticed here—before jumping to the current situation of the form/function divide—, namely, the relevance of two different conceptual distinctions. I just situated both Cuvierian and Geoffroyan comparative anatomies with respect to the two criteria, "design" and "epigenesis"; I also saw them, as usually done, as instances of the biology of function and the biology of form. However, these two distinctions cannot be completely juxtaposed, even though "design" has more to do with functions, and "epigenesis" with form. Obviously, *design* denotes a notion of structure, which is not alien to the concept of form. Conversely, any self-producing system, as understood according to the epigenesis criterion, obeys some requisites of functionality.

So here is the subtle articulation between these two distinctions. Function biology may focus on adaptations or functions$_2$ of parts as the key things to explain; hence, its objects, as we recognize them, are constituted by our assumption of their capacity to function, namely, to survive and reproduce in an environment, which constitutes the design criterion. But, as a corollary of them being "*natural* purposes" (that is, being purposive but *not artifacts*), organisms also fulfill the other criterion, namely, the epigenesis criterion.

Reciprocally, form biology surely assumes by definition the epigenetic criterion, as illustrated above by considering Geoffrey Saint-Hilaire's comparative anatomy, and remains irreducible to function biology. Yet, given that it considers *functional* living forms, it has to assume the fulfillment of the design criterion. As Kant emphasized, the two criteria are different but not separable; at least, in his own account of the organism.

What happened then, with Cuvier and Geoffrey, understood here as labels for two projects of biological explanation that realized the potentialities of the Kantian account of organisms, is a *parting of the ways*. Function and form are two possible interpretations of the notion of an "idea of the whole" as *Erkenntnisgrund*, "principle of knowledge" (*CJ* §65). The two biologists considered this "idea of the whole" differently, and therefore, they *articulated the two criteria for organisms* in a different way. But Kant himself used to assume their solidarity because the very possibility of making sense of some systems that we cannot conceive of except as natural purposes requires the "idea of the whole" to be *embedded in the reflective judgment*, and thus *cannot be divided* or multiplied.

We inherited this parting of the ways, and a split within the "idea of the whole" itself, because it cannot anymore be understood through the transcendental lens that Kant elaborated. In other words, the parting of the ways between Geoffroy Saint-Hilaire and Cuvier, or between a form-reading and a function-(then

adaptation-)reading of the Kantian account or organism, produced two different instantiations of the two criteria, with distinct emphasis in each case, which ultimately led to a dismantling of the Kantian account, insofar it became deprived of its original transcendental context. Biologists indeed, following Cuvier or Geoffroy Saint-Hilaire, did not subscribe to the transcendental perspective set forth by Kant, which constituted the ground of his own account of organisms as natural purposes.

I now turn to the current state of these two criteria and the Kantian account, understood as a historical ground for making sense of "organism" in biology.

11.4.2 Now: natural selection and the organismic stance

Our current conceptions of Kant's two criteria are, of course, framed in the language of one of the major theories proposed to think about life, namely, evolutionary biology, cell biology, and molecular biology.

From the Darwinian viewpoint, as indicated above, "design" exactly means what is explained by natural selection, to the very extent that selection explains traits as adaptations (Brandon 1990), while also explaining the connection between traits as a form of trade-off between adaptive values of these traits (Andre et al. 2022, chapter "Trade-offs"; Huneman 2017b). While the well-known challenge initiated by Gould and Lewontin's 1979 "spandrels" paper consisted in questioning whether a set of trade-offs optimally answering environmental demands could account for the integrated character of organisms, orthodox biologists following the Modern Synthesis are committed to the view that natural selection yields design: simple traits result from mere natural selection, complex traits result from cumulative natural selection—how could they not, given that the probability of an integrated genotype produced by a series of random genetic drifts fixing each of the alleles is extremely low, being a product of many low probabilities?

But the question raised by the followers of Gould and Lewontin (1979) and, most generally, many of the Evo-Devo community, consists in doubting whether this optimality trade-off explanation exhausts what has to be known about design. Gould and Lewontin famously referred to the German word *Bauplan* to talk about the design of the organism. In other words, and phrased in the tone of the previous section, they question the reducibility of "design" to functions, adaptation, and finally natural selection. The reference to the 19th-century transcendental morphology—transparent in the use of the German word—obviously traces back to the tradition of Gegenbaur, to Von Baer's developmental biology, and finally to Kant's idea about an originary organization. The *Bauplan* could be seen as the realization of the originary organization, understood from the viewpoint of Goethe and Geoffroy Saint-Hilaire: a theme, on which adaptation adds variations depending on which environment this theme lives.

The *Bauplan*, for them, as for the opponents to the Modern Synthesis, is a set of constraints stemming from development, rather than a set of trade-offs

optimized by natural selection. This explains why the design of organisms in a given lineage seems to be conserved while the species live in highly different environments—think: guppies and giraffes—where, by definition, natural selection consists in adapting organisms to various environments. The Evo-Devo biologists claim that there is a gap between adaptation and design, even though they agree that adaptive evolution produces some design. They grant that one sense of design could be the functional design reconstructed by Cuvier and his "Principle of conditions of existence," which is ultimately natural selection, as Darwin made it clear. But an organism is not a mere "bundle of adaptations," as Huxley, who coined the term "Modern Synthesis," claimed in his 1942 book. It is more than that, and this "more than that" was understood, or at least referred to, by the term "Bauplan" beloved by transcendental morphologists. So, what happened here?

Evo-Devo biologists, who inherited Geoffroy's agenda for a form biology (see Le Guyader 1997), shifted the explanatory task from the level of natural *selection*—namely, "what were the selective pressures at play when the species evolved?"—to the level of *variation*. Selectionists, they say, classically assume that there is a great deal of variation, which is generally understood as mutations and recombination since the advent of the Modern Synthesis. As Huxley put it to define the overall credo of this Modern Synthesis, "Natural selection, acting on the heritable variation provided by the mutations and recombination of a Mendelian genetic constitution [a], is the main agency [b] of biological evolution" (Letter to Mayr 1951, cited in Huneman 2017b). But suppose that variation (clause [a]) is very small: then there is not much there to select (clause [b]). In this case, what would explain the trait found in nature is rather variation than selection. Then the question is no longer "why is selection favoring this trait?," but "why is development producing only this small range of trait values?" Or: "Why are the genes varying so poorly, and why precisely are these alleles occurring all the time rather than others?" Interestingly, Goethe, arguably an ancestor of the modern non-functionalist/adaptationist biology, saw this difference between questions and the interest of the non-functionalist ones. He wrote, about the canine teeth of the deer-pig (*Sus Babirussa*) that we should not ask "What are they for? but rather, Where do they come from? We will not claim that a bull has been given horns so that he can butt; instead, we will try to discover how he might have developed the horns he uses for butting."[58]

Of course, the question about selection arises in the context of evolutionary biology and could not be formulated at the time of Kant. By making, in principle, natural selection the only explanation of adaptations, the Darwinian viewpoint means that design is not only the principle of reflective judgment, but it is also the effect of an actual causal process occurring at the population level and across thousands of generations. This novelty implied conceptual rearrangements regarding the concept of organism, and first of all, the question of whether

such a naturalistic account exhausts the notion of design by wholly accounting for this reference to an "idea of the whole" embedded in its formulation.

Gould and Lewontin (1979) suggested the Evo-Devo community's answer, namely, that the strictly selectionist account is not complete. Thus, the parting of the ways, already present in the cleavage between Cuvier and Geoffrey, now deepens, since the whole question is posed in naturalistic terms, whereas, in 1830, the two principles could still be seen as transcendental principles, at least insofar as they were necessary presuppositions for reconstructing Cuvierian organisms and then *embranchments*—or Geoffroyan types.

Granted, natural selection explains design, but then, no obvious understanding of this design allows one to think that the "idea of the whole" here is the same "idea of the whole" to which the self-organization of the organism subscribes. And fundamentally, it is not (Huneman 2017a). What appears as design from a Modern Synthesis evolutionary viewpoint seems to be functional design *sensu* Cuvier, understood now as a bundle of adaptations. And—while this has been exposed lengthily elsewhere and I will only gesture toward it—the "functions" in this perspective are what the traits have been selected for,[59] and therefore are indeed adaptations. But, on the other side, the question of the self-organization of an organism does not analytically induce anything relative to natural selection.

Let us unpack this conceptual knot.

First, one sees that the naturalistic understanding of design in a Darwinian way—that is, by following Darwin's own indication that "conditions of existence" means natural selection—is *externalist,* using the epistemic categories coined by Godfrey-Smith (1996). By this term, one means that the properties of a system are explained by reference to its environment. (This Darwinian shift, of course, takes us far away from Kant, who did not have a naturalistic understanding of these concepts of adaptation and function, and even from Cuvier, who did not see the environment as the only *explanans* of the functions of organisms.) In contrast, questioning the self-production of organisms, at least according to current evolutionary developmental theorists, is rather *internalist*, i.e., one looks at the intrinsic properties of genomes and then cells to depict the possible trajectories of a developing individual.

Second, this difference boils down to the explanatory cleavage mentioned above. Design, *sensu* the Modern Synthesis, explained in an externalist way, pertains to *natural selection*; the whole, as a norm for self-production and maintenance, explained by developmental theory in a developmentalist way, mostly concerns the developmental processes and then their capacity for *variations*.

To summarize, the two Kantian criteria, which allowed him to say in the same sentence that a natural purpose is an organized system that self-organizes, are now dismantled. We have, on the one hand, a design understood at the level of populations, via *selection*, in an externalist way; and on the other hand, a self-production understood at the individual level, in an internalist way, with a

concern for possible *variations* (and, then, for invariance, which is a possible outcome of variations-yielding processes) rather than for selection.

In Huneman (2017a, 2019b), I tried to show to what extent the two views could be reconciled, to the extent that the integration of a functional whole due to natural selection, which maximizes inclusive fitness,[60] may account for the whole system aimed at by development. My concern in this book is more general: it consists in presenting the philosophical framework in which this conflict can be formulated and handled, and in analyzing it by explicating the way concepts historically developed. I do think that the story of the parting of the ways after Kant—which is a dismantling of the Kantian account of organisms, beginning with Cuvier and Geoffroy but precipitated by the Modern Synthesis and now instantiated by the ongoing debates about development and evolution—constitutes a crucial element needed to understand the current cartography of these theoretical questions.

This leads me to an examination of the contemporary state of the parting of the ways and the attempts at conciliations, which actually involve novel cleavages.

11.4.3 About design, a second parting of the ways: transcendentalism versus two naturalist approaches

11.4.3.1 Organization, organismic stance, and self-organization in the post-Varelian approaches

A recurring claim asserted by the discontents of the explanatory sufficiency of the Modern Synthesis is the following: the externalist explanations provided by evolutionary biology regarding adaptation and design posit all relevant causal processes at the level of populations, mainly understood as populations of genes (or gene pools). Organisms are deprived of any explanatory virtue, while also being only incompletely accounted for, as I recapitulated this critique above. Walsh (2010) provides us with the most articulated version of such a critique, wholly fueled by advances in biology and especially research on phenotypic plasticity (Sultan 2015; West-Eberhardt 2003). Yet Bateson's (2005) classical paper on organisms in evolutionary biology already sketched this line of critique: by witnessing the deployment of the developmentalist critique of the Modern Synthesis, we would attend to a "return of the organism."

Several caveats should be added to this stance, even though they do not debunk it. First, behavioral ecology, namely the science of all behaviors of the organisms,—"behavior" understood in a very large sense, hence, devoid of any cognitive presuppositions—focuses mostly on *phenotypes* rather than genotypes (e.g., Grodwohl 2019). Granted, it is intrinsically adaptationist—at least methodologically. But it does not explain things in terms of genes, even though one could argue that the causal processes of selection, which are the major explanantia in this field, implicitly boil down to the dynamics of genes.

Second, historically, many of the phenomena considered by this critical stance defended by Sultan, Walsh or West-Eberhardt, namely phenotypic accommodation or genetic assimilation, were already key objects of the classical Modern Synthesis, which included a great deal of research on the way the adaptability of individual organisms impinges on evolution (Loison 2024).

But all in all, I can still discern a robust critical stance here. It argues for the irreducibility of the biology of development, and even the evolution of development, to the Modern Synthesis—namely, the irreducibility of the development of organisms to the Darwinian understanding of design. In other words, Kant's "epigenetic criterion" is not soluble into the Darwinian reading of the other criterion.

More precisely, this *organismic stance*, to give it a name now, does not come in one piece. It includes several distinct variants, often incompatible with one another. In general, what they share is the idea that a naturalistic understanding of development does not at all rely on natural selection, but may explain by itself adaptive features of organisms, including their functional cohesiveness, that the Modern Synthesis sees as rather pertaining to a selectionist or at least evolutionary explanation.

Yet if we decide to focus on the organism as a key concept for biology, and admit the insufficiency of purely Darwinian, selectionist accounts, the theoretical landscape appears heterogeneous and controversial. Some avenues in the organismic stance rely on the concept of self-organization, understood through mathematical modeling. There is indeed a tradition of concepts that begins with the systems theory (von Bertalanffy 1975), and culminates in the concepts of Varela and Maturana, strongly influenced by the concepts of negative feedback and goal-directedness in cybernetics; and with the Boolean genetic networks theorized by Stuart Kauffmann (1993). For Varela, who explicitly vindicated a Kantian legacy (Weber and Varela 2002), organisms and cognition instantiate self-organization, and the question consists in producing an adequate model of self-organization likely to make sense of organisms and their phenomena (Varela and Maturana 1972; Varela 1979).[61]

Nowadays, this tradition flourishes in what is often called the "organizational accounts" proposed, for instance, by Moreno and Mossio (2015), and by several theoretical biologists and philosophers often based in San Sebastián. Besides Kaufmann's (1993) and Rosen's (2000) notions of dual causation (formal/material), the organizational account emphasizes that in some systems, influxes of energy and matter are mediated by constraints, which may trigger other constraints constraining the flux, which is at the same time impinging on them, so that this causal circularity yields self-organization and self-maintenance.

Notwithstanding all the mathematical and theoretical subtleties of these models, and beyond an intent to mathematize processes in a very generic manner, they also share the idea that circular causation in systems far from thermodynamic equilibrium (since they constantly exchange matter with their

environments) is what "teleology" means. Thus, living systems are a specific instance of this teleology. Crucially and additionally, those models aim at a naturalistic account of such systems. Teleology occurs in nature under the form of their structuring and dynamics; biological teleology is a prominent subtype of it, in which constraints and causes are articulated in a characteristic way, which of the organizational account intends to explain (e.g., Moreno and Mossio 2015; Mossio and Bich 2014). The naturalistic perspective is crucial here because the Kantian self-organization is acknowledged by them as the first formulation by philosophers or biologists of the causal scheme of life, and therefore, as the key target of our theoretical project of a generic account.

Overall, the organizational account belongs to the organismic stance; theoretical approaches based on Evo-Devo constitute another aspect of this organismic stance (West-Eberhardt 2003; Walsh 2010; Sultan 2015), and some work in this area require rehabilitating the notion of agency (e.g., Mrozek et al. 2022; Walsh and Rupik 2023), as seen in Chapter 7. Finally, topological approaches that stem from Geoffroy Saint-Hilaire's and Goethe's notion of types and their shift away from Kant's "adventure of reason," evoked in Chapter 10, represent another version of this stance, even though they can be conciliated with organizational accounts and Evo-Devo.[62]

Before taking a stance on these debates, I will recapitulate the present state of affairs regarding organisms, teleology, and naturalistic versus Kantian accounts.

11.4.3.2 Understanding the current cleavages about biological teleology

We met a first parting of the ways when the Kantian account was split between a function perspective and a form perspective, namely, the comparative anatomies of Geoffroy Saint-Hilaire and Cuvier. Then this cleavage was accentuated by the Darwinian naturalization of function and adaptation, turning this parting of the ways into a split between (1) selectionist/Darwinian approaches, which are likely to account for the design criterion and, at least controversially, for the epigenesis criterion, and (2) the organismic stance, i.e., the organizational approach, or the Evo-Devo and in general the opponents of the Modern Synthesis, who took the epigenesis criterion as irreducible to selectionist accounts, and as likely to explain the family-level design as *Bauplan*.

As I said, while the Modern Synthesis can be broadly subsumed under one stance—even though of course at a finer grain cleavages and debates are innumerable, and already began in the 1930s with the founders of population genetics and the debates between Fisher and Sewall Wright (Gayon 1998; Winther 2006; Plutynski 2005)—the other side is fragmented into many conflicting theoretical schools and approaches, including the Evo-Devo approach mentioned in the previous paragraph. But if I now focus on one of these schools, quite visible

within the organismic stance, namely the self-organization-based organizational account, exposed in the previous paragraph, another contrast will appear.

This account may conflict with the selectionist, Darwinian account of design, since both intend to account for design, but the latter approaches design through selection as an *explanans*, while the former approaches design as a result of the self-organization process, fulfilling the Kantian epigenesis criterion, and therefore captures another sense of design. *However,* both views share a *naturalistic* intent. To this extent, both can be contrasted with the original Kantian account, which transcendental, and (precisely for this reason) able to treat the "idea of the whole" as a common reference for the two "sides" of an organism, namely its design and its epigenetic virtue understood as a disposition for self-organization (§4.1). Thus, the naturalistic turn, whether Darwinian or self-organizing, effected the dismantling of the Kantian account and of its idea of the whole, by depriving the account of the (Kantian) reason why the two "sides" do not fall apart and are indissociable; namely, the *epistemic necessities of reflective judgment.* Ultimately, we see why the transcendental claim was so important for the Kantian account of organisms: the unity of the "idea of the whole," and thus the possibility of holding together the two avenues of biological intelligibility rested on the adoption of the transcendental viewpoint and the ensuing claim that purposiveness is a transcendental principle for power of judgment.

Let us conclude this paragraph by assessing the claims of the organizational account to reformulate Kant (e.g., Mossio and Bich 2014). Is it really the case that Kauffmann and then Varela, or Moreno and Mossio (2015), have genuinely naturalized Kant's transcendental idea of purposiveness as a regulative principle?

I remain quite skeptical for the following reasons. First, as I argued at length, the originality of the Kantian account is that its transcendental dimension allows it to keep together functional design and self-organized form, whereas the organizational account has a hard time making sense of all adaptations in the design of organism, unlike the Modern Synthesis account, whose strength is precisely an account of adaptations, including apparently counter-adaptive traits (since inclusive fitness explains them, Huneman 2019b). Evelyn Fox-Keller argued in several papers that the teleology reconstituted by self-organization models is unable to account for the dimensions of purpose and function (e.g., Keller 2009, 2008); the organizational account claims that it has overcome such shortcomings, pinpointing the gap between accounting for the purposive behavior of an organism (which it does), and for the function$_2$ of all traits (which is less easy, because many traits do not genuinely serve the survival of the organisms).

Second, and more generally, the logic of the Kantian account seems irreducible to self-organization, whatever model one employs. As I extensively argued until now, the Kantian account of purposiveness begins with a question about the difference between *nature* and the *order of nature*, and then about the faces this "order" can present. In this context, purposiveness is an a priori concept: its content is less encountered in nature than prescribed by the structure of our

faculty of knowledge and its inability to make sense of some systems indicating by themselves that they are more than merely contingent regarding the laws of mechanics.

Thus, from a Kantian viewpoint, the organizationalist question regarding the emergence of biological self-organization in nature is not radical enough, since one cannot a posteriori find any answer without having already assumed some purposiveness. Since Kantian natural purposiveness is a transcendental principle, it cannot, as such, be the target of a naturalistic account; on the contrary, it guides any naturalistic inquiry, along the lines of what Lenoir called a teleomechanist program. The price of this transcendental grasp on purposiveness is therefore the impossibility of making purposiveness emerge from nature, hence the impossibility of proving that it is something in nature. Granted, organizational accounts often sound similar to the Kantian view since they overemphasize self-organization, and therefore, seem to stand under the umbrella of Kantianism. Gilbert and Sarkar (2000), for instance, viewed Kantianism as the spontaneous philosophy of developmental studies. Yet, Kantianism and organizational accounts actually remain essentially distinct; both talk about self-organization, but neither the justifications nor the ontological stances they are committed to can match.

To this extent, the cardinal issue for organizationalism, namely the difference between autonomy as biological self-organization and self-organization *generaliter*, may resemble the Kantian concern with the difference between contingent and necessary orders in *The Only Possible Argument*. . ., which was the starting point of Kant's inquiry. However, because Kant translated this question into the transcendental framework and ultimately redesigned his concept of natural purposiveness, we witness here only a partial overlap or similarity. When the organizationalist theoreticians claim their Kantian ancestry, they would be credible only if they were referring to the 1763 essay on the proof of God, not the third *Critique.*

To sum up, I wish to draw the alternatives that have been opened by the formulation of the Kantian account of the organism. In this chapter, we saw that the form and the function determined two avenues of research which, ultimately, split, yielding one of the current hotly debated controversies in the field of evolutionary biology. But to this form-function cleavage, the theoretical elaboration of the concept "organism" added another alternative. Such an alternative does not concern the proper interpretation of the reference to an "idea of the whole" embedded within the two criteria defining the Kantian account of organisms. Rather, it touches upon the status of this account itself, namely, whether the transcendentalist attitude is required, or whether one can embrace naturalism. Clearly, the Darwinian account of design is naturalistic, since it grants a natural causal process—natural selection—the resource of yielding adaptations, functions, hence, design. The epigenetic criterion, in turn, is naturalistically accounted for by the organismic stance (organizational accounts, or others). Shifting from

transcendentalist to naturalistic accounts has a cost, it seems to me: namely, the division of the Kantian account and its two criteria, hence its two "norms," the ones for functioning and the others for development.

11.4.4 Contingent order and order from variation

Kant's account of organism, as I argued at length in these pages, stemmed from the problem of contingent order. Throughout his successive works from 1763 to the *CJ*, he revised the meaning of purposiveness, of order, and consequently, of contingency, as I will explain in the next chapter. But before that, let me take a step back and consider the families of naturalistic accounts surveyed in the previous section.

Remember that in the third *Critique* and throughout the texts that led to it the proper object of Kant's thinking is what he calls the "lawfulness of the contingent as such." So let me now speculate a bit.

Natural selection is a process that supposedly produces adapted traits or features based on random variation. Although extremely different (since it does not need any replication), self-organization channels a set of elements into a coherent and robust self-maintained pattern, possibly alive, and in any case, somehow autonomous from the changing flow of recruited elements.

Most generally understood, these two processes account for a visible or detectable order in the world: more precisely, they constitute two distinct recipes for *emerging order*. Therefore, they feature a relation between randomness and order that can be summarized as follows: a manifold of entities—genes, for natural selection, or molecules or anything likely to be understood through a self-organization model—, spontaneously let an ordered structure emerge, even though at their level the disordered and chancy character of the components subsists.

That clearly manifests a specific relation between chanciness or contingency, on the one hand, and order or lawfulness, on the other hand. The general process favored by either the Modern Synthesis Darwinians or the supporters of the organismic stance (e.g., the organizationalists, or the Evo-Devo theorists) always falls under the very general notion of lawfulness superimposed onto contingent variations, or rather, spontaneously emerging from it. Hence, the contemporary naturalistic, mathematically framed accounts of organisms—even if they compete, as do the Darwinian "bundle of adaptations" or the post-Varelian autopoiesis and organizationalism—share the property of being two naturalistic formulations of this general idea, namely, *spontaneous order from variation*.[63] But this general notion corresponds to the *lawfulness of the contingent as such,* which Kant saw as the core meaning of purposiveness, as he studied it in the *Critique of the Power of Judgment*. Thus, to sum up this final insight: while "natural purpose" understood along the lines of the third *Critique*, §§63–65, constituted the transcendental elucidation of the notion of lawfulness of the contingent as such, the scission between function and form—namely, functional Cuvierian type and Geoffroyan formal type—eventually brought about two naturalistic

approaches to this lawfulness of the contingent as such, that is, two notions of a specific order arising out of contingency, based respectively on natural selection and on self-organization.

Let us end up with the consideration of a contemporary research program likely to illustrate the current relevance of these considerations.

In Chapters 2 and 7, I mentioned the fact that the metaphor of the swarm was recurring in the history of the concept of the organism, and that, pursuing Leibniz's idea of the essential *nestedness* of organisms, it currently re-emerged form of the so-called Major Evolutionary Transitions in Individuality program (METI). Initiated by Maynard-Smith and Szathmary (1995) and developed in Michod's (1999) seminal book, this program intends to understand nestedness as an evolutionary outcome of a selection process that occurred in populations of elements living apart and by themselves and eventually coalescing into a group capable of reproducing as one thing. As Michod wrote, "Instead of being viewed as a special characteristic clustered in certain groups of social animals, cooperation is now seen as the primary creative force behind ever greater levels of complexity and organization across all biology" (1999, p.xi). Instances of this creative cooperative process include the transition from replicating macromolecules like RNA to cells, or from unicellular (i.e., prokaryotes) to multicellular organisms two billion years ago. The same reasoning should also explain the emergence of the eusocial insect colonies, since, even if they do not reproduce as a whole, they conferred the reproductive function to a small subset of the colony (e.g., the *Apis mellifera* queen), while other insects are assigned foraging and defensive tasks—an organization analogous to the sequestration of the germ line in metazoa. In Huneman (2013a), I have argued that these emergent colonies constitute a "component transition" toward individuality, while the multicellular organisms a "complete transition." Nevertheless, clearly, this view provides a plausible explanation of why life comes "packed" into organisms. It contrasts sharply with the idea of taking for granted that living beings are organisms, and recognizing them by applying Kant's two criteria. According to the transitions view, a biological individual results primarily from processes of selection at several levels, i.e., competition within groups that favor entities reproducing better than others in the group, and competition between groups, which favors groups having fewer reproductive conflicts, hence entities that have evened out their reproductive output with others. (In the technical vocabulary, these two types of entities are labeled "selfish" and "altruist.") Such "multilevel selection" process is hotly debated by evolutionary biologists (e.g., Martens 2017, 2018; Gardner 2013), yet in general, the METI program mostly appeals to selective processes, even if differently formulated.

This means that here we face two very different takes on biological individuality, which I labeled the Kantian line and the liberal one (Huneman 2023c). The Kantian one has been exposed at length in these pages. Something X is, or is not, an organism, and in the former cases, it satisfies the two criteria of design

and epigenesis. Of course, not all biologists since 1791 have been sharing Kant's ideas, but the general triple idea that some things are organisms, that they fulfill conditions for being organisms more or less akin to the two criteria explicated in the *CJ*, and that organisms are a major locus for biological study, is constitutive of a general stance in biology.

The other, *liberal* approach, instantiated by the METI and the "component transitions" I just mentioned, focuses on biological individuality in general. Colonies, cells, whales, and packs of wolves are variants, to varying degrees, of individuality; no necessary and sufficient conditions exist for being an individual, but having *some* individuality is rooted in the evolutionary (multi-level) selectionist history of a lineage of populations. Multicellular organisms are especially interesting for us as biologists, but they do not constitute the essence of biological individuality. There exist far more biological individuals than just these organisms; hence the term "liberal."

Therefore, current biology deploys several kinds of "lawfulness of the contingent as such," understood in a naturalistic way; these do not imply the same mathematical models. Self-organization stances focus on organisms, which are abstractly taken as self-assembling and self-maintaining systems, possibly instantiated by cells (as in Rosen 2005), or by metazoans or plants. The METI program and, more generally, the liberal approach do not view organisms as the alpha and omega of biology, but aim to understand processes of individualization *generaliter*. Ironically, they remain closer to Leibniz's view of nested organisms than to Kant's dual-criteria account. But both naturalistic approaches see organisms as things of nature, and their intrinsic teleology as the result of some objective natural process; they diverge regarding the nature of the process, and the mathematical apparatus required to make sense of it. Overall, things happened as if the move from a single transcendentalist understanding of biological teleology, like Kant's, gave rise to naturalistic accounts that are not amenable to a single mathematical and physical stance.

11.4.5 Final remarks

In this last reflection, I skipped many differences and details, of course, but I wanted to bring to the foreground the double idea that, first, those competing views on the organization of organisms and their functions are instances of a same general and generic project of explaining order from chancy variation; and second, that this generic aim concurs with Kant's notion of purposiveness. As one could have expected, though, Kant's approach is transcendental and therefore cannot completely converge with a naturalistic take on the same project, whatever its mathematical details and its ontological assumptions.

However, to bring together several threads that have been developed in this chapter, I'd add that the self-organization approach has been the object of a

program of mathematical modeling that can be seen as remotely from deriving Goethe's and Geoffroy's topological idea of form. I discussed in §3.1 above this tradition labeled "theoretical biology." I suspect that one far-reaching goal therein was the elaboration of mathematics that could undertake the question of form and self-organization in a way that does not resort to any mechanistic explanation (even in the very loose sense in which "natural selection" would be mechanistic).

In the specific topology known as *catastrophe theory,* which mathematician René Thom developed (Thom 1974 (1980)), and which he explicitly wanted to apply to morphogenesis, the legacy from Geoffroy Saint-Hilaire was emphasized. The "*plan général d'organisation des animaux"* is supposed, according to him, to allow for an account in terms of sets of "catastrophes" (namely, specific cases of singularities within a topological neighborhood) and the manifolds in which they take place (Thom 1974, p.35). Exposing these views is out of place here, especially since they are no longer highly developed; yet, Thom's reference to Geoffroy, and the notion that a topological non-mechanistic approach to the biological form is still envisaged by scientists, is relevant to my argument. The question of the generation of form and the tradition of topology,—distinct from the mechanisms of causal generation of traits through selection and adaptation—were intertwined in the middle of the 20th century. Those mathematical perspectives initiated by Thom explicitly target biological development: the correspondence that this mathematician had with Waddington, mostly concerning the latter's notion of "chreod" (Franceschelli 2011), as involved in the shaping of developmental canalization, attests that such novel mathematics could be involved in understanding the epigenetic character of organisms in development, and possibly in overcoming the theoretical conflicts I exposed in this section.

One may speculate that, along these lines, the general Kantian account could be saved because the naturalistic approach is not instantiated here, since no explanation properly aims at mechanisms. In this case, the organismic stance would include not only two naturalistic perspectives, the Evo-Devo and the organizational approach, both opposed to the Darwinian naturalistic selection-centered account, but also a non-naturalistic, topology-centered account. The latter would mostly inherit the non-naturalist, non-mechanistic view initiated by D'Arcy Thompson.

This leads me to a final consideration. While the science of self-organization embraces a family of theoretical schools that more or less involve physics (e.g., phase transition, stochastic physics and also thermodynamics, cybernetics; see Keller 2008), a focus on D'Arcy Thompson's legacy suggests that the cleavage between this (naturalist) self-organization family and the (naturalist) Darwinian "natural selection" family does not cover the whole map of theoretical stances regarding the organism, since some alternative mathematical perspectives have been developed.

11.5 Conclusion

The "two great laws of biology" seem to stem directly from Cuvier and Geoffroy, which means from Kant's account of the organism. In what precedes, I have shown that after Kant, and even more so after Darwin, the two dimensions of this account parted ways. The way Darwin understood their subordination—namely, the "unity of type" as common descent being subordinated to natural selection as "conditions of existence" (*Origin*, Chapter 6) is characteristic of evolutionary biology, but is now disputed. The fact that when Darwin writes, with hindsight on Cuvier and Geoffrey Saint-Hilaire, these dimensions appear as natural laws, contrasts with Kant's transcendental understanding of organisms.

In the last chapter, I will question such a philosophical position and derive its most radical metaphysical consequences. But for now, I wish to recapitulate the findings of this chapter, situated within the overall economy of the book. My aim here was to retrace the conceptual trajectory and knots uniting our deeper conceptual debates in biology with the elaboration of an account of the emerging scheme of organism in the late 18th-century. Comparative anatomy, inheriting from Kant through German biologists (and Kant himself being indebted to many other life scientists), played a crucial role in the post-Kantian articulation.

In this study, I have picked up the threads of different stories; many of the authors mentioned throughout the book did not know each other, or were perhaps unaware of any convergent work. The fact remains that there is a coherence here, which indicates that a certain necessity was uniting these various works, a necessity of meaning, by which all of a sudden something like a self-organizing organism, not only became thinkable, but appeared in such a way that living phenomena could no longer be conceived otherwise than in reference to such a focus. The Kantian analyses reflected this necessity, beginning with the turning point constituted by Wolffian epigenesis which demonstrated a specifically biological intelligibility of the vital force. This argument led me to the last (double) moment of the concept of organism, namely Cuvier's functional-adaptive type and Geoffroy's topological (i.e., connection-based) type. In this final moment, the new concepts that Kant presented as necessary for understanding living organisms in their organic specificity (regulative principles, self-production, circularity of whole and parts, etc.) were put into practice at the level of principles, but cleaved, and soon to be overcome by the naturalist turns represented by Darwinism and current-day developmentalism, Evo-Devo or the organismic stance *generaliter*.

The question of function versus form has been presented since E.S. Russell as an eternal divide within biology; some, like Gerald Holton, prone to see robust thematics (like preformationism) re-occurring as a paradigm for a remnant perspective in biology, would agree to this position. But the story I have just told, which ends with the current challenges to the Modern Synthesis from the side of an organismic stance, introduces another cleavage: the transcendental versus the naturalist viewpoint. I chose my camp, arguing for the non-miscibility of the

Kantian approach within the various naturalisms that have emerged since the end of the 19th century, and provided clues to explain and seize all the features conceived by Kant and developed in the science of life by his contemporaries.

However, this examination of *Critique of the Power of Judgment*, which has established its conceptual efficiency in nascent biology, would not be complete if, starting from biology, I did not in some way return to metaphysics. We need to understand how, in analyzing the conditions for thinking about the living world on the basis of the problem of order that I had traced, Kant effectively displaced the metaphysical configuration in which order—and more precisely, *contingent* order—posed a problem.

Notes

1 *Leçons d'anatomie comparée*, pp.5–6.
2 This connection has been studied by studied by Zammito (2018), Reil (2005) or Richards (2000); more specifically, Steigerwald (2019) examined Pfaff's experiments on galvanism, which "tested the effects of different fluids, heat, mechanical stimulus, and size of surface, contact on the circulation and direction of animal electricity. (. . .) He used galvanic experiments as a tool to examine organic vitality (and) concluded from his experiments that not only external stimuli but also nerves sensitive to stimuli are needed to effect contractions in frog legs. A substantive proportion of Pfaff's experiments were dedicated to examining the role of nerves in galvanic phenomena—testing different ways of isolating and applying armatures to the nerves" (p.162). This contributed to show later, with Ritter's experiments, that contraction of muscles is stronger with oxidized than with unoxidized substances. Pfaff's treatise, *Über thierische Elektricität und Reizbarkeit,* was part of his dissertation supervised by Kielmeyer, and then published in the *Journal der Physicks* in 1794 and 1795. On Kielmeyer, see also analyses in Gambarotto (2017), and also Kanz (1994).
3 Letter to Pfaff, December 31, 1788, *Lettres de Cuvier à C.H. Pfaff,* p.82. On December 31, 1790, like Blumenbach he expressed an opinion on the black color of "negroes," which was thought to be due to the action of light rays disturbing the movement of organic particles through the dilation of pores (*Lettres de Cuvier à Pfaff*, p.203).
4 Biographical note on Cuvier by C.H. Pfaff, *Lettres de Cuvier à C.H. Pfaff*, pp.25ff.
5 In August 1792, for example, he gave Pfaff his remarks on Kielmeyer's theory of nerves (*Lettres de Cuvier à C.H. Pfaff*, pp.288sff).
6 In his notice, Pfaff constantly emphasizes the German imprint Cuvier received during his education; thus, meeting him again in Paris in 1801, fourteen years after their separation, he notes: "a truly German imprint and a philosophical spirit distinguished his witty and elegant speeches in the French manner" (Biographical note on Cuvier by C.H. Pfaff, *Lettres de Cuvier à C.H. Pfaff,* p.34).
7 "The force of reproduction is by far the most general force, the one that is spread over the largest scale in organizations, and this is precisely why it could be said that it is their own or characteristic force, which distinguishes them from the other productions of nature, even if it cannot be sufficiently shown here, as in the other previous cases, that it also emerges from inorganic nature, and that it proceeds from forces that reside in this inorganic nature" (*Über die Verhältnisse*. . . Kielmeyer (1802)). One should note that Kielmeyer published his lecture after being strongly encouraged by Pfaff (Steigerwald 2019, p.195).
8 "We must therefore look here for concomitances of another kind, which establish in a more or less precise and more general way the law of variation of irritability in the

series of organizations, and which at the same time give the law according to which irritability and sensibility disappear" (*Über die Verhältnisse*. . .). As is well known, the preface to Hegel's *Phenomenology of Spirit* extensively criticized this division of irritability and sensibility, as well as the notion of laws connecting them, because for Hegel, mathematics cannot capture life, and the division of properties is merely an abstraction. But this criticism was essentially aimed at Schellingian formalism, and remained external to Kielmeyer's text. Kielmeyer did not actually apply a mathematical formalism in the sense of physics to understand the functioning of an organism; his program aimed at descriptive principles applicable not to a living individual, but to the compilation of a table of species.

9 Daudin (1923, p.42) and Foucault (1966, chapter 5).

10 According to Daudin (1923, p.48), Cuvier was the first to generalize dissection for natural history and classification purposes.

11 Recall with Coleman (1964, p.50) that most of Cuvier's sources are Daubenton and Vicq d'Azyr.

12 *Leçons d'anatomie comparée*, I, 1. Certainly, Cuvier's idea of a "vital vortex" in the prologue to the *Leçons* is a theme of animal economy according to the vitalists, a theme that can still be found in this sentence from the 1810 *Rapports sur les progrès des sciences naturelles depuis 1789*: "plant life, like animal life, is a continual circle of action and reaction" (p.264).

13 *Leçons d'anatomie comparée*, I, p.10.

14 *Leçons d'anatomie comparée*, III, p.2.

15 *Leçons d'anatomie comparée*, III, p.5.

16 *Leçons d'anatomie comparée*, III, p.18.

17 Like Etienne Serres in his speech at Geoffroy's funeral, we can see Cuvier as a founder of comparative anatomy ("[Cuvier] créant l'anatomie comparée et en faisant sortir la théorie paléontologique ébauchée par Sténon et Leibniz," "Discours aux obsèques de Geoffroy Saint-Hilaire," excerpt from la *Gazette médicale de Paris*, June 28, 1844, reproduced in Le Guyader 1997), even if this is a somewhat hagiographic simplification, since this denomination could have been borne by earlier authors, such as Vicq d'Azyr, as Gouhier indicated after Saint-Simon (Gouhier, 1964, p.197). Before Cuvier, Peter Camper, Daubenton, Vicq d'Azyr, Goethe, Monro II and others practiced comparative anatomy. But it is with Cuvier that we the conceptual elements, set out here, that impose a change in the structure of biological knowledge. Indeed, Geoffroy Saint-Hilaire acknowledges this during the very controversy that pits him against his former friend: "The works of Perrault, Daubenton, Vicq d'Azyr, etc., but particularly those of 1795 and the following years [i.e., Cuvier's *Leçons sur l'anatomie comparée*, referred to in the previous sentence] began to make comparative anatomy a positive science" (*Principes de philosophie zoologique*, 7, reprinted in Le Guyader 1997 p.189). On the Geoffroy-Cuvier debate in historical perspective, see Apel (1987).

18 *Règne animal*, p.6. This idea of a rigorous, scientific revival of the doctrine of final causes in comparative anatomy can also be found later in Richard Owen's writings: "Comparative anatomy is that branch of natural science which deals with the organization of animals, and considers it with reference to the peculiarities of human structure, or in so far as it illustrates the functions, laws of development, mutual dependencies and coexistences of different organs—or in so far as it indicates the natural affinities of animals, one with another;—or finally, in so far as it elucidates the doctrine of final causes" (Owen 1992, Lesson 1, 16, p.83).

19 *Règne animal* I, p.46.

20 *Règne animal* I, p.47.

21 *Règne animal* III, p.xvii.

22 "Discours sur les Révolutions du globe" (1812), p.104.
23 *Leçons d'anatomie comparée*, I, p.57.
24 "He who can rise to the knowledge of animals must carefully consider and compare together two species of organs, some of which are placed on the surface and others in the large cavities. The former may be regarded as the immediate instruments of their movements, and the latter as the hidden springs of nutrition, sensibility, reproduction, and life" (*Discours sur l'anatomie comparée*, p.34). Vicq d'Azyr was also the instigator of important reforms of the medical institution during the French Revolution. On this scientist, read Schmitt (2009).
25 Jussieu faced the same problem in botany (see Foucault 1966, chapter 5). On Cuvier's classification, Atran noted: "The subjective aim of natural history—which is to explain the world as it appears to us—is replaced by the objective ideal of biology—which is to explain the nature of the living as it is in itself" (Atran 1982, p.140).
26 "The nervous system is the same in every form [phylum]; now, the nervous system is basically the whole animal: the others are there only to serve it or to maintain it; it is therefore not surprising that it is according to it that they regulate themselves" ("Sur un nouveau rapprochement," 1812, p.77). Cuvier's primacy of the nervous system at this time ultimately reflects a vision focused on function as a relationship with the environment—since the nervous system is undoubtedly the most environment-oriented of all systems. But in Year III, in the article "Mammalogie" written with Etienne Geoffroy Saint-Hilaire, the authors reiterated Bichat's division of lives: "If we now consider the various organs of an animal, we find some that constitute its existence, considered in isolation; and others that place it in relation with other beings. It is easy to see that the latter organs must give way to the former; for the animal first IS, then it FEELS and ACTS" (p.169). Thus, it is only later that the relationship to the environment became, with the nervous system, decisive for the subordination of characters. In this article, since existence is fundamental (life in itself) and "the LIFE of the animal depends first on generation and then on the regulated movement of its fluids," it is "generation and circulation" that give the primary characters (thus generation, because we know so little about it, only allows us to distinguish mammals from gemmiparous or oviparous animals)—not nervous system (p.169). The organs of relation, senses, and action, are then used to determine the orders within the classes that these primary characters have carved out (p.170).
27 *Leçons*, I, p.60.
28 "Sur une nouvelle comparaison," p.79. Thus, among the articulates, "if insects prevail in some respects by movements, the other three classes prevail by vital functions; we cannot say that crustaceans are between worms and insects nor vice versa, as we cannot say that birds are between mammals and reptiles, or reptiles between birds and fishes rather than between quadrupeds and fishes. In a word, there are on either side four classes that belong to the same phylum, but without forming a series, nor enjoying an indisputable rank" ("Sur une nouvelle comparaison," p.80).
29 For Daudin, Cuvier replaced the hierarchical unity of the series with functional equivalence between genera, demonstrated by physiology to be immediately distinct according to their organizational plan (Daudin 1920, p.233).
30 "Considering the animal kingdom from this new point of view, and having regard only to the animals themselves, and not to their size, their usefulness, the more or less knowledge we have of them, or other incidental circumstances, I have found that there are four principal forms, four general plans, according to which all animals seem to have been modeled, and whose subsequent divisions, by whatever names naturalists have decorated them, are only rather slight modifications based on the

development or addition of a few parts, but which change nothing in the essence of the plan" ("Sur un nouveau rapprochement," p.76).

31 Among philosophers, Auguste Comte best emphasized this relationship between the milieu and the organism in order to reject vitalism, because of the opposition it established between material nature and life, particularly in Stahl or even Bichat; vitalism, he argues, forgets that the environment is also a set of excitations that give rise to and sustain life in the organism; in other words it forgets the "harmony" between living beings and their environment, without which the phenomenon of life is incomprehensible (*Cours de Philosophie Positive,* 40th Lesson, 671, 678 and also 758). Precisely, Cuvier's comparative anatomy is one of Comte's major references, along with Bichat's general anatomy. When Claude Bernard later wrote in his *Introduction à la Médecine Expérimentale* that life is "the result of contact between the organism and its environment," that its conditions are "neither in the organism nor in the external environment, but in both at the same time," and that to speak only of life is "an abstraction: a force that appears to stand outside matter" (*Introduction à la Médecine Expérimentale*, 1959, p.117), he was following in the footsteps of his positivist master and, beyond that, of Cuvier's teaching, through De Blainville, by whom Comte was introduced to biology. Thus, De Blainville insisted on the "intimate connection" of physiology with physics and chemistry; he criticized vitalists for separating the living from their environment: "It is therefore wrong that physicians and physiologists have maintained that the phenomena of living bodies should be studied independently of those of gross bodies; which has led them to admit for the latter particular forces, as if it were simplifying a phenomenon to sequester it from all that surrounds it" (De Blainville 1833, p.30, my emphasis); and he went on to emphasize that there are no separate bodies, either in the organism or in the universe; so that if zoology studies facts in themselves, it also studies them in relation to all others, i.e., to the environment (De Blainville 1833, p.64).

32 Which Cuvier credits as the greatest contribution that anatomy has been able to make to natural history, particularly in terms of the clarity he brought to the previously confused field of invertebrates. "The limits to the class of mollusks, the reunion of naked mollusks with testaceans, the placement of both at the head of animals without vertebrae and immediately after fish, their complete separation from zoophytes, the limits drawn for the latter, their relegation to the end of the animal kingdom, the particular definition of the small class of red-blooded worms" are in detail this contribution (*Leçons d'anatomie comparée*, III, xxv). Von Baer in his *Entwicklungsgeschichte der Thiere* (1828) integrated Cuvier's theory of the four embranchements into a general theory of embryological types. See Lenoir (1982), and Ospovat (1981) on this.

33 From this point onwards, comparative anatomy and embryology would be able to work together, in particular on a common issue that runs through Darwinism and is defined by the Meckel-Serres law, or law of recapitulation as it was later labeled; Darwinism would confer to this law a new relevance, since it would become a question of confronting two historicities, individual (ontogeny) and specific (phylogeny). On this "law," see Canguilhem et al. (1962); Gould (1977, ch.3–4); Balan (1979, pp.452ff), and, for a heterodox viewpoint, Richards (1992).

34 On Reil, see Richards (2002), Schmitt (2006b).

35 Our interpretation of Cuvier's relationship with Kant here follows in very different ways the reading proposed by Outram (1986, pp.323–68).

36 I presented the complete analysis of this conception in Huneman (2023a, chapters 4–5).

37 On this point, see my Huneman (2023a, ch.4). See also Albury (1981) on Bichat's experimental techniques.

38 When in 1840 Comte in his *Cours de Philosophie Positive* suggested that experiments (alluding to Bichat) and comparisons (alluding to Cuvier) are two avenues of biological knowledge, defining its proper epistemic regime, he captured—despite his immunity to transcendentalism—something of the conceptual space of life sciences that emerged then and was reflected in Kant's writing.
39 For a discussion of the fate of this couple in post-Kant literature, see my introduction to Huneman (2007, pp.15–16).
40 On the relations between Geoffroy Saint-Hilaire and Lamarck, see Corsi (1988).
41 *Philosophie anatomique*, I, xxxiv.
42 "I proscribed all considerations of form and usage" (*Philosophie anatomique*, I, p.445).
43 "I took the decision to deal with just one system, to try to compare it in isolation, part by part, in the whole series of beings. I chose the skeletal system. Once this unknown had been cleared up, the other unknowns, I hoped, i.e., the other organic systems, nervous, circulatory, muscular, etc., could not fail to be illuminated with a bright light, by the facts studied from the cleared-up unknown, or from the determined organ" (*Principes de Philosophie Zoologique*, 9, 218).
44 *Mémoire sur l'organisation des insectes*, read at the Académie des Sciences on March 3, 1830, reproduced in Le Guyader 1997, p.76. On the context of the Cuvier-Geoffroy debate, see Apel (1987).
45 *Philosophie Anatomique* II, xxxiv.
46 *Mémoire sur l'organisation des insectes*, 77.
47 In 1820, Latreille had extended the unit plan of insects to crustaceans; Geoffroy also used Savigny's comparative anatomy of insects in 1820 to enter into this new work; see Le Guyader (1997, p.67).
48 *Leçons d'anatomie comparée*, 8ème Leçon, art.2, p.23. The "alouate" is the generic name for the howler monkey.
49 *Philosophie anatomique*, I, Discours préliminaire, xiii.
50 Here, Geoffroy calls analogy what would be rather homologies. Balan (1979) saw in the progressive understanding of this difference a major achievement of the pre-Darwinian morphology.
51 See Jean Piveteau's contribution following Foucault's talk on Cuvier in the 1970 *Revue d'histoire des sciences* devoted to Cuvier in Foucault (1994), II.
52 On Rashevsky, see for instance Keller (2002).
53 On the passage of transcendental morphology from Germany to France, see Balan (1979); Rehbock (1983, chap.1). Jardine aptly interprets Kant's transition to "transcendental morphology" as a shift in relevant questions, a gradual rearrangement of the scenes of inquiry. A question discarded by Kant, such as "what is the origin of a type?" becomes relevant for Oken; see Jardine (1991, chap.1).
54 One should notice that the exact same inversion is vindicated by Marx when he claims to have re-installed Hegelian dialects on its feet, switching the material basis of conflict and the Hegelian "concept," supposedly the seat of dialectics.
55 "It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved form."

56 Lewens (2009) offers a philosophical analysis and defense of the kind of typological thinking involved in Evo-Devo.
57 Lewens (2004) provides a systematic analysis of the machine analogy in this tradition, including the important methodology of the so-called reverse engineering.
58 "Outline for a general introduction to comparative anatomy," Goethe 1995, p.125.
59 This is called the "selected effect" accounts of functions, and it is due to Wright (1973) and then Neander (1991). "A has the function X," which is the function$_2$; the meaning of "function," in this chapter, means that "A has been selected (in past populations of the ancestor species of the organism featuring A) for doing X." See Godfrey-Smith (1994) for a more recent version of the selected effects account, which solves equivocacies regarding the period of the operation of selection.
60 Inclusive fitness is a concept due to Hamilton (1964), and is crucial in accounting for social evolution in biology (see Birch 2017). Evolutionary biologist often see now selection as increasing inclusive fitness, since many socially altruist behaviors are seen in nature ("altruism" meaning for evolutionary biology a behavior which benefits others at the cost of the agent, costs and benefits being measured in terms of fitness). In my current development, this difference does not really matter.
61 For a history of the heterogeneous and multi-influenced self-organization in physics and biology, see Keller (2008).
62 Kauffmann (1993) may, for example, pertain to all three approaches.
63 Kauffmann (1993) famously says "for free" instead of spontaneous.

12 The naturalization of purposiveness and the critique of contingency

Natural purposes are organized beings. This Kantian thesis is both *epistemological*, concerning the very conditions for a knowledge of the living, and *metaphysical*, since it confers a new scope to the metaphysical notion of finality, through which ancient metaphysics had easily associated natural philosophy and theology. This final chapter develops the metaphysics of purposiveness.

After the third *Critique*, purposiveness no longer articulates the same domains: philosophy, theology, and science would never again maintain the same relationships as in classical metaphysics. The revision of the metaphysics of purposiveness concluded a definitive reversal of the relationships between science and ontological investigation, at the heart of which lies an exemplary status for biology. At stake is a reinterpretation of the relationship between purposiveness and contingency, as highlighted by analyses of the aporia of the contingent order since *The Only Possible Argument*. . . This reinterpretation brings the very meaning of criticism into play: we shall then examine how the need for an analytic of biology ultimately affects the Kantian revision of the fundamental ontological concepts of modality, so that its last impact touches upon the meaning of metaphysics.

12.1 A new concept of purpose: biology and the metaphysics of contingency

To understand Kant's metaphysical thesis, one must measure it against what it supplants overall. A brief confrontation with Leibniz will give us the gist.

The Kantian subordination of mechanism to finality must be distinguished from that of Leibniz. For Leibniz, the mechanism of nature does not exhaust physics, because corporeal substance is not extension, but force.[1] This force itself must be reconciled with teleological determinations: thus, Leibniz's final philosophy grants appetition and perception to monads. Efficient causes, governed by the mechanism of nature—which Leibniz assimilates to geometry—are therefore always subordinate to the teleological relations that govern the world of substances, i.e., forces: and while the former are often sufficient to do physics,

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the latter not only sometimes provide invaluable support, but above all guarantee that such physics alone possesses an objective reality, i.e., actually concerns the bodies of our world.[2] We have a system of efficient causes, concerning only "phenomena" in Leibniz's sense, that is, the beings that appear to us, considered independently of the substances underlying them, which alone give them an objective reality. These phenomena are substances taken in their interrelations, in their order of coexistence, which is space, and not directly at the level of the forces they manifest, namely, a system of final causes, which accounts for the existence and activity of the forces themselves.[3] The relationship between the mechanism governing the expression of forces and the forces in their system of final causes is that of a phenomenon to the substance manifested through that phenomenon. The Kantian reversal then consists in the fact that mechanism *and* teleology stand on the level of (what he calls) phenomena (*Erscheinungen*), and their distinction does not concern ontological characteristics, but types of intelligibility (namely, reflective/determining). Their difference is less ontological than epistemological, and both presuppose a common, suprasensible substratum, which grounds their unity but plays no methodological role, because it is simply unintelligible.[4]

Unlike for Leibniz, the Kantian unity of purposiveness and mechanism is based on our epistemic structure: *for us,* the primacy of purpose in the explanation of nature is in no way ontological; it is simply implied by our faculty of knowing, which demands that means be subordinated to ends, and thus mechanism to teleology. But both the reign of efficient causes and the reign of final causes are integrated by Kant into the order of phenomena; as for the foundation of phenomena themselves, it is henceforth external to these two types of intelligibility.

The break with the Leibnizian concept of finality then deepens, so that in thinking of natural purposiveness as the fundamental meaning that enables *us* to understand organized beings, Kant simultaneously undoes the collusion between natural history and natural theology, that is, between the order of the living and the divine plan, that this concept of purposiveness traditionally sealed. For Leibniz, the finality that underpinned the mechanism of the reign of nature indeed referred to a God-architect who turned out to be the same as the God-monarch of the reign of grace, an order of spirits where final causality reigns alone.[5] For Kant, nature leads only in a regulative way to an "original understanding," and the purposes of such understanding are too incomplete, too conditioned, to allow us to see in it, dogmatically established, the Creator and all-powerful God, endowed with all his attributes. The unity of the efficient and the final causes is established by Kant around an indirect reference to the suprasensible that supports them, in the sense that both pertain to phenomena, which are by definition grounded on inscrutable noumena; yet unlike Leibniz, it is not centered on a single God—who would then reconcile nature and grace around Him.

Physical theology could certainly prepare minds to think about God, and has a definite rhetorical function (remember that Kant attributed to the physical-theological proof the virtue of being the most popular) but it is not, for all that, an empirical path that converges toward the God postulated in turn by practical reason (as established in the second *Critique*). If we believe this, it is because a surreptitious nudge from practical reason has made it possible to determine concepts that theoretical reason must leave undetermined, such as that of an "original understanding."[6] Such original understanding, which teleology ultimately postulates from the concept of "natural purpose" empirically conditioned by the experience of organized beings, cannot be further determined in its concept, as would be appropriate for a physical theology, because the "final purpose," i.e., the answer to the question "Why a nature?," does not exist within nature.[7] Thus, by detecting the objective reality of the concept of natural purpose in organized beings, i.e., in the biological order, the critical deepening of this concept separates itself from the theological order, hence emptying living nature of God.

We certainly find a great deal of perfection in nature, says Kant in §85, yet not everything is perfect, so that in proving a creator God, wise God, etc., we conclude cannot from this partial perfection to "all possible perfection," an inference that physical teleology alone does not allow. If physical teleology had demonstrated that there is a final goal (*Endzweck*) of nature, the great perfection empirically observed could certainly have been attributed to a divine plan to achieve this final goal, and it would have been legitimate to presuppose all possible perfection, even if not apparent, insofar as it could be included in the perfection of this plan. But since natural teleology does not go so far as to detect a final goal in nature, the passage from "much perfection" to "all possible perfection" requires a different legitimation.[8]

So, purposiveness in nature, in its unity with the mechanism of nature, is not "one of the most effective and sensitive proofs of the existence of God," as Leibniz thought. Despite the analogy of the craftsman embedded in the traditional physico-theological argument, purposiveness in nature according to the *Critique of the Power of Judgment* does not posit a divine wisdom at the origin of the world, in other words, a choice of the best.

Therefore, it cannot eliminate the Spinozist hypothesis of a supreme cause that would blindly produce the world by the mere necessity of its nature. Did this original understanding, posited as a regulator by reflective judgment as the origin of organized beings,

> have a final purpose for nature as a whole and for its production (a final purpose (*Endzweck*) which, in this case, would not be found in the nature of the sensible world), this is what the theoretical study of nature will never reveal to us; knowledge of it, however thorough, cannot establish whether this supreme

> cause is the final foundation (*Urgund)* in all these things according to a final purpose, and not *rather by virtue of an understanding determined by the simple necessity of its nature to the production of certain forms* (by analogy with what we call instinct in animals), without it being necessary to attribute to it wisdom, for this very reason, and even less a supreme wisdom joined to all the other qualities required by the perfection of its product.
>
> (§85, p.441, my emphasis on the typically Spinozist phrase)

In other words, if we want to extend teleology into physical theology, then we cannot get rid of the Spinozist or pantheist hypothesis of a unique substance whose necessary predicates are the things of the world; and all finality and contingency thereby disappear.[9] So, the *only proper* theology is moral, as argued in the *Critique of Practical Reason,* and it cancels and extends physical theology, which only leads to emptiness.[10] The contingent order cannot by itself lead reason to the God of theology, and moral support is needed to move from the uncertain theology provided by teleology—uncertain because it is still threatened by Spinozism, and uncertain, ultimately, because contingency as such can just as easily turn into enlightened choice as blind necessity[11]—to the omniscient, omnipotent being that theologians actually believed they could read in this contingent order. But once we have recourse to this kind of support, the whole of physical theology disappears, since moral proof needs no natural preliminaries and is self-sufficient. This is why Kant writes: "Moral proof (which, it is true, proves the existence of God only from the practical, but nevertheless inescapable point of view of reason) would still retain all its force if in the world we found no matter, or only equivocal matter for physical theology." (478)

Through all this investigation, Kant elucidated the concept of purposiveness as the notion that the experience of organisms must mobilize in order to give rise to a biology, and at the same time deconstructed the traditional collusion between natural history and natural theology. The perfection of natural organisms does not prove God, nor does it disqualify a Spinozist atheology in favor of a Leibnizian theology. Purposiveness is *natural*—and as such, a necessary concept of the reflective faculty of judgment—only at the cost of the impossibility of determining a concept of a wise and intelligent God, architect, and monarch, who would unify the reign of nature and the reign of freedom.

This move can be equally understood in the following way: in the third *Critique*, the concept of purpose no longer takes as its direct model that of the engineer who creates a machine for a certain purpose, but that of the artist who orders materials into a whole that will be its own end. This shift is manifest both in the conception of the general presupposition of the reflective power of judgment (examined in the Introduction of the *CJ*), for which nature has no utility but merely the form of the "fitness to our understanding," and in that of the

organism, which we have seen to self-organize without each part having been created with a utility in mind. But then, within this framework, from the notion of a natural purpose, we can no longer infer that of a craftsman who would create the world as a machine fulfilling certain ends. The shift in the meaning of purposiveness in the third *Critique* blocked the traditional logic of the transition from *natural* finality to *natural* theology.

Whether the perfection of the world was a contingent choice of a God, or whether it was necessary from all eternity, this is an alternative that the study of nature supported by teleology cannot resolve. In thinking in this way, by destroying physical theology—Moses Mendelssohn after all nicknamed Kant "the all-destroyer"-, Kantianism stripped the concept of finality of its metaphysical implications.

Leibniz accepted final causes and leaned toward a contingent world, without being able to provide a satisfactory concept of contingency; Spinoza deduced from the metaphysical necessity of the world the ideality (i.e., the imaginary character) of finality and therefore of contingency: Kant has, however, made the concept of purpose independent of these metaphysical options, thus somehow naturalizing it. By developing his own concept of natural purpose from a critical reflection on the presuppositions of knowledge of organized beings, Kant separated the concept of natural purposiveness from the problem of the ontological contingency of the world, which underpinned physical proofs of the existence of God, from Aquinas to Leibniz. Not that the two concepts are unrelated, as we have seen: simply, the use of the concept of natural finality no longer entails any metaphysical decision on contingency. It is as if the metaphysical question of the contingency of what exists were cancelled out and shifted by Kant toward the critical question of the meaning, use, and limits of the concept of natural purposiveness, i.e., ultimately, toward an analysis of the presuppositions of knowledge of life.

With this metaphysical decision on contingency neutralized as a problem, the double issue of contingency and purpose becomes that of understanding the fact, *no longer of purposiveness itself* (as in the physical-theological argument and its Leibnizian or Spinozist solutions, or even Hume's deconstruction of the argument of the analogy between God and a designer), but of the necessity of our use of the concept of purpose. What is meaningful, not in terms of the world but in terms of the very structure of metaphysical questions, is that we *ought to* use the concept of finality as we would use the concept of organism. To the metaphysical question of the necessity or contingency of what is, Kant substitutes the critical question: "What does it mean, then, that we need the concept of finality?" Why can we not think of living nature without this concept? More to the point: how is the concept of finality itself possible, and why does it refer indirectly to the suprasensible, in such a way that, as we have just seen, no metaphysics can be based on it?

12.2 Metaphysics of purposiveness, antinomy, and dialectics

The teleological *Critique of the Power of Judgment* finally broke with what is still often taken for granted: it unties finality and intention. This break is symmetrical to the one that the aesthetic *Critique of the Power of Judgment* made between beauty and perfection (as we can interpret the expression "purposiveness without purpose").[12] This double break opened up a new meaning of purpose, asserting both the autonomy of biology (which naturalizes purposiveness) and the autonomy of aesthetics (which becomes independent of morality). Thus, purposiveness appears distinct from the laws of nature, supported by the understanding (according to the *Critique of Pure Reason*), and from the moral law, pertaining to practical reason.[13] Hence, purposiveness as "the lawfulness of the contingent as such" is indeed emerging in contrast to these two forms of lawfulness.[14]

Therefore, *Critique of the Power of Judgment* enabled Kant to define, through the investigation of the principles of reflective judgment, the field of a new necessity that I called "reflective necessity" (Chapter 8), which is no longer that of the *Metaphysical Foundations of Natural Science,* and corresponds to the application of the concept of natural purpose. Remember that, when Cuvier completed the constitution of the concept of organism with its principles (Chapter 11), he was, specifying a use for this new necessity whose territory Kant had indicated.

With the contingent fact of the existence of organisms, Kant delimited a certain type of scientific explanation correlative to the necessity inherent in this contingency, different from that of the physical sciences.[15] Strictly speaking, the latter is less an explanation, an *Erklärung*, than a way of understanding a phenomenon whose foundation cannot be explained in the sense of the natural sciences (insofar as it is an "originary organization"). We have seen that, through the internal necessity of reflective judgment, the explanation of organic phenomena requires the use of the concepts of "vital forces," "formative forces," and "formative tendencies" (Chapter 9); but we also know from the "Appendix to the Transcendental Dialectic" that reason requires us to tend toward the unity of forces in order to think about the systematicity of nature (Chapter 5). How can we reconcile these assertions?

In a way, this reconciliation lies at the heart of both the teleological *Critique of the Power of Judgment* and its "Methodology of Teleological Judgment." The latter outlines the paradigmatic framework for the study of living phenomena: the agreement between a teleological reflective judgment concerning an originary organization and a determining judgment applying mechanistic laws to think about the interaction of this originary organization with external stimuli during embryogenesis. "Dialectics"—by definition, for Kant—attempts to think through the very *principle* of this agreement, that is, how is it possible for teleology and mechanism to be both *separate* in the forms of judgment they implement, and *concurring* in the knowledge to which they give rise?

12.2.1 Dialectic, the antinomy, and the contingency of life

In Kantianism, "dialectic" indicates that there is an illusion somewhere and names the project to dismantle its bases. The dialectics of teleological judgment faced the absorption of knowledge of living things into either ordinary physics or theology. In the first case, all knowledge would be based on the constitutive principles of the understanding, ignoring the epistemological specificity of the organism, which, as we have seen, requires principles to regulate reflective judgment; in the second, these latter principles would be taken as constitutive, so that the living really does seem to be the result of a transcendent (and therefore divine) design. The illusion at the root of this dialectical alternative is that the concept of objective material purposiveness (corresponding to the organism and at the root of the principle of teleological judgment) subsumes an object—the organism—which must be given in experience, in other words, which must exist in nature. To this extent, the idea of natural purpose easily seems to concern nature *directly*, and not through the intermediary of the form of our knowledge; thus, we quickly get the impression of dealing with a constitutive and not a regulative idea, hence the dialectic.[16]

Dialectics, here as well as in the first *Critique* (remember the "Antinomies of experience") means the emergence of an antinomy. Teleological judgment gives rise to an antinomy, because faced with the contingent unity of particular laws, whether of species or of the functioning of an organism, there are two maxims for thought. One a priori and universal, proceeding from the understanding: mechanism, namely the principles of nature set out in the *Metaphysical Foundations of Natural Science*—and the other is "proceeding from particular experiences that appeal to reason" (§70), namely from the encounter with organized beings. The antinomy thus opposes a universal principle of the determining faculty of judgment and a particular principle of the reflective faculty of judgment, so that if these respective statuses are respected, it is spontaneously resolved. Kant points to the solution, specifying that while I must reflect on all natural phenomena according to the principle of mechanism "as far as I can," this does not preclude occasional use of the second maxim, which belongs to another type of judgment.[17] Indeed, if we pay attention to this difference in status between the maxims, we understand that no one is asserting here the essential impossibility of a mechanism producing living forms, but only that *we ourselves cannot think* of such a possibility: "*human reason in following this maxim* will never be able to find the slightest foundation for what specifically constitutes a natural purpose" (§70, p.388, my emphasis).[18] This is exactly the reason why I argued that nowadays Kantian accounts of organisms cannot be resolved in a (naturalist) organizationalist account of any kind (Chapter 11).

Thus, according to the regulative status of the maxim of reflective judgment, the teleological causality it invokes "is a simple idea to which no attempt is made to grant reality (*Realität*), but which is simply used as a guiding thread of

reflection, and which thus always remains open to all mechanistic principles of explanation and does not stray outside the sensible world" (§71, p.389). In this way, the conception of the genesis of organisms can reconcile the two maxims without succumbing to antinomy, as we saw earlier (Chapter 9). The errors of those who reabsorb biological thought into physics or theology consist in failing to grasp this difference in status, i.e., the difference between the *heautonomy* of the reflective faculty of judgment, which gives itself its own maxim (i.e., takes as its principle the possibility of its reflexive use, see Chapter 8, §3), and *the heteronomy* of the determining faculty of judgment, which receives it from the understanding and thus, given its role as legislator of nature, works on a constitutive level.

McLaughlin pointed to the interpretive problem posed by the antinomy (McLaughlin 1990, pp.141ff): is it solved by asserting that both maxims are regulative, or, as Heinrich Cassirer read it (Cassirer 1938, pp.343ff.), by positing that the teleological one is regulative but the other is not?[19] I prefer this second interpretation, since in my view, the antinomy is played out in the power of judgment itself (it is "the antinomy *of* the teleological power of judging"), and is therefore resolved by distinguishing between the heteronomy and heautonomy of this faculty, that is, the determining judgment and the simply reflective judgment, i.e., the constitutive and the regulative. Otherwise, we would not understand why the rational regulative maxims of homogeneity and specification in the first *Critique* (see Chapter 5), which can certainly be opposed in their use as two reflective principles, *do not give* rise to an antinomy. H. Cassirer thinks that the two maxims of the third *Critique* are called regulative, and the antinomy is said to be "of the judgment of reflection" (§70), because they do not concern things in themselves (Cassirer 1938, p.347); however, he acknowledges that Kant "should" have said that mechanism is here the principle of the determining judgment (Cassirer 1938, p.351), if we consider its use by our faculty of knowing. Cassirer is undoubtedly right, since neither constitutes its object.[20] But the *acts of judgment* in which these maxims *arise* are distinct: mechanism arises from the Second Analogy of the C*ritique of Pure Reason* (i.e., what we ordinarily call principle of causality), hence from determining judgment, that is, ultimately from the understanding and its constitutive principles, while teleology arises from simply reflective judgment.

The difficulty here lies in the fact that mechanism stems from the principle of causality asserted in the second analogy as *constitutive of* experience, but is less general and in some ways represents a stronger thesis (its restriction to causality from parts to the whole, see Chapter 9), which is why it is used as the *regulative* principle of *reflection*. It is true that in the Dialectic of the *Critique of Pure Reason*, in the third antinomy, mechanism had already appeared as a regulative principle, opposed to freedom, and it has been said that Kant was aiming for such a regulative use of the principle of causality. But things are different now, as the question of the purposiveness as a concept pertaining to reason (and above all,

to practical reason) has shifted to the power of judgment, and, more generally, as the reflective power of judgment has emerged as an autonomous instance.

For then, the regulative maxims may well give rise to an antinomy at the level of the power of judgment itself, since a distinction must be made between the use of the reflective power of judgment and the use of the determining power of judgment. In current scientific terms, this distinction means: (in embryology) identifying the type aimed at by a developmental sequence versus unfolding the physicochemical mechanism by which it is achieved; or (in physiology) specifying the function of an organ versus analyzing the mechanisms by which its states result in its function$_2$ and then the contributions of these functions$_2$ to a function$_1$.

Table 12.1 summarizes the variety of uses of "regulative" and "constitutive" for different levels of knowledge, according to the different texts (Introduction to CJ, Dialectic of CRP, Dialectic of CJ).

Dialectic, in all three *Critiques*, means the field of necessary illusions of reason and of its critique. Hence, to fall prey to one such illusion is to fail to recognize that one maxim is objective, and the other "subjective," in the sense of pertaining to knowledge and not to the object. Thus, teleological causality, unlike mechanistic or even technical causality, is "subjective"; the latter accounts for the possibility of phenomenal objects, while the former intervenes to make possible our thinking about certain objects, namely, beautiful objects or living ones (§74).

Unlike mechanism, the concept of natural purposiveness has no general, indeterminate objective reality (i.e., independent of what exists in the world). Its only objective validity is when applied to organisms. The presentation of the concept should already have made Kant's readers sensitive to this point, but he returns to it to state explicitly that the concept's lack of objective reality is ultimately due to its relationship to contingency (in the sense of the contingent fact of the existence of organisms).

We indeed know life only negatively: as a contingency in relation to natural laws; and this contingency implies that our judgments about it will never be "dogmatic" (namely, theoretically assertive, or, as in our current language, strongly

Table 12.1 The variety of uses of "regulative" and "constitutive"

	Constitutive	*Regulative*
(Phenomena of) Nature	Causality principle ("Second Analogy")	Mechanism (from causality) (Dialectic of CRP: Second Antinomy)
Order of nature		Principles of Homogeneity/ specificity/affinity (Appendix to the Transcendental Dialectic); Formal objective purpose (Introduction to CJ)
Organization	Mechanism	Teleology (material objective purpose)

ontologically committed). If they were, this would mean that we could establish a certain necessity of the object of the concept of natural purpose, namely (self-) organization; but then, (self-)organization would no longer appear *as (self-) organization, since this very concept derives from the structure of the concept of natural purpose, as a regulative principle of reflective judgment.* The possibility of life appearing and being said *as such* implies that the discourse that addresses it is not exactly a "dogmatic" one, i.e., a discourse that establishes objective realities; it is rather, for Kant, a *reflective* discourse, namely, a discourse that is at the same time concerned with the very conditions of our thinking.[21]

Thus, the concept of natural purpose is susceptible only to *critical* use (i.e., "in relation to our faculty of knowing, hence to the subjective conditions for thinking it"); this is why Kant would be able to say later, at the threshold of the methodology of the teleological faculty of judgment, that "teleology as a science, belongs to no doctrine, but *only to criticism*, and to the criticism of a particular faculty of knowledge, I mean the power of judgement" (§79, p.417, my emphasis). We can therefore only use the concept of purpose in a "merely critical" way, which means that the use of teleology teaches us something both about certain objects—organized beings—and about our own faculty of thinking; it is as if our thinking on the occasion of these objects reflected on them to read its conditions.[22]

12.2.2 The two registers: articulating them metaphysically

This metaphysical explication, proper to Kant, allows us to understand what the teleomechanist strategy, as analyzed by Lenoir (1980, 1982) and discussed by his critics, should mean in the proper context of Kantian critical philosophy.

If the two principles of mechanism and teleology were "dogmatic," they would be irreconcilable: an object produced, say, by the laws of falling rocks in an avalanche is not an avant-garde sculpture by Joseph Beuys exhibited at the Paris FIAC (Contemporary Art International Fair), intentionally made: this pile of rocks in front of us is susceptible to only one of these two explanations.[23] However, if both principles are properly grasped—one as dogmatic, the other as critical—then we know that their concurrence enables us to understand organized beings. But in this case, we have to think of the unity of these two registers in a certain way; in other words, we have to presuppose a common, though unfathomable to us, *grounding*. "Undoubtedly," Kant writes, "the principle of the mechanism of nature and the principle of causality according to ends in one and the same product must be bound up in a single higher principle and derive from it commonly, because otherwise they could not stand alongside each other in the study of nature" (§78, p.411–412).

The secret of the demonstration lies in insisting on the *phenomenal* character of nature. This reminds us that its "mechanism" is a condition of phenomena, as a constitutive principle of experience. But these phenomena as such must refer

to a suprasensible substratum of nature, which is by definition independent of the conditions of phenomenality, so that its relationship to the mechanism of nature is absolutely undecidable. In this sense, we may well think that the principle of teleology—which also concerns phenomena, since it only concerns the elucidation of our experience—is suspended in the supra-sensible substratum of nature, so that there, the question of the heterogeneity of these two forms of causality no longer even arises, since the *category of causality itself only concerns phenomena*. Insofar as the two heterogeneous principles of teleology and mechanism do not apply to an absolute nature (which is a contradictio in adjecto, since nature is a set of phenomena governed by laws, as asserted in the *Metaphysical Foundations of Natural Science*), but to the phenomena, their opposition dissolves at the absolute (= without relation to the knowing subject) level of the supra-sensible. "The common principle of mechanical deduction on the one hand, and teleological deduction on the other, is the *supra-sensible*, which we must posit at the bottom of nature as phenomenon" (§78, pp.411–412).[24]

The consequence is that this union itself, however thinkable, is incomprehensible to us, since "from a theoretical point of view, we cannot form the slightest positive determined concept of it [the supra-sensible]" (§78, pp.411–412). The supra-sensible is *indicated*, indeed, by the very form of our knowledge since the constitutive role of the understanding points to a supra-sensible *substratum* to the intuitions regulated by its principles. But *no knowledge* can reach it, since all knowledge requires this same form lent by the understanding. Thus, the unity of the mechanistic principle of determining judgment and the teleological principle of reflective judgment only makes sense from the point of view of reflective judgment (remember, determining judgment only provides objective knowledge).[25] With this unity, we hold a thought empty of determinate knowledge, which simply warrants the study of nature for organized beings and their relations,[26] in the same way that the presupposition of the reflective faculty of judgment concerning the *formal* finality of nature ensures the formation of empirical concepts (according to the Introduction of the *Critique of the Power of Judgment*).

This primacy of reflective judgment in the conception of the principle of unity determines the ways in which this unity is achieved, since mechanism is *subordinate* to teleology. Teleology, which assumes an end, always requires means, and mechanism is valid as a means, while means are by definition subordinate to the end.[27] However, in principle, the end implies the means; thus, the teleology of organized beings presupposes that they *also* obey the mechanism of nature, without which they would not be "products of nature," and the concept of natural purpose could not be applied to them. In other words, the teleology of organized beings cannot be applied on its own, as it is devoid of content: it only deploys its explanatory power in combination with mechanism, according to an explanation whose possibility is guaranteed by the common supra-sensible reference of these two principles and with respect to their two respective registers (determining/

reflective). In the common reference of these two principles to the suprasensible, then, we find the possibility of a unity that necessarily presents itself as relation of subordination. Under these conditions, the whole world can appear to be governed by a mechanism that is itself subordinate to a higher understanding endowed with teleological dispositions, as §§66–68[28] indicate, and as I will now describe.

12.2.3 The variety of necessities

The extension of purposiveness beyond organized beings, and based on their teleological performances, makes it possible to generalize to *the whole of nature* the subordinate double explanation they allow, namely, mechanism together with teleology. Nevertheless, this gradual extension, first to the utility relations between different organisms and species (birds help fields not to be eaten by insects, etc.) (§67) and then to nature as a whole (§68), reveals levels at which teleological necessity has a weaker status than in the case of the internal purposiveness of organized beings, precisely because this *extension is conditioned by such an internal purposiveness and derives from it*.

In a nutshell, since organized beings exist, realizing the concept of natural purpose, we can consider some *relations between* natural beings, and sometimes even their entire *network*, as purposive. Kant seems to reintroduce the traditionally teleological vision of nature in these paragraphs (§§66–68); yet at the same time, he shows its essentially dependent character. All the paragraphs that follow the analysis of the concept of natural purposive and its two criteria in §65 are indeed successive derivations of the various usual levels of finality. Each level of finality has as its condition the preceding one, that is, ultimately the organism in its internal purposiveness; each one being therefore *weaker* (i.e., more conditional) than the preceding one; and each one, basically, realizing *a more general but weaker level of reflective necessity than the preceding one*, a necessity that sometimes characterizes a whole scientific field (see Chapter 8, §3.6).[29]

To this extent, §66 moves on from the consideration of wholes and parts within an organized whole, i.e., an organism, as we have seen, to that of means and ends, legitimizing the consideration of everything in the organism as ends and means, from a physiological perspective. Then §67 derives the relative finality proper to what we might call ecological relations (Toepfer 2008, 2019a), between organisms or species, and the following paragraphs generalize a teleological necessity to the entire universe (Huneman 2014c). The crucial shift introduced by Kant here is that not all kinds of purposiveness, hence not all reflective necessities—in the sense that when an end is given, means are necessarily given—, share the same modal strength. While the necessity of the laws of nature is the strongest, since they are required for a nature to exist (remember the definition of nature in the *Metaphysical Foundations of Natural Science*: the set of phenomena that exist under laws), the necessity included in internal purposiveness of organized beings, and for instance registered in Cuvier's principle

of the conditions of existence (Chapter 11), is conditional upon the existence of organized beings, hence, upon the explanatory interest of the cognitive agents in understanding these things as organisms. Then, all other purposes are conditioned upon the existence of such beings and upon the interest of the cognizer in treating them as organized and then understanding nature as *their environment.* In contemporary terms, the laws of physics have the highest mode of necessity; the laws of biology—as internal purposiveness—have a subordinate degree of necessity, which is the first and principal degree of reflective necessity; and then, only once this necessity is acknowledged, can one subscribe to the idea of ecological necessities, which are subordinate to the purposes of organisms; finally, a teleological view of the whole nature is therefore justified as mere heuristics, only from the moments on all these levels of necessity are admitted.[30]

12.3 Finality and finitude

Natural purposiveness is not a concept that would make general experience possible, like those explored in the Analytic of the *Critique of Pure Reason*; nor, as we have seen, is it an Idea of Reason, whose regulative use would be necessary for nature as a system. If we are to think of certain products of nature as final, at least in a regulative way, as the *Critique of the Power of Judgment* has established at length, whence does it come that this concept of purposiveness is available to us for this project? What is the particular feature of our faculty of knowing that implies the necessity of using purposiveness, since that is a *regulative* concept, and therefore does not find its *raison d'être* in the possibility of objects as phenomena? This question is answered by §77 (*CJ*) by appealing to the *discursivity* of our understanding. The very concept of purposiveness is indissolubly linked to a certain constitution of our understanding, and in a way expresses this constitution. Let us develop this answer.

"Our understanding is a faculty of concepts, i.e., a discursive understanding, for which must be contingent the quality and diversity (*welcherlei und wie sehr verschieden*) that the particular given to it in nature can present and can be subsumed under its concepts" (*CJ*, §77, p.406). The "concept" thought of by the understanding is general: from this general, the particular does not derive in a determinate way. We may have the concept of a rectangle, but we can in no way deduce from it the rectangular bodies we might encounter in the world: "in how many ways various things, which nevertheless agree in a common quality, can present themselves to our perception, that is a contingent thing" (*CJ*, §77, p.406). A discursive understanding is one for which the particular is contingent in relation to the general; this discursiveness stems from the fact that *understanding and sensibility are two distinct sources of knowledge*, each with its own type of correlate. The concept is always *general*, while intuition always deals with the *singular*.[31] The general is *thought* by the understanding, the particular is *given* to sensible intuition. This duality of the two sources of knowledge implies the impossibility

of deriving the particular from the general.[32] This also means that *a discursive understanding needs a reflective faculty of judgment*: for on its own, it cannot find the general that subsumes a particular, because this particular is always contingent for its concepts, since, as our example of rectangles showed, it could be subsumed under several concepts.[33] The question of the Introduction to the *Critique of the Power of Judgment*, which led to the transcendental presupposition of formal purposiveness of nature, was that of the derivation of the particular, as we have seen (Chapter 8, §2). Now, since the discursivity of the understanding implies the presence of a reflective power of judging, and while the *Critique of the Power of Judgment* has shown that natural purposiveness is the proper concept of this reflective power of judgement, we would expect the meaning "purpose" to have its *raison d'être* in the discursivity of human understanding. It is now a question of clarifying this foundation and grasping its consequences and scope.

12.3.1 The finitude of our understanding

To say that the "natural purpose" is a regulative concept of reflective judgment is to say that, due to a singularity of its constitution, our faculty of knowing implies the content and structure of this idea. We should therefore realize that our understanding has a particular constitution—in this case, its *discursivity*—and therefore, logically, we could forge the idea of another possible understanding that would be otherwise constituted. Similarly, in the *Critique of Pure Reason*, in order to grasp the difference between phenomena and things-in-themselves, and to understand the phenomenal status of the object of our intuition, we "had to have in our ideas another possible intuition, [namely, a creative intuition, an *intuitus originarius]* if ours were to be regarded as being a particular kind of intuition" (*CJ*, §77, p.405), a particularity appearing only by contrast.

More precisely, what exactly does our discursive understanding contrast with? With an *intuitive understanding*, i.e., an understanding for which the particular would not be contingent in relation to the general, since it would not proceed from the general to the particular by means of increasingly restricted concepts, each time having to produce a corresponding intuition to subsume it, as we do when going from the general (e.g., the rectangle) to the particular (the red rectangle) and then to the singular (this brick). Such an understanding would produce the intuition of the particular *at the same time a*s the general concept: just as we were able to conceive (and here Kant alludes again to *Critique of Pure Reason)* of a "complete spontaneity of intuition," which contrasted with our sensible intuition and which, as such, was ultimately an understanding in the most general sense, so we can very well think of an "*intuitive* understanding (negatively, i.e., simply as non-discursive), which would not go from the general to the particular and then to the singular (through concepts), and for which there would not exist this contingency of nature in its productions according to *particular* laws vis-à-vis the understanding" (*CJ*, p.406).[34]

Admittedly, we cannot imagine how such an understanding would think, but it is at least conceivable. For our faculty of knowledge articulates understanding and sensibility as two separate sources, but this constitution is given to us as a fact, and there is nothing to indicate that *all thought must think under such conditions;*[35] or, in other words, that the subsumption of the singular under the universal takes place through overlaying an intuition under concepts each subsumed under the other, and through the mediation of the faculty of judging. That the latter finds the concepts for an intuition or a collection of intuitions, while "schematism" makes the intuition transparent to the concept, is not the absolute definition of the exercise of knowledge, but the particular constitution of the faculty of knowing that is given to us: yet, we can *conceive of* another one, which is precisely that of the intuitive understanding. When we say that purposiveness is a rule for our reflection on certain products of nature, we are implying that another understanding could see these products without finality and even as resulting from mechanism.[36] The very use of purposiveness as a rule implies reference to a suprasensible ground for a possible unity between purpose and mechanism, a ground likely to be conceived of as an intuitive understanding.

To sum up, in the *Critique of the Power of Judgment*, purposiveness appeared as a response to the twofold problem of contingency: the contingency of the unity of the particular laws of nature, and the contingency of organic performances in relation to the universal laws of mechanism. In both cases, we saw that derivation proved impossible, and that the reflective power of judgment had to posit respectively the transcendental presupposition of nature's finality with respect to our understanding, and, concerning organized beings, the concept of "natural purpose." We are now in a position to understand how this meaning of "purposiveness" is constituted and where it comes from.

In the case of a living thing, we cannot deduce it from physical laws and explain it by them; it is contingent with respect to them. "According to the constitution of our understanding, a real whole of nature is to be considered only as the effect of the convergence of the driving forces of the parts" (§77, p.407); yet with the organized being we have a "real whole of nature" such that the sole effect of the motive forces of the parts—that is, of the interaction of the parts according to the laws of physics—cannot account for its performance. When, however, we conceive of its possible knowledge, this means that we believe that another understanding, namely, the intuitive understanding, can know it. The concept of such a whole, i.e., of an organized being, will therefore be that *which our understanding can form of the concept that an intuitive understanding would form of such an object.* This iterative moment—that is, the concept *of a concept*—is crucial to understand Kant's take on purposiveness.[37] It provides an ultimate justification for the intertwining of reflectivity and purposiveness.

In contrast to our discursive understanding "which, in its knowledge of the cause of a product, must go from *the universal-analytical* [i.e., concepts] to the particular [the given empirical intuition]," the intuitive understanding would go

"from the *universal-synthetic* [of the intuition of a whole as such] to the particular, i.e., from the whole to the parts." In other words, our discursive understanding must proceed "from the parts as reasons thought universally," i.e., under the laws that describe the governing forces in them and thus make them causes. In contrast, an intuitive understanding "in its representation of the whole does not include within itself the *contingency* of the connection of the parts to make possible a determinate form of the whole, a contingency that is only superimposed onto our understanding, which must proceed from the parts as universally thought reasons to the various possible forms that can be subsumed as consequences" (§77, p.407). Thinking about life thus yields a two-tiered concept: a thought starting from the synthetic universal, itself conceived of by a thought starting from the analytic universal.

Kant then analyzes this product of nature—an organism—as follows:

> If, then, we do not wish to represent to ourselves, as befits our discursive understanding, the possibility of the whole as dependent upon the parts, but rather, according to the measure given by an intuitive (archetypal) understanding, the possibility of the parts (according to their constitution and connection) as dependent upon the whole: this, by this very property of our understanding, cannot be done in such a way that the whole contains the ground of the possibility of the binding of the parts (which would be a contradiction in discursive understanding), but rather in such a way that the *representation of* a whole contains the ground of the possibility of the form of the whole and the binding of the parts that belong to it. Now, since the whole would in this case be an effect (*a product*) whose *representation* is considered the *cause* of its possibility, but we call *purpose* the product of a cause whose basis of determination is the mere representation of its effect, then it follows that this is simply a consequence of the particular constitution of our understanding, if we represent as possible products of nature according to another kind of causality than those of the natural laws of matter, i.e. simply according to the causality of purposes and final causes, and that this principle does not concern the possibility of such things (themselves considered as phenomena) according to this mode of production (*Erzeugungsart*), but only the judgment possible on them for our understanding.
>
> (§77, pp.407–408)

12.3.2 The reflection of finitude

I now have to explain and develop this dense text in the light of the analyses of purposiveness in the *Critique of the Power of Judgment* developed in Chapters 8 and 9. Its central argument is the following: while an intuitive understanding represents production as going from the whole to the parts, in other words, can derive the parts from its intuition of the whole, we can only think of this

derivation *as thought by an understanding that is not our own*, i.e., for us, this derivation should go from the *representation of* a whole, to the determination of the constitution and connection of the parts. We cannot think of a causality from the whole to the parts, because our understanding only understands by proceeding from the parts to the whole.

In other words, for our understanding, the synthesis is not given; it has to be produced, and to do this, we have to exercise the synthetic activity of judgment. Its principles are made explicit in the principles of the Transcendental Analytic (of the first *Critique*), which underlie the universal laws of nature: this is why Kant said that our understanding proceeds from the parts "as a universally-thought ground." The derivation of the parts from the whole, as would be done by an intuitive understanding for which the synthesis is given, can only be thought of by positing *the representation of the whole as a concept*—since we do not have the synthetic *intuition* of the whole—and by thinking of a derivation of the parts from this representation.

This argument essentially relies upon the separation of our faculty of knowing into intuition and concept, sensibility and understanding: since we do not have synthetic intuition, i.e., intuition-of-the-whole (but must always construct the whole, either mathematically in intuition, or by regression in the synthesis of the conditioned, as taught in the Appendix to the Transcendental Dialectic), we can only think the intuition-of-the-whole as an intuitive understanding would have it, hence as a representation of this intuition, and more precisely, as a concept. In this concept of the whole, which is our only way of thinking the whole-in-itself-thought-through-this-thought-that-we-lend-to-an-intuitive-understanding, we think of the form of the whole as already determined, and thereby the role, form, and connection of the parts: these are thus posited by the representation of the whole. For us, the causality of the products of nature that are organized beings, insofar as it is not to be equated with natural causality according to the principles of understanding, must therefore be thought of in the following way: the concept of the whole determines the parts, i.e., what (according to the connection of events for our discursive understanding) would be its own cause. In other words, for us, the causality of certain products of nature, which is unthinkable according to a discursive understanding, is made explicit in a causality that starts from the representation of the whole and determines the form of the whole, and thus the connection of the parts and their constitution. This type of causality, says Kant, is *purposive causality*: X, such that the representation of its effect is the cause of its cause (here, of the parts of X), is a purpose.

This reasoning thus allows us to assert the following: the very constitution of our understanding, namely its discursivity, and thus more originally the split of our faculty of knowing into a spontaneous understanding and a receptive intuition—in other words, our *finitude*—implies that the causality we must lend to certain products of nature in order to conceive of them, insofar as they prove unthinkable by the ordinary causality of our finite understanding will be a

causality of the purposive type. Hence, the notion "purposiveness" is constructed through the reference that our discursive understanding—i.e., our finite thinking—must make to an intuitive understanding from within its finitude. There are no natural purposes except relative to finite thought: this is the lesson of the critique of teleological judgment, which echoes that of the critique of aesthetic judgment, according to which only a finite reasonable being (in other words, one whose rationality is constrained by sensibility) can have aesthetic experiences.[38]

So here we approach both the constitution of the meaning "purpose," and its limits. How so? Insofar as it is the thought we have of a thought that is structurally different—namely, that of an intuitive understanding—this meaning can in no way concern the conditions of constitution of the objects of possible experience, in other words, the phenomena. This meaning is instead generated in a movement by which our thought reflects its own structure through reference to the idea of another understanding, in relation to which its particularity can appear, in other words, in a movement through which it reflects its own finitude, on the occasion of certain experiences. The term "reflective judgment," whose importance for teleology Kant never ceased to emphasize, takes on its full dimension here: through the principles of such a judgment, our thought relates to the contingent specificity of its structure, as a finite structure.

Hence, of course, Kant's final clarification of the limits of the concept of finality in the text just quoted, which both repeats a hundredfold warning about the properties of reflective judgment and its regulative principles, and sheds new light on it: "this principle does not concern the possibility of such things (themselves considered as phenomena) according to this mode of production (*Erzeugungsart*), but only the judgment possible on them for our understanding" (quoted above). From the genesis of the meaning "purpose" in the reflection of its finitude by our thought, it indeed appears that the operation of producing phenomena is not governed by this meaning, for that meaning arises only in the movement by which we think another thought, that is, by which we form the idea of a knowledge that is in principle possible even though it is impossible for our finite thought. For such reason, "natural purposiveness" is not a principle of the phenomena, but of our possible judgment of them; in other words, it is confirmed as a regulative principle of reflective judgment, not a constitutive principle of the determining faculty of judgment.

Since the *Other* causality (in relation to mechanisms, to the universal laws of matter) that we attribute to the living must be thought as thought by the *Other* understanding—the intuitive understanding—, the "representation of the whole," which causes the parts, should not be a moment in the order of phenomena, but only the effect of the reflection of our finitude: it should be the effect produced by a discursive understanding in attempting to think, as thought by an intuitive understanding, the intuition-of-the-whole that this intuitive understanding could think and posit. Consequently, and according to the very origin of its meaning, the relation of purposiveness, which brings into play the parts and a

representation-of-the-whole (this "idea of the whole" that the §65 crucially mentioned), cannot be seen as a *real* relation, internal to the phenomena. It must be thought of as a *rule* that our thought gives rise to within itself, in order to make knowledge possible, even though its finitude precisely prevents it from acquiring knowledge according to the usual rules of knowledge that the understanding prescribes for nature. Such finitude, recall, is above all the contingency of the parts with respect to the whole, and ultimately of the particular with respect to the universal.

Thus, natural purposiveness appears as transcendentally constituted in the reflection of finitude by our finite thought, and is necessarily posited as the regulative principle of reflective judgment. But if we now remember the analyses carried out in Chapter 9 (§2), the regulative status of the concept of finality is precisely what enabled Kant to think of the organism as such, i.e., in its dimension of *productivity (Zeugung)*. The "formative force" of organisms was the ontological flipside of the epistemological regulative dimension of finality, and reflected the *epistemological specificity of biology*.

We can therefore move one step closer to the conclusion of this examination of the relationship between Kantian thought and the constitution of biology: thinking of living beings as organisms, that is, making use of a concept of "natural purpose" as a regulative principle of reflective judgment, is ultimately rooted in the contingent constitution of our understanding, and thus in the finitude of our faculty of knowing (I would even say: of our thinking). This regulative dimension of the concept is what makes it special and marks its role as a principle for the foundation of an autonomous biology. Constituted outside philosophy, the concept of organism as it emerged in biology at the turn of the century (see Chapters 1, 2, 4, 6, and 10), was brought back to its roots by transcendental philosophy, namely to the finitude of thought, through the precise elaboration of the genesis of the meaning "purpose." And such a genesis reveals its limits. This also suggests that philosophy now should undertake the general task of thinking about the necessities by which concepts impose themselves upon thought: in this case, the concept of organism, in relation to the requirements imposed on us by the form of our thought when it comes to the concept of totality, or, more precisely, of a *system*.

12.4 Purposiveness and the metaphysics of modalities

If finality only made sense against a background of contingency, the transcendental elucidation of the meaning "purpose" should ultimately shed new light on the notion of contingency and, beyond that, on the question of modalities. It would complete Kant's response to the aporia of contingency in Leibnizian metaphysics, namely the instability of the main distinction between contingent and necessary order, which was a fundamental problem of coherence in this metaphysics. Remember that its treatment was the essential background to the problematic of order since *The Only Possible Argument. . .* (Chapter 3).

The heart of the question in the third *Critique*, as the problem that relaunched critical analysis after the first one was, as I said, the notion of contingency. After this journey through Kant and nascent biology, which has enabled me to assess the re-elaboration of the meaning of "purpose" and the unraveling of the conditions of the concept of organism in finite thought, I can now return to this question by setting out the Kantian results concerning contingency.

To do this, I need to first sketch out the general problem of modalities that the Kantian theory of purposes is ultimately based on. The Kantian thesis, from *Critique of Pure Reason* onward, is that modalities first and foremost concern the relation of the object to the faculty of knowing. As the *Progress of Metaphysics* says of the concept of necessity: "it is a simple concept of modality, which does not contain the relation to the subject as a constitution of the thing, but only the relation to the object by means of the connection of the representation we have of it with the power of knowing" (Ak. XX, p.304). What difficulties does this thesis address?

12.4.1 The modality problem: generalities

An object can have three modalities: it *is*, it *can* be, it *must* be—existence, possibility, necessity. Insofar as necessity can be defined as "*can* not not *be*," we can provisionally concentrate our examination on the two categories of *existence* and *possibility*. In the table of categories (in the Transcendental Analytic of the *Critique of Pure Reason*), necessity indeed is the third category of modality: as such, it follows from the other two, even if it cannot, for this reason, be confused with them. "Where the third category can be used, it always contains something even more than the first and second taken together and for themselves, that is, the deduction of the second from the first (a deduction that is not always possible); so, for example, necessity is nothing other than existence *insofar* as it can be concluded from possibility."[39] This allows us to defer our analysis, focusing on existence and possibility. The correlative notions of necessity and contingency will then come into play.

I see that an object exists. Now, what does it mean that an object *can* exist? The first point to emphasize is the essential correlation between the notions of "possible" and "thinkable." When I *think of* a situation, such as being President of the United States of America, this implies that the situation is "possible." If a situation is not possible, I cannot think of it. Consider indeed "a triangle with parallel sides": it is unthinkable, and this unthinkability guarantees that it cannot exist—more precisely: that no object of this shape can exist.

More generally, to posit a being as possible, I must think of it: positing it as possible presupposes having implicitly posited it as thinkable, as if the minimum we could demand of a possible were that it be thinkable.[40] As if, more profoundly, the very category of "possible" only made sense within the horizon of a thought that thinks objects.

Possible and thinkable, therefore, seem isomorphic; but this isomorphism vanishes if we want to make it more precise. First of all, I do think something when I think the thought (1) "triangle with parallel sides," otherwise I would not be able to say it: in this sense, this object is not absolutely unthinkable.[41] We must therefore distinguish between what we might call a meaningful thought (triangle) and a thought devoid of meaning, such as (1); only the object of a thought with meaning[42] will be called possible. And all meaningless thoughts, despite their verbal diversity, will actually be of the same content: they contain nothing, or more precisely, they refer to no possible object. However, this emptiness, exemplified by (1), is more radical than that of a definite description without a referent, such as "the current King of France."

I am using Frege's and Husserl's lexicon to deal with these questions, a lexicon that is not Kant's, of course. But the fundamental idea, which defines the first aspect of the problem of modalities, is this: if the possible can only be defined in reference to the thinkable, we need a criterion internal to thought to define thoughts that determine a possible, i.e., thoughts that have meaning. Apparently, contradiction provides a good criterion. The thought (1) means nothing because it is contradictory. Hence, the first solution: a non-contradictory thought has meaning; it thus defines a possible. To be possible is to be the object of a non-contradictory concept. It could now be argued that our detour via the "thinkable" was pointless, since the possible can be directly defined by the non-contradictory; but this is to forget that contradiction and non-contradiction arise originally in thought. The result is that the category "possible" only makes sense to us in reference to thought, and is then defined by non-contradictory thought.

This analysis calls for three comments. First, it simply seems to have taken the difficulty up a notch, because there are many possibles that nobody has ever thought of. So, we need to rephrase the definition and say: I call possible that which *can* be the object of non-contradictory thought. The circle is obvious. One way out is to posit a thought-in-act for which all non-contradictory thoughts are thoughts: thus, possibles are thoughts in an infinite understanding.[43] This is the Leibnizian solution, and we can see that it seems to be the obvious one if we take seriously the implicit reference made by the category of "possible" to any kind of thought. This solution also has the advantage, of course, of conferring a status to the possible, whereas the possible initially had an enigmatic ontological status, which at first glance seems to relegate it to psychologism: the possible, as a non-contradictory object of *thought*, would be in our mind. By not going as far as the Leibnizian solution of a divine understanding, the possible would thus flow back into the imaginary.[44]

Second, the thought (2) "a beaver president of the United States" does mean something; and yet it is a blatant impossibility. It seems, then, that the criterion of non-contradiction, delimiting meanings, is not enough to circumscribe the possible. Unless, of course, we grasp that the President of the United States is,

by definition, a human, so that the statement appears manifestly contradictory because it envelops the negation of an analytic judgment. But in this case, if the possible is equivalent to non-contradiction, it appears that non-contradiction is too strong a criterion to define meaning, as (2) has meaning. Hence, the discrepancy between the notions of meaning—i.e., ultimately of the "thinkable"—and the possible, the possible itself being defined by this non-contradiction, which could only be its criterion by asserting an essential correlation between the possible and the thinkable.

12.4.2 The logically possible and the really possible (by Leibniz and Kant)

The possible is, therefore, at least thinkable, even if not all the thinkables are possible. The Leibnizian idea of a divine understanding as the locus of possibilities derives its legitimacy from this inclusion. But then, the equivalence of possibility and non-contradiction becomes itself dubious: this is an essential point of the problem as it arises with Leibniz and then Kant. While the square circle is indeed impossible because it is contradictory, we can find non-contradictory thoughts whose object is not possible despite being non-contradictory. I can think of a body without weight, but for all that it is worth, such a thing is not possible, and at the same time, it is not *prima facie* obvious that this thought is contradictory unless weight is included in the definition of a body. This example is, of course, Kantian; Kant uses "all bodies are heavy" to illustrate the synthetic judgment. For if weight is not included in the concept of "body," then this judgment is not analytic, so that "non-weighting body" is not contradictory.[45] If a non-weighting body is not possible, then possibility is not only defined by non-contradiction. To define it, we need to take into account impossibilities that result from synthetic a priori relations between a subject and a predicate. So, we see that the classic expression of the Kantian problem, as Kant himself formulates it ("how are a priori synthetic judgments possible?"), necessarily encompasses the question of the category "possible," is to be defined as well as what I am addressing here very generally under the heading "problem of modalities."[46]

In any case, we can, with Kant and according to the general distinction initiated in the 1764 essay on *Negative Magnitudes* and fundamental in the *Critique of Pure Reason*, distinguish between *logical possibility* (square circles are logically impossible, like incorporeal bodies; non-weighing bodies are logically possible) and *real possibility* (non-weighing bodies are really impossible). The question, then, is to understand their articulation. In the terms of the *Critique of Pure Reason*, real possibility is defined by compatibility with the conditions of possible experience. But this claim must be situated, once again, within the general problem of modalities, and the overall question of possibility as I attempt to formulate it here.

Of course, this issue is not a matter of deciding what is possible and what is not; it is a question of explicating the meaning of the category "possible," even though the immediate understanding of this term does not seem to give rise to a univocal use. In this respect, the Kantian formulation of the question presents a modern echo of its formulation in Aristotle, where it was a matter of distinguishing between the possible (*dunaton*) in the logical sense and the physically possible (*dunamis*), i.e., the power that belongs to a thing in its own right, a distinction made in *Metaphysics* $\Delta 12$. But while in both cases the aim is to articulate the logical and the physical, a radical difference in ontological presuppositions separates Kant from Aristotle. Aristotelian physics concerns substances capable of being, by their very essence, causes of something else (this is the "formal cause," form as a cause in the *Physics*), and therefore having in themselves the power to do and not to do certain things; Kantian nature is post-Galilean, devoid of these essential powers. A thing is no longer in itself a cause; or rather, insofar as the intervention of a cause is marked by a change, as the Second Analogy indicates,[47] the cause must itself be another change.[48] In any case, Kant took up the question of the articulation of the two kinds of possible from the perspective of modern science.

It may be objected that this is too schematic, since Leibnizian physics—whose importance for Kantianism we have emphasized here—understands substances as forces, and presents itself as a *dynamic*, in other words, as the reinstatement of the dimension of *dunamis* that Cartesian physics had nullified by equating matter with extension (see also Chapter 5, and Gaukroger 2010, chapter 1). The answer to this objection is that, for Leibniz, the ontological value of mechanics is less than for Aristotle, since it only concerns "well-founded phenomena," whereas the substance itself, as we know, is of metaphysical nature. To this extent—that is, insofar as physics depends upon theological metaphysics—Leibniz developed an original solution to the problem of the possible, which we shall precisely trace, because, once again, the Kantian solution appears to respond to its inadequacies.

Let us return to some examples. When I said that I could be President of the United States, I know that this is logically possible, in the sense that there is no contradiction here—but at the same time, according to the ordinary use of language, it is impossible: I know that I will never be President of the United States. How would you describe this knowledge? You could say that, while a "square circle" is impossible, my being President of the United States is rather a possibility that will never come true, but could be. Indeed, for the possible to be a separate category, distinct from existence, there must be a possible that never obtains, as Aristotle says somewhere.[49] However, if I never go to Saint-Nazaire in my entire life, I still feel that there is a difference between these two statements (supposedly uttered at the end of my life): "I have never been to Seattle" and "I have never been President of the United States." The latter claim seems to us to denote an impossibility (first of all, because I was not born in the USA, which is

a necessary condition to be president), while the former seems to state a contingent fact. How can we account for this difference between these two unrealized facts? How can we think that the former was really possible, and the latter only logically so?

12.4.3 Leibniz and possible worlds

The Leibnizian theory of possible worlds provides an answer to this question (and the matrix of Kripke's, Stalnaker's, and Lewis's much more sophisticated semantics of possible worlds). The divine understanding defines logical possibilities in the sense of non-contradiction. Each possibility is then compatible with some possibilities and not with others. A set of compatible possibles defines a possible world. A logical possible is, as it were, a being or a state of affair such that there is a possible world in which it is possible, since it is not contradictory in itself: thus, my being President of the United States undoubtedly belongs to one of these worlds (in which I am born in the USA, or in which the rules for running for US presidency are different). But since this certainly does not belong to our actual world (i.e., the possible world that has been chosen by God to exist) because it is incompatible with many of the characteristics of that world, then it cannot occur in our world, so it is impossible here.[50] Recall also (Chapter 1) that God is an optimizing machine, computing the amount of reality in each world and actualizing the one with the greatest degree of reality: *Cum Deus calculat et cogitationem exercet, fit mundus*.[51]

However, if we wish to be rigorous, the statement "I am President of the United States in another world" is in itself erroneous, since in another world I am no longer "I." Here we must assume *rigid designators* in Kripke's sense (Kripke 1980), which identify their referent transversally across possible worlds; or simply, that there are "counterparts" (Lewis) of myself across all worlds, which allows the translation into these worlds of statements about myself. Here, there is a conflict between the need to be able to speak absolutely about an individual, for example Adam or Caesar as Leibniz considers them in the *Théodicée* and the *Correspondence with Arnauld*, where his theory is elaborated (and Leibniz talks about possible Adams, or possible Julius Caesars that did not cross the Rubicon), and the impossibility of identifying substances across different worlds, since they differ according to at least one predicate. Leibniz uses the notion of a *vague Adam*, correlative of the "incomplete notion" of Adam, which would allow us to speak of Adam in all possible worlds (since in such a notion one has not developed all his predicates), but many contemporary theoreticians of possible worlds would say his solution remains unsatisfactory, since the Adam referred to is not sufficiently identified. Yet, the "vague Adam" and the incomplete notions are supposed to do the metaphysical job done today by the notion of counterparts (a "vague Adam" is the notion under which fall all counterparts of Adam). Nevertheless, for the present issue, I can make explicit what is at stake

in the Leibnizian distinction between possible and compossible without going into these questions.

The Leibnizian articulation between logical possibility and real possibility boils down to the articulation between divine understanding and will, the one conceiving all possible worlds, the other positing one actual world.[52] It is correlative to the doctrine of conditional or hypothetical necessity; namely, logical possibility is absolute, while real possibility is hypothetical, as it stands under the condition that a certain possible world be realized. A being (or an event, or a state of affairs, it does not matter here) can be absolutely possible and conditionally impossible.

This Leibnizian theory provides us with a valuable guideline for the problem of modalities, which I will explain shortly. The fundamental idea is the distinction between possibility and compossibility. This means that a real possibility is one for which there are no incompatible events in the actual world. So, we have a criterion of real possibility. A problem then arises: in the absence of any proven contradiction of the real world with a possible X, can we posit the real possibility of X? It would seem so, but of course, there may be hidden contradictions, unknown to us, which make X impossible in reality.

Let us leave this case aside for the moment. It should be pointed out that the statement "X is possible" is undoubtedly time-dependent: at time t, there is no event in the world incompatible with X, so X is possible, whereas at time t', there is a new event, Y, incompatible with X, so X has become impossible. X has thus been successively possible and impossible. But then two new, seemingly insoluble problems arise.

1 How can we tell the difference between a (logically possible) X that is impossible in our world, and a (logically possible) X' that has become impossible in our world but was once possible? This difference hardly seems detectable, and yet here the difference between logical possibility and real possibility must come into play. Conversely, we could say that every real impossible (logically possible) X' is in reality a previous real possible that has become impossible, and the difference between logically possible and really possible vanishes, and with it the whole construction of possible worlds.
2 Conversely, if X is logically possible and really impossible at time t, however, this does not mean that it will not be really possible at time t'. In other words, real impossibility does not seem to be genuine impossibility, since I could always say that X, which is really impossible at time t, could be possible at time t'. It seems, then, that the theory of possible worlds only holds on condition that all events in the world at all moments in time are made interdependent, in other words, with the analyticity of all judgments, as Leibniz posited. Then, any event occurring for a given substance is a priori included in its individual complete notion, so the possibilities and impossibilities, in themselves, do not depend upon time.

> Indeed, in Leibnizian doctrine, because of the analyticity of all judgments, events in the world are all dependent on one another, both at an instant t and in the course of the world as a whole, so if there exists in a world W at instant t an event Y incompatible with X, then this event was contained in the essence of the world W (at least for the divine understanding), possibly through an infinity of mediations, so that X was from all eternity impossible in W (or "really impossible" when W is the actual world). The "possible" thus has a timeless meaning.

But formidable difficulties then arise. The first is the following: when we define the real possible as a being possible under the condition of the position of our actual world, we are at the same time defining a being which, due to the dependence between all events in the world, will be posited as real by the very position of our world. For Leibniz, every substance envelops within itself, in its notion—that is, as a simple possibility—a relation to all other substances: "(God) perceives completely any singular substance, thanks to its notion, the very truth of all accidents, without having recourse to anything extrinsic, because each envelops in its own way all the others and the whole universe."[53] *The real* possibility of something not present resolves itself into future existence in our world. In the Leibnizian universe, it does not seem possible to find any unrealized real possibilities, since, being connected to all events in our world, and thus implicated by them, the real possible will eventually be brought into existence. Then, if, as with Diodorus, the real possible is reduced to the future or past existent, our efforts to distinguish between the real possible and the logical possible have been in vain; the "really possible" only means "actual," and the only two genuine modalities are the actual and the logically possible. The Leibnizian version of the theory of possible worlds comes up against the point I made earlier about God's choice, namely that contingency appears purely verbal.

Now, let us assume in turn that our actual world somehow contains genuine real possibles, i.e., events that are not incompatible with any past or future event of our world, but are not logically entailed by them, so that the necessary facts of our world would constitute the core of the actual world but not the whole of it. Then we can define a halo of "possible worlds" around this actual world, each possible world being defined by the realization of one of these independent possibles. And by the same reasoning, we can define the halo of any possible world W, where W is a given possible world but not the actual world W_o. Thus, we envisage a version of possibility that avoids the last-mentioned problem of necessitarism. But an important question arises concerning the epistemological accuracy of this metaphysical model of possible worlds.

What about an unrealized possible event X in W_o? Either we say that X was possible in W_o and possible in other worlds W_o, but then what is the difference between W_o where X does not happen and W_o' where everything is like in W_o except that X happened? A world being a set of compossible events, there is no

difference between W_o and W_o' (both include X and the rest, as possible). But we said they are two worlds, which is a contradiction. Or we begin by saying that a world is the complete set of compossible events. Then in W_o, a possible event X that never happens is a contradiction, since a world is a *complete* set of compossible events, so W_o' is the only possible world (W_o is incomplete because it lacks X, hence not a world). Then, how can we account for the non-realization of X without invoking some kind of incompossibility between X and W_o'? But then, X is at the same time not compossible with W_o', and compossible with it (as compossible with W_o, which is like W_o' except on X).

With this puzzling question of the non-realized possible in a possible-world account of modalities arises the epistemological question of hidden non-contradiction. How can we distinguish between an event X that is really possible and unrealized, and one that is truly impossible, because it involves an incompatibility with the actual world *that has never been detected*? If we cannot, then our definition of real possibility in terms of possible worlds and incompatibility collapses. But we can only do so on one condition: that there exists somewhere a thought for which hidden contradictions are detected; otherwise, the notion of a hidden contradiction, never detected and never to be detected, is meaningless. Leibniz fulfills this condition because he posits a divine understanding that sees all relations between logical possibilities; without this divine understanding, his multi-world solution to the problem of the possible no longer holds.

12.4.4 The Kantian solution

12.4.4.1 Why a new conception of modalities?

Be that as it may, in this Leibnizian account, real possibility, while now timeless, is always relative to the position of a possible world. This is one of the essential points of the analysis: *real possibility only makes sense in relation to something*. In thinking of the possible as relative to the conditions of our experience, Kant would remember this. But he radically abandons the rest of the Leibnizian position; the difficulties just mentioned are reason enough for searching for a new account. To understand the Kantian move, however, I will present the theoretical difficulties a little differently.

Let us assume that there are possible worlds. By this supposition, possible worlds exist in a certain way. Leibniz specifies this way: they exist in the divine understanding. Our actual world is a *posited* possible world. Its difference from other possible worlds is that we experience it. There is no other provable difference. We could postulate that other possible worlds exist like the actual world, for subjects who have the same relationship to them as we do to our world: this proposition would be rigorously unfalsifiable. It is David Lewis's modal realism, where possible worlds exist: an interpretation of the semantics of possible worlds

that is quite ontologically radical and contrasts with the other, minimalist interpretation, defended by Robert Stalnaker, according to which a possible is just a way this world might exist.[54] In other words, we can grant all possible worlds the same kind of existence, with the sole difference that only our world is perceptible to us. But this difference is relative to us, and does not concern the concept of "existence" itself: all possible worlds would exist in the same way. Then the difference between possibility and existence collapses.

To preserve it, there are two solutions: firstly, to posit a reason for the difference between our perceptible world and other possible worlds; this is explicitly the role of the *principe du meilleur* in Leibniz. Since God is good, He posits in existence the best of all possible worlds He knows, and this defines the actual world, our world. To save the difference between the categories of possibility and existence, our world must thereby have been *chosen*; and for this choice to be thinkable, it must have had a reason, which can only be the preferability of our world, i.e., its *optimality*. The difference between existence and possibility is thus reinterpreted by Leibniz in the form of the difference between divine will and divine understanding. This is why, *a contrario*, when Spinoza says that in God understanding and will are not distinct, he is saying at the same time that everything happens by the mere necessity of its essence and of the divine essence, which always develops all its consequences, and is at every moment all that it can be, so that nothing "*can* happen" without actually happening.[55] (This means that there is no difference between possible and existent, according to a modern version of the Diodoran thesis.)

Obviously, this Leibnizian account raises all the problems we have seen.[56] Hence, a second solution: this reference to our perception, which distinguishes our posited actual world from other possible worlds, is, in fact, *essential to the category of existence* itself.[57] This is not very far from Lewis's thesis that the proper nature of actuality, the characteristic of our world in relation to all possible worlds that all exist, is *deictic*, namely that it is "this world," in other words that the proper nature of its existence lies in its relation to us, in the fact that it is our world. So, for Kant, the hypothesis of possible worlds that exist but are imperceptible to us no longer makes any sense, since it misuses the category of existence, which is only meaningful in reference to our perception, our experience.[58] In other words, "existence is not a real predicate":[59] otherwise, the differences between possibility and existence would collapse.

Possibility and existence are thus defined by the structure of the knowing subject: while existence only makes sense as a position in perception, the possible refers to our thinking, since we have seen that the very notion of the possible includes a necessary reference to thought.[60] Kant thus indicates that the possible is always the object of one of our thoughts; recourse to an Other thought is no longer appropriate, because existence has from the outset been indexed to our faculty of knowing, so that possibility must also make sense in relation to it. The Kantian elaboration of the problem of real possibility as a synthetic a priori

notion, and its solution given in the first *Critique* in the chapter called "The Postulates of Empirical Thought," by reference to the conditions of possible experience, only makes sense against the backdrop of this new account of modalities.

But under these conditions, while the distinction between concept and intuition corresponds to the distinction between possibility and existence, the *categories of modality themselves* are dependent upon the contingent finite constitution of our faculty of knowing (the understanding–sensibility distinction). This is expressed in §76 of *Critique of the Power of Judgment*:

> It is inescapably necessary for human understanding to distinguish between the possibility and actuality (*Wirklichkeit*) of things. The reason for this lies in the subject and in the nature of his faculties of knowledge. *If it were not for the requirement of two completely heterogeneous parts (Stücke) for their use: the understanding for the concepts and the sensible intuition for the objects (Objekte) that correspond to them, then there would be no such distinction (between the possible and the actual).* If our understanding were intuitive, it would have no other objects (*Gegenstände*) than the actual. Concepts (which simply refer to the possibility of an object) and sensible intuitions (which give us something, without making it known to us as an object) would disappear into each other. Now, our whole distinction between the merely possible and the actual rests on the fact that the former simply signifies the position (*Position*) of the representation of a thing relative to our concept, and in general to the faculty of thinking, while the latter signifies the position (*Setzung*) of a thing in itself (outside this concept). So, the difference between possible and actual things is one that is only subjectively valid for the human understanding, since we can always have something in mind even though at the same time it does not exist (*ob es gleich nicht ist*), or we can represent something as given even though at the same time we do not yet have any concept of it. Thus, the propositions: things can be possible without being actual; we cannot conclude from mere possibility to effectivity, are quite rightly valid for human reason, without, however, thereby establishing that this difference lies in the things themselves.
>
> (§76, p.402, my emphasis)

Possibility and existence are therefore not determinations of things in general, but the translation into phenomena of the phenomenological difference between receptivity and spontaneity—intuition and thought—which defines the finitude of our thinking.[61] This is undoubtedly where the categories of modality differ from the others: of course, all categories are objectively valid only in relation to phenomena, insofar as they constitute a possible experience. But the first three kinds of categories—quality, quantity, relation—concern phenomena in themselves, they are the different moments of the objectification of what arises in the intuition—whereas the categories of modality express the relation of our finite

thought to those phenomena, for which the other categories have provided the structures of objectivity.[62] In other words, while the first three registers of categories enable the constitution of an experience with appearing objects, the last one simply expresses the fact that this experience is experience *for a finite subject;* it reflects on these phenomena the constitution of the subject's faculty of knowing. This is why possibility and existence are categories that never concern the object, but always the relationship it may have to the subject's power of knowledge; this is also why an investigation of reflective judgment, as carried out in the third *Critique*, would primarily concern the categories of modality, if one remembers that reflective judgment judges the phenomenon *insofar as it comes to reflect on the essential constraints of our knowledge* (see above, §3.2). This explains the presence in the book of this §76, a "remark" devoted to modality. It is here that the notion of "reflection" reveals its profound meaning for critical philosophy, which includes the contribution made by *Critique of the Power of Judgment* to the definition of this term.[63]

12.4.4.2 The locus of ideas

One consequence of this must be made clear: to the extent that the modalities concern the relationship to the subject, any reasoning from the possible to the existing is excluded. The unique foundation of the radical proof of God, described in *The Only Possible Argument*. . ., and which was a proof supposedly based on the metaphysical fact that the possible presupposes a ground of the matter of the possible, now collapses because the very notion of the possible has no meaning externally to our finite thinking.[64] This means that the locus of the possible, namely what was classically called "infinite understanding,[65] disappears. Not only does the ontological argument for a proof of God collapse, as the first *Critique* demonstrated with the thesis that "existence is not a real predicate" correlative to this Kantian doctrine of modalities, but also more fundamentally, the idea of a locus of the possibles, of an Other thought that would contain the possibles, or (in Leibnizian terms) the essences, or even the meanings, is ruined, because it is only for our thought that there are possible things.

Thus, the possibles are no longer special beings, posited in an infinite understanding, and which would in some way precede the existing. Even more fundamentally, there is no Other thought that contains the whole of the thinkable and grants it a kind of existence, because the thinkable itself, insofar as it is affected by the modality of the possible, cannot be detached from our faculty of thinking without losing its content. This is one of the major advances of Kantianism, and one in the face of which several later philosophical directions seem to retreat from. Bolzano's logical philosophy, which inspired Frege, comes to mind first. The idea of "meanings in themselves" (*Wissenschaftslehre*), which would be independent of our thinking, and which would become "thoughts" according to Frege (*Logische Untersuchung* I) or "meanings" (*Sinn und Bedeutung*), independent of

the "acts of thought" or "representations" that grasp them, stems from a reluctance to root meanings in our finite thinking, as Kant wanted. Although, after Kant, one no longer speaks of God and divine understanding, yet Bolzano and Frege stand much closer to Leibniz than to Kant, since they assign to thoughts, meanings—and therefore to possibles, if we grant that a *Sach-verhalt* (state of affair) is indeed a possible, i.e., a specific kind of being, distinct both from the existing (what Frege calls "the object" in "Concept and Object") and from a state of mind. Admittedly, Kant is not suspicious of the mentalism or psychologism that Bolzano and Frege criticized (before the Husserlian *Prolegomena*), but he cancelled out the question of the kind of existence to be granted to possibles, relative to that of the existing, because such a question would absolutize what is merely an effect of our finite thinking, namely the emergence of the duality of the possible and the actual.

By restoring consistency to this question, while maintaining the Kantian cancellation of the immediate correlation between the question of the being of the "possible" and divine being, Bolzano and Frege opened up an approach to the possible in terms of "signification" or "meaning." This arose in the philosophy of logic and the phenomenology of Husserl's *Formal Logic and Transcendental Logic,* with the question of circumscribing syntactically correct sentences, then sentences that make sense, then sentences whose meaning can be fulfilled by intuition.

12.4.4.3 The origin of intuitive understanding and the finitude

Yet, on all these points, I have not yet explicated the specific advance represented by *Critique of the Power of Judgment*. Let us first clarify the extent to which an intuitive, i.e., infinite, understanding can emerge from and within our finite thinking. Kant states that this is a requirement of our reason, which he presents in the following terms. That the claims (set out above, on the possible and the existing) "do not possess a value for things in general, is what clearly results from the incessant demand of reason to admit something (the original foundation, *Urgrund*) as existing necessarily without condition, and in which possibility and actuality must no longer be distinguished at all, and for which our understanding has absolutely no concept, i.e., cannot discover any way in which it should represent such a thing and its way of existing" (§76, p.402). The distinction between the possible and the actual, a consequence of the finitude of our thought, implies, insofar as it is not absolute but precisely relative to such finitude, *the thought of an instance where this distinction no longer applies.* The Dialectic of the *Critique of Pure Reason* had determined the requirement of this original understanding on the basis of the principle of complete determination (Chapter 5), as the transcendental support of a whole of possibilities (this principle grounding ultimately the notion of an unconditioned in the disjunctive synthesis, which corresponds to the Idea of God). Here, its status is further clarified:

the *Urgrund* arises from our finite thinking's relation to the difference between the possible and the actual. Because this distinction, once again, phenomenologically translates the structure of our finite thought, it calls up a background of indifference on which it can detach itself as a distinction, or more precisely, it causes it to arise from it, just as shadow alone causes light to appear.

But precisely, this background is only an empty instance X: as the reverse side of our finite thought (Kant says: "faculty of knowledge"), it cannot be thought according to its forms; for my thought can only *represent* it *as possible* either by forming a concept of it, or, if it were given to me in intuition, *have* it *present as existing*—but in both cases, the instance X would be present to me under the alternative of possibility and existence, even though it is the cancellation of this alternative. "Therefore," Kant concludes, "the concept of an absolutely necessary being is undoubtedly an idea of reason, but for the understanding it is an inaccessible problematic concept" (§76, p.402). I can only think this instance X because thought appears to me as contingent: nothing in my faculty of knowledge indicates that the separation between understanding and intuition is of the essence of all thought, *so* I can presuppose an Other thought where it does not take place other words, I can think the instance X of indifference between possibility and existence.

This instance X, where possibility and existence cancel each other out, arises for the reflective faculty of judgment as an instance where the difference between mechanism and purposiveness disappears. Such an envelopment within teleological reasoning of a reference to a supra-sensible instance where mechanism and purposiveness coincide had proved to be constitutive of teleological judgment (§2.1). We now understand that this supra-sensible reference in teleological judgment is based on the emergence of an instance of In-Difference within the very reflection of finitude. This reflection makes teleological judgment possible. This marks the most original emergence of infinite understanding (intuitive, etc.), in the process by which finite thought gives rise to the image of an Other thought, in which its reflection forges the guiding concept of reflective judgment, namely, purposiveness. Purposiveness implies a reference to the (empirically impossible) unity of purpose and mechanism, because the notion "purposiveness" is constituted in a mirror game in which an infinite understanding emerges as a reflection of finitude.

The contribution of the third *Critique* to the question of modalities thus consists in showing how this infinite understanding, undone by the Kantian thesis on modalities, emerges at the very heart of finite thought. After the first *Critique*, the *Critique of the Power of Judgment* presents it as a "demand of reason" (§76), and grants its three forms, namely three figures through which an Other thought is invoked as an instance of In-difference, and which are tied to the three faculties of the mind: faculty of knowledge (theory), faculty of desire (practice), feeling of pleasure and displeasure (hence reflective faculty of judgment and teleology). Later, §77 captures the emergence of these forms at the heart of thought, by

summarizing their advent in the course of the *Critique of the Power of Judgment*: let us return to them in detail one last time.

First of all, the reference to a creative understanding in the teleological judgment was practicable precisely because it was neutralized, the analogy with a technique of creation being suspended in the very use of the language of purposiveness as employed in the theory of organisms (see Chapter 9, §3). In the teleology of organisms, then, the Other (infinite) understanding intervenes in the reference to a super-sensible as a substrate of organismic phenomena, which can eventually conjoin mechanism and purposiveness (see §2.1). This is the instance of indifference referred to in §76 under its third figure, which comes into play here. But we also find such an Other understanding in the transcendental presupposition of the reflective faculty of judgment, when it conceives as purposive the fit between nature and our understanding *vis-à-vis* the particular laws of nature.[66] However, these two figures of the Other understanding, correlative to the two uses of the concept of natural purposiveness (organisms; nature's purposive fit), can only be constituted through the reflective movement that Kant then described—here analyzed—whereby our understanding (starting from the universal–analytic) thinks the thoughts it lends to an intuitive understanding (starting from the universal–synthetic) and produces in this reflection the very meaning of purposiveness.

In other words, our thought, due to its structural particularity-namely, the contingency within it of the relation of the parts (of a signification) to (its) whole, or of the universal to the particular—gives rise, through the reflection of this contingency, to the image of an Other thought in which this contingency would be suppressed. *In this Other thought*, existence and possibility are indifferent. Conceived by our thought, the meanings thus reflected are teleological meanings, in the two forms of the concept of organism and of the transcendental presupposition of the reflective power of judgment.[67]

This teleology is *necessary* in that it imposes itself on every finite power of knowledge. It therefore has a reflective, i.e., intersubjective, universality. The universality of reflection is correlative to a necessity that is no longer that of natural laws. As we have seen, emergent biology posits this reflective necessity for vital processes. It is now added to the two Kantian necessities, the purely logical and the transcendental, which is correlated with the conditions of possibility of experience. The purely reflective necessity of teleology, coordinated with a natural purposiveness whose status is regulative, connotes a universality that is only reflexive, i.e., valid only for those subjects whose faculty of knowing requires such regulation, and deriving precisely from the constitution of that faculty.

Correlatively, biology is characterized by a level of necessity of its own, a necessity whose sign is the fundamental circularity of the vital phenomena that we have seen to be for Kant part of the meaning of organicity. Such a sign was later attested by the operative use of the organism in both Bichat's experimental physiology and Cuvier's comparative anatomy (on that, see Chapter 11). For

Kant, biology thus marks a third level of necessity, above the analytic necessity of the form of judgments, and the real necessity realized by the a priori synthetic principles of understanding. According to this necessity, the eyes of a mammal *ought to* see—even if they are blind—as all biologists can attest.[68] This is the same necessity that applies to physiological functions and the embryogenetic development of an organism, namely, the normative necessity of the norms of the living, represented in the teleological principle of the reflective power of judging.

We thus see how *the contingency of the relationship between the universal and the particular*, or between the whole and the parts in our understanding—a contingency which defines the fact of its discursivity—becomes, through its reflection in the reflective judgment, the transcendental origin of the notion "purpose, and, beyond this, of the Kantian rearrangement of the relationship between the category of possibility and the infinite understanding, as well as of *the ternary distribution of the category of necessity*. This, in turn, enables us to understand the fate of the other two categories of modality that I had left out of my treatment of the modality problem, namely necessity and its correlate, contingency.

I had shown how the question of contingency—the place of contingency in being in general and, before that, the very meaning of the concept of contingency—was at the heart of the problem of order as investigated in *The Only Possible Argument*. . . (Chapter 3); I had shown how the formula "lawfulness of the contingent as such" made the critical elucidation of the meaning of purposiveness the methodical entry point into this question (Chapter 8). I will now, by involving the general issue of modalities, identify the significance of the third *Critique* as a treatment of this problem of contingency, which is the horizon of the problem of purposiveness (§4.5). Finally, based on considerations on the role of reflection as it eventually appears in the third *Critique*, I will show how the very definition of critical activity emerges enriched and clarified by these developments (§5).

12.4.5 Contingency

The Leibnizian construction fails to account for contingency at the level of divine decrees; or rather, we have seen how the concept of contingency could hardly be formed from the very requisites that allowed us to distinguish between hypothetical and absolute necessity, and to confer meaning on a necessity that is not defined by the impossibility of the opposite. Throughout his work, Kant's considerations of order and system have appeared to me as a discussion of Leibniz and such difficulties inherent in Leibnizian thought. Let us see how this explication is resolved in the *Critique of the Power of Judgment*, and the light that such a consideration finally sheds on the concepts of necessity and contingency.

The fourth Antinomy in the first *Critique* had shown the inanity of the question of the contingency of the world, and of deducing from it a necessary being.

Kant's argument rested on the distinction between the concept of contingency as a *pure* concept and its *empirical* applicability through which it acquires its meaning; on the first level, no knowledge can be produced. Correlatively, as the "transcendental ideal" section shows, the concept of an absolutely necessary being cannot have an object, because necessity itself is meaningful only in relation to a possible, and therefore conditioned, object of experience.

Let us first examine these two correlative arguments in detail, then consider the contribution of *Critique of the Power of Judgment* to the general problem of contingency. The text of *Critique of Pure Reason* debunked the proof of a necessary extra-mundane being on the basis of the contingency of worldly events:

> The contingent, in the pure sense of the category, is that whose contradictory opposite is possible. However, we cannot conclude from empirical contingency to intelligible contingency. What changes is that whose opposite (the opposite of a state) is real at another time, and therefore also possible; consequently, this state is not the contradictory opposite of a previous state, which is why it is required that, at the same time as the previous state was, the opposite of this state could have been in its place, which can in no way be concluded from the change. A body that was in motion = A goes to rest = not A. Now, from the fact that a state opposite to state A follows it, we can by no means conclude that the contradictory opposite of A was possible, and consequently, that A is contingent; for this would require that, at the same time that motion took place, rest could have existed in its place. Now, all we know is that rest was actual in the following time, and therefore that it was possible. But beginning at one time and resting at another are not contradictory opposites. The succession of opposed determinations, i.e., change, therefore in no way proves contingency according to the concepts of pure understanding, and therefore cannot lead, according to these pure concepts of understanding, to the existence of a necessary being. *Change only proves empirical contingency*; i.e., that the new state, by virtue of the law of causality, could not have occurred at all by itself, without any cause belonging to the previous time
>
> (CRP, A460/B488, my emphasis)

The Kantian distinction between the *pure* concept of contingency and the *empirical* concept of contingency concerns *time*. Contingency, as it would be thought by a pure understanding, consists simply in being able not to be, or not to be as it is, i.e., to be such that its non-being, in other words, its contradictory opposite, is possible. But if I want to apply this concept, I have to apply it to objects that can be *given in an intuition*, that is, objects *in time*. Now, when it is transformed, a state of affairs does not indicate that its non-happening is possible, or rather, this transformation indicates that such a non-happening is possible at another time. If A takes place at an instant t, we cannot say that it is possible for non-A to take place at the same instant t, because to do so

we would have to have already decided on the necessity, or otherwise, of the causal series that links A, at instant t, to all antecedent states of affairs. But this decision is challenged by the argument of the antinomy thesis; more precisely, such a decision, insofar as it concerns a totality of intuitions that is not given, is insoluble by the very reasoning of the Dialectic. So, with respect to a state of affairs A, we cannot assert that, outside the conditions of time, this state of affairs is contingent, i.e., could not be; we can only assert a weak concept of contingency, "empirical contingency," according to which non-A is possible *at another time*. That non-A at time t' is possible is not the contradictory opposite (*kontradiktorisches Entgegengesetzes*)[69] of A at time t, because the two things can subsist together. More generally, we cannot prove that the contradictory opposite of A is possible because of the fact that our objects exist in time. For us, intelligible contingency is an empty concept; we can only use the empirical concept of contingency, whose scheme in this text appears to be *change*. "X is contingent" means that X has changed; and then, its change is caused by something (given that everything stands under the laws of nature). To this extent, Kant's analysis of contingency matches what Beatty (2006) proposed as a clarification of the concept of contingency: one should distinguish between absolute contingency ("X is contingent" means "It is possible that X does not exist") and relative contingency, namely the phrase "contingent upon." In the latter sense, "X is contingent" means "X has a cause, therefore if the cause were not there, X would not be there." This second meaning is the "empirical concept of contingency" considered by Kant.

This demonstration has two consequences.

The first is the difference between the Kantian understanding of contingency and the Leibnizian one. For Leibniz, contingency ultimately pertains to the conceptual order, since it means the innumerable infinity of the binding of a predicate to the subject;[70] for Kant, the only concept of contingency that has objective validity, namely the empirical concept, is not about relations between concepts, but about relations between intuitions of objects thought by these concepts. There are no purely conceptual relations that allow us to conclude that there is an empirical contingency, and concerning intelligible contingency, it cannot be stated in relation to any object.

The second consequence concerns the concept of necessity. If contingency is to be used as an empirical concept, then the same applies to necessity. This means that this category cannot be used in an absolute sense: no being can, based on its mere concept, be declared necessary.[71] In other words, there is no such thing as an inherently necessary being. This is the decisive moment in the critique of the ontological argument for God. The determination of the categories of modality as qualifications of the relation to the subject's faculty of knowing obviously implied that necessity itself could not be the pure predicate of an object considered in itself, in other words, that the concept of a being necessary *per se* is empty (*Progress of Metaphysics,* Ak. XX 303).

Like possibility and existence, necessity and contingency are therefore categories that not only depend on our faculty of knowing but also characterize the modes of dependence of objects on our faculty of knowing. We cannot say that a thought in general (without specifying that it is infinite or finite) would view objects as necessary; thus, in speaking of the necessity of a priori synthetic judgments, Kant attaches to "our understanding" the precision: "in which we find a concept such as that of necessity."[72] And precisely because they express the contingent constitution of our understanding, these concepts—necessity, contingency—only make sense when used in the conditions under which our understanding can provide us with knowledge, i.e., in relation to other intuitions, in other words, as the "empirical concepts" of necessity and contingency.

That contingency and necessity, as connected in their meaning to our faculty of knowing (since they characterize the relation to the subject), must be reconceived according to their origin within the finitude of this same faculty of knowing, has become clear with the third *Critique*. We can now measure the contribution of this work to the requalification of the problem of contingency as approached by Kantianism. For a minimum of clarity, this requires me to take up certain points from previous analyses.

Let us recall that the question of order in *The Only Possible Argument. . .* arose from the difficulty raised by the status of contingency in Leibniz's system. At the time, Kant could not entirely shake off the threat of a Spinozist or Maupertuisian necessitarism. The apparatus of the "Appendix to the Transcendental Dialectic" had then presented an initial notion of purposiveness, but the question of contingency was eclipsed (Chapter 5). We have seen how later the shift of purposiveness from reason to the reflective faculty of judgment allowed one to make the notion of purpose effective by entrenching it within the experience of organisms, and thus to circumscribe the domain of contingency, purpose being the "lawfulness of the contingent as such" (Chapter 8). At the same time, this correlates the establishment of the prerequisites of an autonomous science of the living with that of the presuppositions of the formation of empirical concepts, since this is the prerogative of reflective judgment. In this way, Kant was able to provide contingency a status—that of irreducibility to the universal laws of nature—as well as a rule for thinking about its deployment, through an analysis of "the lawfulness of the contingent as such," according to the formula explained above.

But the meaning of "purpose" was itself traced back to the finite constitution of our understanding, which makes it possible and of which it is the expression. Certainly, purposiveness presupposes contingency; but §77 indicated that the meaning of "purpose" was only constituted in relation to a contingency internal to our thinking, the contingency that separates universal and particular for our judgment, and results from the finitude of our faculty of knowing.

This gives rise to a remarkable result, which can be grasped by noting the use of the term "contingency" in §77: according to the *contingent* constitution of our faculty of knowing, in our thinking the particular is *contingent* for the universal

that is its concept. In other words, there is an original contingency of our faculty of knowing—"we think like this," so to speak, and it is a fact manifested by the contingency of the universal/particular relationship in judgment. The meaning "purpose" makes explicit this original contingency, which we have called finitude.[73]

The iteration of the term "contingency" must be seen in the context of the elucidation of the presuppositions of reflective judgment. We could say that, at the root of this reflection, the contingency of the constitution of the faculty of knowing is reflected in itself as the contingency of the universal-particular relation, from which the notion "purposiveness" is constituted in that other reflective relation I described above, between the Other thought of an intuitive understanding, and the thought proper to our understanding. Therefore, reciprocally, the judgment that concerns the relation of an object to our faculty of knowing, insofar as this faculty has such a reflexive structure as the principle of its possibility of constituting meanings or empirical concepts, is called "reflective." It seems to me that the transcendental investigation here reaches its ultimate point, in the sense that it can no longer simplify such epistemic structure, and it can no longer designate an absolute origin (=intuitive understanding) of thought, other than already reflected, already marked by a contingency that it cannot deduce or reduce by ascribing it a locus in a metaphysical system.

Thus, let us clarify my view here. If modalities only impose themselves on our finite faculty of knowing, and if necessity and contingency are not predicates of things, then we must be struck by a singularity in the Kantian text: the constitution of the concepts of modality, and therefore of "contingency," refers back to the *contingent* constitution of our faculty of knowing. The category of contingency can therefore only be transcendentally elucidated by presupposing it in this elucidation. This is a circularity from which Kant not only cannot avoid, but which seems constitutive of the very concept of contingency. The most original contingency is that of our (form of) thinking, because it is from this that the concept of contingency itself—as with all other modalities—can take on meaning. Even before saying that modalities express the relation of the object to the subject's faculty of knowing, we must presuppose that we pre-understand the meaning of "contingency" in order to be able to speak of the contingency of our faculty of knowing. Hence, the impossibility of reducing the contingency I have just been talking about.

So, *first of all,* to decide for or against the "contingency *of what is"* proved absurd, not only because the Fourth Antinomy has shown this, but more simply and radically, because contingency is only ever a form of the finitude of our thought. The aporia of Leibnizian metaphysics, in which contingency is both required and unthinkable, and which gave its impetus to the problem of necessary vs. contingent order in *The Only Possible Argument. . .*, is thus overcome.

But, *second*, precisely because the concepts of modality are traced back to the contingency of our faculty of knowing, the question of the status of contingency as

a concept is taken over by the investigation of the forms of meaning throughout—as reflective meanings—the contingency of our thinking is made explicit, i.e., above all "natural purposiveness", which applies to organisms.

The fact that thought produces in itself, through the reflection of its finitude, the ability to think of life, is what both develops and eliminates the problem of contingency in metaphysics. "Develops," because the question of the contingency of an order is transformed into that of the rules of application of a teleology. "Eliminates," because instead of an ontological question on the necessity or contingency of what is, when we carry out the most radical investigation of the concept of contingency, we find an interrogation upon the emergence, within thought and from its most intimate nature, of the possibility of thinking life; in other words, upon the reflection of thought in life. The Kantian theory of modalities (in the first *Critique*) provided a solution to the status of *the possible in general*; the theory of purposiveness in the third *Critique* resolves the Leibnizian problem of the status of *contingency* in metaphysics.[74]

12.5 Criticism and contingency

On this basis, one could describe critical philosophy as the investigation of the forms of contingency in our thinking. This determination results from *Critique of the Power of Judgment*, which appears as the culmination of the critical enterprise.[75] To demonstrate this, I need only follow a Kantian indication. In a famous letter to Reinhold, in which Kant announces the writing of a "*critique of* taste" that would become the third *Critique*,[76] he writes:

> For the faculties of the mind are three: the faculty of knowledge, the faculty of feeling pleasure and pain, and the faculty of desire. I found a priori principles for the first in the *Critique of Pure* (Theoretical) *Reason*, and for the third in the *Critique of Practical Reason*. I was also looking for them for the second, and although I had once considered it impossible to find them, I was nevertheless *put on this path by the systematicity that the analysis of the faculties previously considered had led me to discover in the human mind*, and which will provide me with sufficient material to admire and explore, as far as possible, for the rest of my life.[77]

The *systematicity of the faculties of the mind* is therefore the guiding thread that allows us to pursue the critique, in the sense of the transcendental analysis of the a priori presuppositions of the exercise of our faculties. But then, such a thread should be confirmed in its reality: in other words, for criticism to be able to follow such a thread, it must be solid, robust. This means that the systematicity of the faculties, and thus beyond that, systematicity *as such,* must be ensured. Now, to understand the legitimacy of this assurance is precisely the aim of a critique of the reflective faculty of judgment, as set out in the introduction to

Critique of the Power of Judgment. Hence what I wanted to establish: only a *Critique of the Power of Judgment,* by deducing the transcendental presupposition of purposiveness yielded by the reflective faculty of judging, and by grasping the constitution and legitimate use of the concept of purpose itself, justifies systematicity and thereby ensures in return that critical philosophy's guiding thread was not illusory. In the third *Critique,* Kant's criticism eventually finds the guarantee of its method; to be precise, the reassurance of being able to give itself a method.

As we have seen, this guarantee rests on an investigation of the consequences, for our judgment, of the very form of our thinking. In this sense, criticism can only confer its own legitimacy, that is, can only ensure that its movement is well-founded, by investigating the contingency of our thought. The contingency of our thinking was already on the horizon of the *Critique of Pure Reason* when Kant pointed out that there is no need to ask why space and time are the two forms, and the only two, of our sensibility. But with *Critique of the Power of Judgment*, the contingency of thought is itself the issue at stake; and Kant then shows how cardinal significations themselves—beauty, (self-)organization, the sublime—are generated by our thought as given to itself (i.e., as contingent in form), and reflecting this contingency.

If philosophy is to be critical rather than metaphysical, as Kant says, this means that it must no longer talk of "being," and thus deal with an absolute thought in which being would be both thought and thinkable, but rather analyze the meanings imposed on our thought by the fact that it has such a peculiar contingent form—the meanings by means of which "being" can be grasped. This is undoubtedly the ultimate lesson of the above-mentioned sign of the transition from metaphysics to criticism, namely, the suppression of a divine understanding. More generally, the shift of the question of the contingency of being toward the analysis of the presuppositions of the knowledge of life, and the highlighting of the genesis of the meaning "life" itself in the reflection of finitude, was the movement by which Kant achieved the transition from what he calls metaphysics to critical philosophy.

For all these reasons, I said that the third *Critique* defines criticism as the investigation of the contingency of thought. Of course, the first *Critique* ultimately connected all the a priori to human finitude, in the sense of the originary cleavage between concept and intuition. But here, fundamentally, finitude itself—the contingency of the constitution of our thought—is at the very origin of the cardinal meanings of reflection, because it is what is reflected in the process of the constitution of these meanings.

The *Critique of the Power of Judgment* thus confirms the result of the *Critique of Pure Reason*, but goes further by indicating how the finitude of thought produces a priori meanings in its reflection.[78] In this way, life acquires a fundamental role in the renewed philosophy of critical activity. It is the first *objective* meaning of the reflection of finite thought in itself (since beauty is *subjective* finality, as we know). This is why any investigation of the contingency of thought should

be interested first and foremost in the use of this meaning, in other words, in the ways in which our thought thinks about organic life and life manifests itself to thought.

Criticism necessarily brings to the forefront of philosophy the question of the relationship between thought and life. This transformation, pointed out in §4.5,[79] finds its ultimate justification in the becoming-criticism of philosophy, and in the ultimate determination of criticism that the third *Critique* has enabled us to posit. Kant was able to accurately grasp key moments in the constitution of the concept of organism, and draw out its presuppositions, because the transformation of metaphysics into critical philosophy ultimately put the consideration of life at the center of criticist activity, insofar as the concept of "natural purpose" was constituted throughout the reflection of finitude, and finitude, as the contingency of the form of our thought, imposed itself at the heart of the criticist concern. Eventually, the Kantian connection between life and *finite* thought could also be seen as a philosophical clarification of the movement mentioned in the previous chapters, detectable in Cuvier and Bichat, and according to which life as an object of knowledge can only be said, read and thought through the mediation of death, this indubitable figure of our finitude.

Notes

1 See Chapter 1 and DM, §XII and §XVIII ("Now this force is something different from the magnitude and figure of motion, and we can judge from this that all that is conceived in the body does not consist solely in extension and its modifications, as the Moderns think."). And also: "Those who want extension itself to be a substance, reverse the order of words as well as thoughts. In addition to extension, there must be a subject, which is extended, i.e., a substance to which it belongs to be repeated or continued. For *extension* signifies only a repetition or multiplicity of what is spread, a *plurality, continuity, and coexistence of parts*; and consequently, it does not suffice to explain the nature of the substance spread or repeated, whose notion is prior to that of its repetition" (*Letter in support of the June 18, 1691 article in the* Journal des savants).

2 "But the path of the finals is easier [than the path of efficient causes], and is often useful for guessing important and useful truths that would take a long time to seek by this other, more physical route, of which anatomy can provide considerable examples. I also believe that Snellius, who first invented the rules of refraction, would have waited a long time to find them, if he had first wanted to find out how light is formed. But he apparently followed the method the Ancients used for catoptrics, which is indeed by the finals" (*Discours de Métaphysique*, §XVIII).

3 This unity is conceived in particular in *Instauration d'une physique nouvelle*. Later, in the final formulation of his philosophy, articulated around the concept of the monad, Leibniz expresses this as follows: "And the perceptions in the monad arise from one another by the laws of the appetites or *Final Causes of good and evil*, which consists in remarkable perceptions, regulated or deregulated: as the changes of bodies and phenomena outside arise from one another by the laws of *efficient causes*, that is, of movements. Thus, there is perfect harmony between the perceptions of the monad and the movements of bodies, pre-established first, between the system of efficient

causes and that of final causes, and it is in this that the agreement and physical union of soul and body consists, without one being able to change the laws of the other" (*Principes de la Nature et de la Grâce,* §3). The distinction between final and efficient causes is now formulated, in monadology, on the basis of the monad's internal distinction between perception and appetition; and appetition is indeed the principle of the connection between perceptions, of the passage from one perception to another; hence, the subordination of the efficients to the finals. On the steps in Leibniz's thinking on mechanism and finality, see Fichant (1998, pp.163–204).

4 We need to keep this reversal in mind, to avoid reading an anticipation of the Kantian unity of mechanism and teleology in Leibniz's crucial text on the convergence of the two methods to explain the organism: "I even find that many of nature's effects can be demonstrated in two ways, namely by considering the efficient cause, and again separately by considering the final cause, for example by making use of God's decree to always produce his effect by the easiest and most determined ways, as I have shown elsewhere in explaining the rules of catoptrics and dioptrics, and will say more about this shortly. It is worth making this remark to reconcile those who hope to explain mechanically the formation of the first weave of an animal, and of the whole machine of parts, with those who account for this same structure by final causes. Both are good, both can be useful, not only for admiring the artifice of the great craftsman, but also for discovering something useful in physics and medicine. (. . .) The best thing would be to combine the two considerations, for if it is permissible to use a rough comparison, I recognize and exalt the skill of a craftsman not only by showing what design he had in mind in making the parts of his machine, but also by explaining the instruments he used to make each part, especially when these instruments are simple and ingeniously designed. And God is skillful enough to produce a machine a thousand times more ingenious than that of our body, using only a few simple enough liquors purposedly formed in such a way that only the ordinary laws of nature are needed to unravel them as required to produce such an admirable effect, but it is also true that this would not happen if God were not the author of nature" (*Discours de Métaphysique*, §§XXI–XXII). The whole Leibnizian construction rests, of course, on God and the technical metaphor, which we have seen Kant neutralize. Admittedly, Kant takes up Leibnizian language (efficient and final, the problem of their concurrence in explanation, etc.), but the distance in concepts is the same as that between the organism—as a set of tools in classical and galenic physiology, where Leibniz still finds his examples and models—and the organism of modern biology-physiology, whose constitution we are studying. (On the Kant-Leibniz difference on this point, see Huneman 2005).

The text quoted in the previous note, from the *Principes,* brings to this a reinterpretation of the contest of the efficient and the final in terms of pre-established harmony (the *Nouveau Système* was written ten years later than the *Discours*) and of the monad-phenomenon distinction, or more precisely, of the distinction internal to the monad between appetition and perception. But it is all about the same distinction, the same unity of the substantial and the phenomenal, the metaphysical and the geometrical. This unity of "efficients and finals," Leibniz thinks of it as the harmony of soul and body, or life and matter, in the following text: "everything in bodies takes place mechanically, i.e., according to the intelligible qualities of bodies, which are magnitudes, figures and movements: and everything among animate beings must be explained vitally, i.e., by the intelligible qualities of the soul: perception and appetite. Moreover, we discover that there exists among animate bodies an admirable harmony between life and mechanism, so that what takes place mechanically in the body is represented vitally in the soul, and the execution of what is exactly perceived in the soul is fully demanded of the body." ("On the Principle of Reason," Couturat 12,

Textes logiques et métaphysiques, p.473.) The essays against Stahl develop this second thesis on harmony at length, as we saw in Chapter 1, but we should note here the identification of the vitality and the reign of final causes.

5 *Principes de la Nature et de la Grâce*, §15. On these notions (monarch, architect), Burgelin sees in the architect a Platonic tradition stemming from the *Timaeus*, and in the monarch a more Christian theological vision. "In the order of *doing*, God shows himself as architect, which is less reminiscent of the Bible than of Plato's *Timaeus*, whereas in the order of *acting*, God manifests himself as monarch, an image that is certainly also evoked by the royal soul of Zeus in the *Republic*, but which corresponds better to the biblical concept of the sovereign God" (Burgelin 1968, p.221). God thus unites the concern for singularity and that for universal harmony: "God is an aesthetic demiurge who governs the world by universal laws, even if one distinguishes a hierarchy of dignities among creatures, he puts harmony above all else. *Deus sive harmonia*," wrote Leibniz in his youth. But God is also the one who, in the Gospel, cares for every creature; he is Providence and he is Grace" (Burgelin 1968, p.225).

6 "But if we demand to show what drives us and furthermore authorize us to complete in this way (*jene Ergänzungen zu machen*) [the merely regulative and indeterminate concept of the original understanding according to physical teleology, in order to obtain the concept of God], we shall look in vain for a basis for our justification in these principles of the theoretical use of reason, which absolutely requires that, in order to explain the object of experience, we attribute no more properties to it than we find empirical data for their possibility. Closer examination would show us that, strictly speaking, an idea of a supreme being, based on an entirely different use of reason (the practical use), is found as an a priori foundation in us, and that it is this idea that drives us to complete the defective representation that a physical teleology makes of the original foundation of purposes in nature by going as far as the concept of a divinity, and we would not falsely imagine that we have established this idea and with it a theology thanks to the theoretical use of reason in knowledge of the physical world, still less that we have demonstrated its reality" (§85, p.438).

7 "Now I say that physical theology, however far it may be pushed, can nevertheless reveal nothing to us about a final purpose of creation; indeed, it does not even rise to the question that concerns it. No doubt it can justify the concept of an intelligent cause of the world as a subjective concept—the only useful one in relation to the constitution of our faculty of knowing—of the possibility of things, which we can explain to ourselves by ends; but it cannot further determine this concept, either from a theoretical or a practical point of view; and its attempt does not realize its purpose, which is to found a theology, but remains always and only a physical teleology, because here the final relation is and must always be considered only as conditioned in nature; it cannot therefore even question the purpose for which nature itself exists (whose foundation must be sought outside nature), whereas it is on the determined idea of the latter that the determined concept of this supreme cause of the intelligent world and consequently the possibility of a theology rests" (§85, p.437).

8 Kant thus returns to the Hume of the *Dialogues on Natural Religion*. For Hume, the argument of physical theology is an analogy (world-work, craftsman-God), whose structure remains dubious. In particular, the relative perfection of the world does not strictly allow us to prove by analogy the absolute perfection of its creator. The strangeness of the quantitative leap in analogical inference was noticed by Hume: from the point of view of the infinity of divine attributes: "how can an effect which is either finite, or so far as we know susceptible of being finite, how can such an effect, I say, prove an infinite cause?" (§IX).

9 The "difficulties surrounding the teleological path to philosophy" are precisely, as Kant diagnosed in a letter to Jacobi, what "probably decided Spinoza to build his system" (Letter, August 30, 1789, n°375), a system that prevails over physical-teleology, because it sees its inadequacies and presents itself as an attempt to remedy them; this attempt fails in turn.

10 The "General remark on teleology" states this explicitly: "the moral proof of God's existence does not, strictly speaking, simply *complete (ergänzt*) the physical-theological proof to make it a finished proof; rather, it is a particular proof, which *supplements (ersetzt*) the lack of conviction resulting from the latter: insofar as the latter in fact can do nothing other than direct reason in judgment on the ground (*Grund*) of nature and its contingent order, albeit worthy of admiration, which can only be known to us through experience, towards the causality of a cause, which contains its ground (*Grund*) according to ends (a cause which we must think of according to the constitution of our faculties of knowing as an intelligent cause), and this in a remarkable way, so that it is more receptive to moral proof. Indeed, all that the latter concept requires is so different from all that natural concepts can contain and teach, that it needs a particular argument and proof (*Beweisgrund*) quite independent of the former, in order to provide in a manner sufficient for a theology the concept of a supreme being and to conclude to its existence" (p.478).

11 By way of historical clarification, we might mention Zammito's claim (1992) that the Methodology of Kant*'s Critique of the Faculty of Judgement* was written during the pantheism quarrel, which, as we know, was about the inescapability of Spinozism for any rationalism.

12 On the concept of purpose in the esthetics, see Zuckert (2007, chapter 7) and Lebrun (1970, part II).

13 §11, Ak. XX, p.246. See also the commentary on this passage in Cassirer (1938, pp.171ff).

14 One should always be reminded that lawfulness according to Kant refers to the necessity which is prescribed by reason, as Ameriks (2018, p.43) makes clear: "'Lawfulness' as such just is necessity in the strict sense, which is the sense that Kant holds cannot be justified by any mere exposure to uniform sensory data or other contingent factors such as ultimately arbitrary social or supernatural forces."

15 Sloan (2002, 2006) notes that this difference between the sciences is often marked in Kant's differentiated use of *Naturlehre* versus *Naturwissenschaft*; nevertheless, there is nothing systematic about the use of these words.

16 The problem does not arise for *subjective formal* finality, as used in aesthetic judgment, because it is not empirically conditioned, it is contingent upon the fact of beautiful objects; in other words, beauty seems more easily inherent in judgment, as concerning the subject's relationship to the object, than the material purposiveness of organisms; this is why the idea of beauty can less easily be mistaken as constitutive. See Zammito (1992), Dumouchel (1994), and Zuckert (2007).

17 Victoria Wike pointed out that this antinomy, which, like those of theoretical reason in the first *Critique*, is resolved by clarifying the relationship between objective and subjective, pits assertions against each other through apagogic proofs (Wike 1982, p.28; see also Al-Azm (1972) for a study on the origins of the Antinomies).

18 Or again: "it is also indubitably certain that in relation to our faculty of knowledge the simple mechanism of nature can provide no principle of explanation for the *production (Erzeugung)* of organized beings" (§71, p.389).

19 For a discussion of the interpretation of regulative vs. constitutive in this text, see the Introduction to Huneman (2007, pp.9–11).

20 Among the commentators, Körner (1990, p.208) holds that both maxims are reflexive; he draws a parallel with light in modern physics, which can be considered, depending on the context, as a wave, or as a stream of particles, without these two perspectives being incompatible.

21 For Körner (1990, p.209), this is the resolution of the conflict between mechanism and teleology. Or rather, there can be no conflict, since Kant has established a "mechanistic" metaphysics, that of the *Metaphysical Foundations of Natural Science*, whereas there can be no teleological metaphysics, since teleology can only be the object of criticism. There is therefore no conflict between a mechanistic metaphysics and a supposedly teleological metaphysics.

22 The whole *Critique of the Power of Judgment* attests to the fact that the reflective judgment—finding the rule for the case, as we are too quick to say—is a judgment that turns toward the subject's thought, that exhibits something of the subject to itself. Here, like Hegel later, Kant exploits the double meaning of the word "reflection." Obvious in aesthetics—the beautiful is a character not of the object, but of the relationship between object and subject; in the sublime, the subject grasps his own moral force as superior to all natural resistance—this dimension is also present in Kantian teleology.

23 "When it comes to one and the same thing in nature, the two principles (*Prinzipien*) as grounds (*Grundsätze*) for explanation (deduction) cannot be linked, i.e., they cannot unite as dogmatic and constitutive principles (*Prinzipien)* of the intellection of nature (*Natureinsicht*) for the determining power of judgment. (. . .) Indeed, one mode of explanation excludes the other, even supposing that objectively both foundations of the possibility of such a product rest on a single foundation, and that we take no notice of it." (§78, pp.411–412).

24 McFarland (1970, p.130) rightly notes the difference between this solution of the antinomy of teleological judgment by the common reference of the principles to the suprasensible, and the solution of the third antinomy in the first *Critique*, opposing freedom and natural necessity, which is resolved by referring each of the maxims, one to the suprasensible, the other to the phenomenal. Renate Wahsner overlooks this fundamental difference and equates the two antinomies (Wahsner 1993, p.22). On this point, McLaughlin (1990, p.178) adds that in the third antinomy we have a kind of "direct access" to the suprasensible level in the figure of noumenal freedom, and moral reasons for assigning it causal efficiency in the world of phenomena—whereas these two points do not occur in the antinomy of teleological judgment.

25 "Since we can only have of the latter (the suprasensible) the indeterminate concept of a foundation, which makes possible the judgment of nature according to empirical laws, without being able moreover to specify it by any predicate, it follows that *the union of the two principles cannot rest on a foundation of explanation (*explicatio*) of the possibility of a product according to given laws for the determining faculty of judgment, but only on the principle of exposition (*expositio*) of the same for the reflective faculty of judgment*. Indeed, to explain is to derive from a principle that we must be able to know and indicate (. . .). But if this common objective principle, which justifies the community of maxims of the study of nature that depend on it, is a principle such that it can be well indicated, but can never be precisely known and clearly presented so that a use can be made of it in given cases, then no explanation can be derived from such a principle, i.e., no clear and precise deduction of the possibility of a product of nature according to these two heterogeneous principles" (§78, p.412, my emphasis). This singularity sheds light on the difficulties of interpreting the antinomy we mentioned earlier, difficulties according to which it was difficult

to decide whether the two maxims Kant reconciled were reflective, or whether only teleology was reflective, whereas mechanism was, in the line of the second antinomy, a constitutive principle of determining judgment. This second interpretation is therefore correct, but the first must be granted *that the unity of the maxims should be thought of only within reflective judgment.*

26 "We cannot therefore explain how (. . .) as a principle, nature (according to its particular laws) constitutes for us a system, which can be recognized as possible both according to the principle of production (*Erzeugung)* following physical causes and according to that following final causes; but when objects of nature arise which cannot be thought by us in their possibility according to the principle (*Prinzip)* of mechanism (which always holds for a natural being) without our invoking teleological principles (*Grundsätze*), we can assume that we can confidently study the laws of nature in accordance with both principles (when the possibility of their production is knowable to our understanding from either of these principles*) without encountering the apparent conflict* that arises between the principles of judgment: for at least the *possibility that both can be objectively united in a principle is assured (since they concern phenomena, which possess a supra-sensible foundation)*" (§78, p.413, my emphasis).

27 "In place of what (at least for us) is thought to be possible only according to an intention, we can admit no mechanism, and in place of what is known to be necessary according to it, we can admit no contingency, which would need a purpose as a principle of determination, but we can only *subordinate* the one (mechanism) to the other (intentional technique), which can very well be done according to the transcendental principle of the purposiveness of nature" (§78, p.414, 226, my emphasis).

28 I analyze this generalization of purposiveness in Huneman (2006b, pp.3 ff.).

29 The distinction between kinds of necessities has been recently seen and addressed; see Watkins (2018, pp.6–18), and, very differently, Massimi (2018, pp.153–160), who draws on the distinction between *ratio cognoscendi* (conceptual necessity), *ratio essendi* (real ground, which yields a posteriori necessities such as what scientists unravel when they show that gold has the atomic number 79), and *ratio fiendi*, which inserts those grounds in the network of multiple causes and grounds the necessity of dispositions.

30 Characterizing the kinds of necessity more generally, Watkins (2018) insists that both morality, the aesthetic and nature itself instantiate necessities of different sorts. The necessity proper to the latter is "determination" in the sense that "the body that serves as a cause determines, or makes necessary, the effect, but it does so according to the law of the equality of action and reaction, where it is this law that expresses the necessity of the actions that cause the precise changes of motion in the two bodies in such a way that the acceleration and deceleration are equal and necessarily so" (p.18). The necessity implicit in morality is obligation.

31 Strawson (1995) built his commentary upon the idea that understanding and sensibility provide, respectively, access to the universal and the particular. This reading is legitimate, even though it is not exclusive of others, and confers Strawson's interpretation its distinctive flavor. In any case, the epistemic gap between these two faculties is a basis of critical philosophy.

32 Strawson directly interprets the duality of intuition and concept as that of particular instance and general type: "The duality of intuition and concept is merely the epistemological aspect of the duality of particular instance and general type" (1995, p.48). And p.20: "his word for awareness in experience of particular instances of general concepts is 'intuition'." From another perspective, Gram (1968) builds his interpretation of the *Critique of Pure Reason* based on a "semantic" distinction between concepts

and intuition, according to which intuition is the representation of a particular, and is thereby distinguished from concept. Hence, a judgment is no longer the inclusion of one concept in another, but the affirmation of the instantiation of a concept by a particular represented in an intuition (even if the former theory sometimes survives in Kant): intuition is then no longer, above all, sensation. (See, e.g., pp.65, 72)

33 See Longuenesse (1995) for an analysis of this notion of discursivity.

34 The admission of the possibility of such an intuitive understanding is at the core of the critique of Kant, first, by post-Kantian philosophers, and also by Goethe and Novalis. Nassar (2013) writes that "In order to gain knowledge of nature, we must transform the visible into the invisible, the sensible into the ideal or symbolic. This transformation, however, does not imply—as it does in Kant—a subjectification of knowledge aimed to disclose the principles that underlie and inhere in nature itself—in other words, it seeks to grasp the 'unity' that constitutes, as Goethe puts it, 'the multitude.' For Kant, of course, this was impossible; by contrast, for both Novalis and Goethe, grasping nature's laws and thereby discerning the unity of nature is the essence of knowledge, and this knowledge, according to both, depends on the possibility of non-sensible intuition" (p.61).

35 "I cannot presuppose in every knowing being thought and intuition as two different conditions for the exercise of the faculties of knowing" (§76, p.403).

36 "Certain natural products must, on account of the particular constitution of our understanding, *be considered by us*, according to their possibility as intentionally produced and as ends, without there being any reason to require for this that there is actually a particular cause, having at the foundation of its determination the representation of an end, without denying, therefore, that another (higher) understanding than the human understanding can also find the basis for the possibility of such products of nature in the mechanism of the latter, i.e. in a causal connection, for which an understanding is not exclusively admitted as cause" (§77, p.406).

37 A similar move of thought is ascribed by Guyer to Kant, regarding systematicity as purposiveness, in this paragraph: "while at one level—call it the empirical level—we have to think of the systematic order of nature as existing independently from our always incomplete representation of it in order to think of it as lending necessity to particular empirical laws even when we are not yet in full possession of their systematic context, at another level—call it transcendental—we have to recognize that *the very idea of the complete system and of its source in a supreme intelligence is in fact our own idea*." (2018, p.64, I emphasize the reference to our idea of the source of an idea in a supreme intelligence).

38 On this connection, see Zuckert (2007) on the aesthetics, and Ginsborg (2015), who addresses the question of norms within aesthetic judgment.

39 Letter to Schultz, February 17, 1784.

40 I know that the relation between conceivability and possibility is a hot topic in metaphysics, in that many theses have been argued for. In this chapter, I only deploy a simple analysis likely to expose the context of Kant's shift regarding modalities.

41 For a longer examination of impossible and inexistent objects, see Quine's classical paper "On what there is." Wittgenstein argued at length that thoughts like "triangle with parallel sides" have no meaning, so that they have actually the same status as syntactically impossible statements such as "the or never cheese of."

42 Within the thinkable, Leibniz distinguishes between the possible and the impossible by the criterion of distinction. Thinking of a "triangle with parallel sides," we believe that we are thinking something, but we're thinking confusedly—and the idea dissipates if we make it explicit, because it reveals a contradiction; we were then thinking the impossible. The impossible cannot be thought other than confusedly. "A

term is either possible or impossible. That which can be thought of distinctly without contradiction is *possible*; for example, *being, God, heat, non-being.* The *impossible* can certainly be thought confusedly, but if we try to think it distinctly, we discover that the notions that make it up are incompatible with each other, in other words that it envelops a contradiction. For example: *the fastest movement, the largest circle, a bodily spirit*" ("Definitions of First Terms and First Attributes," TLM 100).

43 The correlation between being thought by a divine understanding and being possible is also supported by Thomas Aquinas: "what is in divine science is not that things are, but that they can be" (*Summa Theologica*, 14, 9, p.105).

44 The present discussion retains a generality that embraces the considerations of Kant and Leibniz as well as more contemporary theories. I will not, therefore, enter into contemporary discussions of possible worlds, which, following Kripke's semantics of possible worlds and the work of David Lewis, have renewed the interest in the question. Lewis's *On the Plurality of Worlds* undoubtedly defined the terms of today's discussion. Indeed, Lewis justifies the need to posit possible worlds in order to account not only for the modality of judgments, especially for conditionals, but also for elementary metaphysical concepts such as causality or property. Lewis's modal realism (the view that possible worlds "exist"), so counterintuitive, is of course highly controversial. Nevertheless, the problems considered here are at the heart of these discussions, and I will recall in passing the extent to which Kantian positions are sometimes reactivated.

45 On "all bodies are heavy" and "all bodies are extended" as examples of synthetic and analytic judgments, see Garver (1969, pp.255–256); the author defends an interpretation of analytic statements as rules of grammar in Wittgenstein's sense.

46 Stegmüller shows how, within the realm of logically possible theories, a priori synthetic principles make it possible to circumscribe theories that are actually possible, thus legitimizing Newtonian theory, even though it cannot be founded purely logically (1977, pp.104, 116).

47 The Second Analogy reflects the second law of Newtonian dynamics, namely, each acceleration is proportional to a force, as many commentators (e.g., Allison, Cassirer, Watkins, Vuillemin) had noted.

48 Schopenhauer would insist on this point in *The fourfold root of the principle of sufficient reason,* stigmatizing Kant's still persistent hesitations and confusions.

49 The point is also made by Leibniz: "If indeed certain possibles never exist, then existences are not always necessary, otherwise it would be impossible for others to exist in their place, and therefore no existence would ever be impossible" (*On Freedom*, Foucher de Careil, 179). In this text, Leibniz admits that the never-realized possibilities are what lead him out of the necessitarian feeling and into the problem of contingency. If all possibilities were realized, existence would be equal to the possible, in other words, a possible being would be existent by virtue of its very possibility, and, therefore, necessary; the word "possible" would have no meaning outside of necessary existence. See Vuillemin (1984, chapter 2).

50 The duality of possibilities was an early Leibnizian preoccupation, as in the aforementioned 1676 text, "On Mind, Universe and God," where he notes "Double origin of impossibility: one from essence, the other from existence or position" (A, VI, iii 464, TLM 18).

51 Written in the margins of a 1677 essay called *Dialogo.*

52 One of Leibniz's most profound differences with the Thomistic model is that God does not create the possible, whereas for Aquinas God was the cause of the possible, since his science causes its objects (*Summa Theologica*, 14, p.8). It is easy for Leibniz to see that knowledge of the possible and knowledge of the existent are not of the same order. Thomistic philosophy was faced with the difficulty that God, through

his science, causes both the possible and the existent; it has therefore to distinguish science which is itself a cause, from science insofar as it causes the existent: "The science of God is the cause of things; for the science of God is to created things what the science of the craftsman is to his works" (*Summa Theologica*).

53 "Necessary truths and contingent truths" (Couturat, 19).

54 Stalnaker (2003), Lewis (1986).

55 *Ethics* I, Prop.33: "Things could not have been produced by God in any other way or in any other order than they were produced"; and prop. 35: "Everything we conceive to be in God's power is necessarily." The scolie of proposition I, 17, affirms that understanding and will in God are not distinct; on this point, Koyré comments on the absence of analogy between human understanding and a postulated understanding in God (Koyré 1971, pp.93–102).

56 There is, of course, another, Spinozist solution, which consists in equating the existing with the possible, by making the possible a mere *ens rationis*. Being is at every moment necessarily all that it can be; there are no possibles outside our imagination. Thus, events and beings follow from the nature of God with "the same necessity" as the property of having the sum of angles equal to two rights follows from the essence of the triangle, which is indeed a logical necessity (*Ethics*, I, p.17). More generally, there are two necessities in Spinoza; not that there is a logical one and a moral or natural one, but we must distinguish between the internal necessity represented in a thing by its own essence, and the "external constraint" that necessarily acts on singular things, insofar as they are determined modes and therefore limited by something else. The absence of the latter, the fact of being subject only to the former, then represents freedom, which no longer presupposes the concept of contingency (see Letter LVIII, to Schuller).

57 The distance from Leibniz is not abysmal, since the Hannover philosopher wrote in 1676: "The only idea of existence that we possess is that we conceive that things are felt. And there can be no other, for existence is contained in essence only in the case of necessary beings. If there were no sentient being, nothing would exist." But the next sentence shows the difference from Kant: "If there were not a primary sentient being, which is also identical with the cause of things, nothing would be sentient" (A VI, iii, 588; TLM 30).

58 For Lewis, of course, possible worlds do "exist"; but it is his concept of "actuality" that coincides with the Kantian concept of transcendentally defined existence, i.e., defined in relation to our faculty of perception.

59 In the sense of the "real of the possible" in *The Only Possible Argument. . .* commented, Chapter 3.

60 "The relation (of an object) to perception is existence; the relation to mere thought is possibility. The relation to thought insofar as it determines existence: necessity" (*Reflection 4299*, XVII, p.500).

61 On the problems posed by receptivity in the Kantian sense and the double assimilation of intuition-receptivity and concept-spontaneity, whereas the transcendental deduction requires a synthesis of intuition, see Longuenesse (1995, chapter 2, "La "triple synthèse" et le modèle mathématique"), and Sellars (1969, p.186): "it is clear that Kant applies the term 'intuition' both to representations that are formed by the synthesizing activity of the productive imagination and to the purely passive representations of a receptivity that is the 'matter' (A86, B108) that the productive imagination takes into account." On the affection involved in receptivity, see comments by Buchdahl (1969, pp.244 ff), for whom "transcendental matter" itself is *affected* by *the* forms of space and time "in the context of the activation of sensibility" (p.245), while sensibility reproduces at the level of experience the contingency of what is in

general "by finding itself (. . .) with this or that sensation," i.e., "is 'affected *by*' what is expressed by the notion of 'transcendental matter' or '*Sachheit*'" (p.247).

62 On this difference, see Walsh (1975, pp.147–148, §27).

63 If we remember that *Critique of the Power of Judgment* is an investigation into the formation of empirical concepts, it is worth noting here George Schrader's interpretation of Kantian concept theory. According to him, and in an undoubtedly Quinean perspective on Kant, the difference between pure concepts and empirical concepts is one of degree, not of kind: the latter are contingent, the former are necessary (Schrader 1957, p.271), because in the empirical concept the content is prominent, whereas in the a priori concept it is the "rule" that is prominent (Schrader 1957, p.273). But the empirical concept is not abstracted from sensible intuition—an operation that is somewhat impossible in the Kantian dualism of concept and intuition. It is a rule too, but a contingent rule compared to those laid down by a priori concepts. I agree with Schrader's conclusion: to investigate the formation of empirical concepts is to investigate contingency, and more specifically, the contingency of the particular relative to the general that defines the form of our faculty of knowing (itself contingent).

64 Commenting on the rigor of a proof of God's existence based on the possible in Mendelssohn's *Preliminary knowledge of truth, appearance of error,* in a letter to Schütz, Kant pointed out that this proof makes it possible to posit the distinction between the real and the possible for things in general, in other words, that it is correlative to the validity of this distinction in itself—so that if criticism relativizes such a distinction, it undoes the infinite understanding. Let us quote the text: "in the presentation of the subjective conditions of the use of our reason, the author finally comes to the conclusion that nothing is *thinkable* unless it is *really thought* by some being, and that, generally speaking, without a *concept* no *object* can really exist (p.303), and concludes from this that an infinite and at the same time active understanding must therefore really exist, for it is only in relation to it that possibility or reality can have any *meaning as predicates of things*" (Letter 256, November 1785). It should be noted that, in line with the account outlined here, Kant refers the question of modalities to that of the thinkability of the thinkable. On the neutralization of the proof of *The Only Possible Argument. . .* in *Critique of Pure Reason,* see Huneman (2019a).

65 But see Chapter 3 for Kant's departure from this notion already in the radical proof of *The Only Possible Argument. . . .*

66 "We must think of another understanding, in relation to which and prior to any end attributed to it, we can represent to ourselves as *necessary* that agreement of natural laws with our faculty of judging, which is thinkable for our understanding only by means of the reason of ends" (p. 407).

67 Whose correlation we have seen, in particular, through the concept of the history of nature—Chapter 9.

68 Hannah Ginsborg develops this analysis, according to which the field of the organism is characterized by a specific necessity that has the character of a *norm*, which may not always be realized (Ginsborg 2001).

69 On this expression, which signifies two mutually exclusive concepts, see CRP B48, on a body that is and is not in the same place.

70 Among other statements: "Of derived [i.e., non-identical] truths, there are two kinds: some are resolved into original truths, others require infinite progress in resolution. These are necessary, these contingent" ("On Freedom," TLM 332). On the calculation of contingent propositions, see Rescher (1981, "The infinite analysis of contingent truth," pp.42–55). The infinite resolution of contingents is a procedure of maximum calculus, by which one investigates whether a predicate maximizes the reality of the possible world to which its hypothetical subject belongs; the divine calculus that

determines *actual existence* by optimizing the amount of essence in the world, and the infinite analysis that tests the *truth* of a contingent proposition, are thus complementary as "different ways of seeing the work of one and the same process" (p.53).

71 Or as W.H. Walsh puts it, "it is not the existence of substances but the existence of their states that is necessary; it follows that such necessity is rather conditional than absolute." (Walsh 1975, p.153).

72 Letter to Marcus Herz, May 26, 1789, letter 362.

73 Recall that, as Ameriks (2018, p.46) emphasizes it, this contingency does not at all deprive the transcendental principles of their own necessity: "But even though the ultimate contingency of the latter forms entails that the principles themselves have a kind of contingent status, these principles are not simply loose statements of general facts but have the special status of being transcendental constitutive conditions; that is, they hold determinatively for all possible experience of our kind."

74 In this sense, I depart from the interpretation by Baümler (1923), who saw the irrational as the central problem unifying the project of the third *Critique.* The two interpretations are certainly compatible, but it seems to me that the third *Critique* completes a process of questioning the fundamental metaphysical meanings of necessity and contingency (in their Leibnizian sense), rather than aiming at the possibility of integrating the irrational (beauty, vitality) into (critically reconstructed) rationalism. This process was already underway in *The Only Possible Argument. . .* Contingency certainly leads to the question of the irrational, of that which does not fit into a rationally comprehensible necessity, and here I agree with the interpretation of Baümler; but I think that the question of the meaning of this category first belongs (systematically, at least) to the endeavor of a critique of metaphysics, and only then (or in the context of the *Atheismusstreit*, the dispute over atheism in early post-Kantism), expands into the "problem of the irrational."

75 The same understanding of the *Critique of Judgment* is shared by Ginsborg recently when she writes: "even while recognizing the importance to Kant of aesthetics and teleology for their own sake, we can attempt to interpret the *Critique of Judgment* as contributing to the understanding of judgement not just in the special sense of discerning aesthetic value or suitability for a purpose, but in the sense relevant to the fundamental question of how cognition is possible" (2015, p. 13).

76 On the delay between this announcement and the actual publication of the third *Critique*, due to the addition of a critique of teleology, see Lebrun (1970, pp.291–292 ff); Guillermit (1986, pp.52–54) states that in this letter teleology is still a doctrine (and not a critique)—to which the critique of taste serves as a propaedeutics.

77 Letter, December 28, 1787, n° 313, my emphasis. It was undoubtedly at the time of his *Observations on the Sentiment of the Beautiful and the Sublime* that Kant considered it impossible to find such a priori principles for judgment.

78 Anselm Model makes "reflection" the pivot of his reading of the third *Critique*, relating this concept to Leibniz's monad as the "living mirror" of the universe. The third *Critique* thus appears as a new monadology, and the increasingly clear role of reflection in the definition of this *Critique* extends Leibnizian preoccupations with the thought of the individual and its relationship to the whole (Model 1987, §3.3.2). However, it is difficult to subscribe to the correspondences established by the author between the paragraphs of *Monadologie* and those of the *Critique* of the teleological judgment (Model 1987, §4.4.1)

79 See also Chapter 5, § on "the organism of reason."

13 Conclusion

> The *actual* organism is the middle term which unites the being-for-itself of life, with the *outer* in general, or with *being-in-itself*.
>
> G.W.F. Hegel. *Phenomenology of the Spirit*. §285.

13.1 Wrapping up the trajectory

My aim in this study was to follow developments in Kantian thinking on living beings, relating them to certain elements in the constitution of the concept of organism. When Kant enunciated the concept of organism—or, of "organized being"—in the *Critique of the Power of Judgment*, he was reflecting on a novel notion that had just been coined and established as the basis of a new body of knowledge, namely, the assumption that vital phenomena should be understood as organisms, that is, as organized wholes (with no soul). I have explored the Leibnizian and Stahlian break with pure mechanism, then the elaborations and debates of Haller and the vitalists on vital properties, correlated with the establishment of a notion of vital force whose operative significance was eventually constituted in the embryological work of Wolff and Blumenbach. Those moments appeared as the main milestones in the formation of such a new notion, and they constituted for me the guiding thread of nascent biology.

All these elements found an echo in Kantian thought, because they were taken into account in his thinking about the specificity of animals and plants for the science of nature, a concern included within more general metaphysical preoccupations with *order*. Wolffian epigenesis represented a particularly important piece in this history. While meditating on the so-called problem of generation, Kant indeed succeeded in sketching a new concept of "natural purposiveness," likely to apply to the living in such a way as to account for its cognizability in a specific type of knowledge. This new concept did not directly involve theology.

In the wake of Buffon's new understanding of biological species, Kant elaborated his theory in his essays on races (Chapter 6), in which he stated the operative use of the concept of purposiveness to solve some of the aporias of the

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science of the living. The *Critique of the Power of Judgment* was then written based on the results of Caspar Wolff's conception of the vital force; the organism in the Kantian sense could then take on an epistemological status of its own, circumscribed by the concepts of "simply reflective judgment" and "regulative principle" (Chapters 8 and 9). Concerning purposiveness, Wolff's transformation of embryology away from the idea of a general physics of the living (Chapter 4) was echoed in Kant's shift between the purposiveness embedded within reason in the Appendix to the Transcendental Dialectic in the *Critique of Pure Reason* and the purposiveness in the third *Critique*, a concept now specific to reflective judgment.[1]

In this way, the encounter between Kantian thinking on the organism and the developments of comparative anatomy and zoology in Goethe, Cuvier, and Geoffroy Saint-Hilaire becomes intelligible (Chapters 10 and 11). Type thinking and the principle of the conditions of existence are fully in line with the epistemological structure that Kant assigned to biology in the third *Critique*. The Cuvierian principle precisely meant the institution of a circularity of cause and effect—like that of whole and parts—which was specific to Kant's concept of organism, as an operative instrument in the treatment of living matter for comparative anatomy and paleontology. The concept of organism was thus definitively established in this last movement (analyzed in Chapter 11), becoming the scheme under which the new life sciences—physiology, comparative anatomy, paleontology, embryology—should apprehend living beings.

But while the sinuous evolution of biological thinking may have been reflected in Kantian thought, this thought does not *immediately* and *directly* investigate the conditions of possibility of knowledge of the living, and is still less a reflection on life. As it emerges from the present study, the problem of life arose from the distinction between the contingent order and the necessary order in *The Only Possible Argument* . . ., and the attempt to reduce the latter to the former as far as possible. And even before this question of order, which led to purposiveness according to the third *Critique*, the original issue was the very status of the category of contingency, as Leibniz had bequeathed it to the metaphysical tradition, in the aporia constituted by the idea of a *possible* world that God would *never* have willed under any circumstances, because it is less good than the actual world. The *Critique of the Power of Judgment* is therefore a long meditation on contingency, as evidenced by the necessary relationship between purposiveness and contingency, since the former only occurs where a meaning or phenomenon is contingent with respect to the laws of nature. Thus, the last *Critique* set out to resolve the aporia of contingency in the context of a philosophy that has discarded the metaphysical function of God as a warrant of the order of the world.

Life, then, emerges for the Kantian analysis as the privileged locus for analyzing the status of the category of contingency in our finite thinking. In life, the category of natural purposiveness, in the form of the concept of organism, finds

its objective reality; and this category *derives precisely from the contingent form of our thinking* similarly, another figure proper to our finite thinking, namely, the distinction between contingency and necessity stems from it, (Chapter 12). The ontological question of the contingency of being itself no longer arises because, like all modalities, in critical philosophy contingency concerns only the relation of finite thought to its object. But, instead of this dismissed question, comes the form in which this finite thought is reflected in what is most proper to it, namely, the contingency, within it, of the particular with respect to the universal. This form is the figure of the organism, which then appears as the necessary result of such reflection.

When philosophy becomes the investigation of the forms and constraints proper to our finite thought as such, the metaphysical question of a decision on ontological contingency gives way to the analysis of the conditions for using the concept of organism, understood as a meaning stemming from this reflection of finite thought on itself. The conditions of an autonomous biological discourse then become a decisive issue for critical philosophy, because witihin them unfolds a form of finite thought, namely, the organism as a figure of the reflection of finitude, making the fact of life knowable. The movement of this transformation of the metaphysics of contingency is achieved by the third *Critique.* It is the ultimate consequence of Kant's refusal to correlate meanings, concepts, or truths with a divine understanding that would contain them or provide their principle, as Leibniz had proposed.

What I have called the problem of modality, namely the very circumscription of the categories of modality, only finds its full formulation in Kantianism with the decision to trace back the separation of the possible and the actual to the original contingency of the form of our thought; and the third *Critique* formulated such a decision. Then, this separation, which institutes modalities and thus the category of contingency, proves correlative to the concept of organism itself, insofar as this concept arises from the reflection of the finitude of finite thought.

Contingency in classical metaphysics, or at least in the Leibnizian metaphysics to which Kant refers, features both the aspect of the *logical* problem of modalities, i.e., the difficulty of defining it in terms of possible worlds that God never intended, and an *ontological* dilemma, namely, the contingency of what is. According to Spinoza, the decision to deprive the category of contingency of any objective meaning went hand in hand with the affirmation of the radical necessity of what is. But in Leibnizian and Spinozist systems, the category of contingency was developed on the basis of the position of an absolutely necessary being. Criticism, on the other hand, brings to the fore the contingency of our own thinking: all meanings are loaded by the constraints placed on them by this contingency, manifest in the fact that our power of knowledge is cleaved between a sensibility (accessing particulars intuitions) and an understanding (accessing universals in concepts).

The new Kantian definition of modalities overcomes the Leibnizian aporia concerning the categories of contingency and possibility by avoiding making them determinations of being. By the same token, the concept of purposiveness becomes obsolete for metaphysics, but finds an operative meaning in the territory defined by the concept of organism (namely, that of living beings), because here contingency—which is a determination bearing solely on the relationship of our thought to its object—is susceptible of a use that no longer falls into the metaphysical and logical aporias revealed by Leibnizism. Hence, the analysis of the conditions of possibility of biological knowledge in the third Critique, through the definition of the "natural purpose," its identification with organized beings in their self-organizing dimension, and the question of the reconciliation between teleology and mechanism, constituted the end of the enterprise of criticism of Leibnizian metaphysics inaugurated with *The Only Possible Argument*. . . . In this latter text, we saw that the phenomenon of life indeed made it difficult to be satisfied with a solution close to the ontology of Maupertuis or Buffon (also close to a certain Spinozism), which attempted to reduce the contingent order to the necessary order through Kant's "genetic" epistemology (Chapter 3).

13.2 Metaphysics

We can thus understand why the question of life was important for understanding a new dimension of the transformation of philosophy brought about by Criticism, and in particular, the transformation of the relationship between the discourse that called itself metaphysics and that of science. Neither a philosophy of life, nor an epistemology, the teleological section of the third *Critique* nevertheless has a singular status, which is undoubtedly better understood when one situates it within the Kantian progression, in which life first appeared as a decisive phenomenon in the elaboration of the concepts of order and contingency (through the so-called contingent order). Knowledge of the living itself is neither the goal of philosophy nor the object of reflexive discourse. The moments of its constitution are reflected in the Kantian text, because the question of how our finite thought can conceive of life—that is constitute and apply a concept of organized being—is decisive from the moment the collapse of Leibnizian metaphysics requires us to find a consistent meaning for the concept of order, in its difference from the concept of laws of nature, which are traced back to the legislating activity of our understanding.

13.2.1 The fate of the mathesis

Basically, the science of nature, whether biological or physical, had until Kantianism been part of a space that could be described as *mathesis*, grounded in God—divine understanding—as the warrant of truth, and bounded beyond itself,

by God as the creator of known objects—divine will. The *mathesis* concept was exposed in the introduction above and Chapter 1; I want to get back to it, to assess what has been shifted after Kant's critical philosophy.

These two divine limits are metaphysical. We can call "philosophy" either the whole of this knowledge (as Kant's predecessors and contemporaries did, *mathesis* being the framework of "natural philosophy"), or simply (as we would tend to do) its metaphysical extensions. What is essential is the continuity between *mathesis* and metaphysics, i.e., the fact, best exemplified by Leibniz, that a mathematical ideal of intelligibility governs both the constitution of knowledge about the world and the investigation of its foundations. Paradigmatic here is the identity between Leibniz's demonstration of the possibility of combinatorics (hence universal characteristics) and that of the possibility of God (whose existence is then ensured by the ontological argument), thanks to the non-contradictoriness of elementary concepts:[2] a paradigm dispelled by the Kantian assertion of the reality of the negative in his 1764 essay on *Negative Magnitudes*. "Logics, metaphysics, and theology are identical at their core," said Leibniz.[3] And more generally, the ontological proof of God was so prevalent in this philosophical context of the *mathesis* because it indicated the possibility of including the foundation of objective knowledge in the deductive operations constituting knowledge itself, which implied certain requirements on the categories of modality, including the admission of the concept of "necessary being."

After Kant, philosophy is no longer such classical metaphysics, with its position as a double extension of *mathesis*; it becomes that discourse which, instead of founding knowledge, or tracing it back to an absolute being, must above all *relate* the conditions of knowledge to the *constraints* of the form of our *finite* thought. This implies that it cannot itself be the instance that *produces* knowledge. From this point on, a range of philosophical positions toward science, visible in Schelling's philosophy of nature, in Schopenhauer as well as in Hegel, Emerson, and Bergson, can be deployed, with varying degrees of divergence from the properly Kantian critical position (a divergence which can become antagonism[4]). Nevertheless, these positions all trace back to the Kantian break with the schema that united *mathesis* and metaphysics, and in which the philosophical project was assured of its meaning—a structure in which it becomes easy to identify, as Kant did, the three traditional objects, God (foundation of *mathesis*), the soul (as the repository of the knowledge of *mathesis*) and the world (as the object of this knowledge).[5]

The question of the *foundation of thought*, in the dual sense of "where do meanings come from?" and "how can they lay claim to objectivity?," emerged in Kantianism by the dissociation of divine understanding from the substrate of meanings. In the philosophy of *mathesis*, this question did not arise, or rather was obliterated by its double metaphysical dimension. "Metaphysics" was that discourse in which the anxiety of thought for itself and for its foundation could itself be resolved by closing the space of *mathesis* at both ends: on the one hand,

God guarantees objectivity; on the other, it is the locus of ideas. As early as *The Only Possible Argument. . .*, Kant indicated that his radical argument of the proof of God based on considering the possible "touches the foundation of all thinkability" (Ak. II, p.81). In all the elaborations on contingency I have partly traced here, this question or preoccupation with the foundation of thought remained in the background (Huneman 2019a), as demonstrated, for instance, by the problem of the *formation of empirical concepts* in the *Critique of the Power of Judgment* (see Chapter 8). There is no doubt that this question remains constantly at the heart of the movement by which criticism dispelled the old metaphysics.

While the radical proof of God through the possibles (according to the 1763 essay) was neutralized in the *Critique of Pure Reason*,[6] the questions of contingency and purposiveness continued to concern the "foundation of all thought." By neutralizing the aporias of contingency in metaphysics, Kant brings *the contingency of our thinking* to the fore. In this way, classical metaphysics appears *in retrospect* as a discourse in which the anxiety of thought for itself and its foundation was formulated and structured in conjunction with *mathesis*, and thus projected its appeasement. But with the critical turn, such discourse can no longer be sustained, and must instead become the object of reflexive analysis or critique when it comes to rethinking the "foundation of all thinkability."

The Kantian doctrine of the transcendental Ideal is a major element in this analysis. The *Critique of Pure Reason* turns the Idea of God into a *focus imaginarius*, this unreal entity toward which conditioned-to-conditions relations converge, in much the same way as light beams in a mirror reveal an illusory focus (Chapter 6). By this argument, Kant is taking up and transcendentally elucidating the Leibnizian metaphor of a God who would be, in the infinite, the convergence point of those lines of perspective that are the monads. The Kantian inflection then consists in making this focus an imaginary one, i.e., in recognizing that there is no a priori warrant that all these lines would converge in the infinite.

This project of sobering up Leibnizism continues in the third *Critique*: here, the lines of purposive relations scattered throughout the world no longer converge, *ad infinitum*, on a monarchical God whom they would both presuppose and prove. Let us quote Kant on the end of a focal point:

> "How does it help us," one might rightly protest, "to put at the root of all these oriented services a vast intelligence, infinite for us, and to admit that it arranges this world according to intentions, if nature tells us nothing, nor can it ever tell us anything about this final intention, without which, however, we can establish ***no focus*** *of relation common to all these natural purposes*, no sufficient teleological principle, partly to understand the purposes as a whole in a system, partly in order to form for ourselves of the supreme understanding as the cause of such a nature an idea that can serve as a measure for our reflective faculty of judgement judging teleologically about that nature?"
>
> (§85, V, p.440; my emphasis)

13.2.2 The new metaphysical locus of life

All this sheds light on the dual character of critical philosophy so often pointed out (especially in the first and third *Critiques*): an undertaking that is both metaphysical and epistemological. The *same necessity* simultaneously requires the critical decoding of *metaphysical* ideas *and* the tracing of *objective* meanings back to their conditions in *finite* thought, because the correlation between infinite thought (Leibniz's divine understanding, for instance) and *mathesis*, as it classically defined philosophy in its former metaphysical regime, has faded. The cornerstone of the Kantian argument is the finitude of thought, and the reflection of this finitude in which the meaning "life" arose.

The point of the critical analysis of finality in the *Critique of the Power of Judgment* is the following: in the reflection of finite thought on itself, the meaning "purposiveness"—i.e., the possibility of thinking something like "life"—is constituted by a reference to the figure of an Other thought, of an infinite understanding, which arises through the very movement of this reflection (Chapter 12).

In a way, "life" names this difference between the two understandings, our own and the Other image it gives rise to. This is why it is no longer a figure of perfection, as it was for Aristotle or the Scholastics, for whom life must be attributed to God.[7] Only a finite being, a finite thought, understands life as such; hence, "life" is the closest meaning to "thought," no longer because of the theory of the "three souls" as in Aristotle (where the living possesses sensation and where thought is read in an analogy with sensation), but on the background of finitude as the gap between receptivity and spontaneity and, beyond that, the contingency of the relationship between universal and particular. Put metaphysically: life now appears constituted, as meaning, in the self-appearing of thought.

13.2.3 The paradox of "life": narrowing positivity and speculative extension

That allows one to explain this intriguing coincidence: the very moment of the constitution of biology as an autonomous science—in other words the attribution to life of a status of *positivity* around 1800—, is contemporaneous with the inflation of the metaphorical or at any rate broad use of the term "life": in *Naturphilosophie*, the philosophies of life (*Lebensphilosophie*), etc.[8] Following Kant, life, as the object of the concept of organism (and here, for the moment, I leave aside the "other" Kantian discourse about life as desire, examined Chapter 7), takes on its meaning only in a relationship of essential reflection with the finitude of thought. Hence, the moment when the concept of organism asserts itself as an operational obviousness is also the moment when self-questioning thought encounters the notion of life as founded in itself. In other words, the philosophical investigation that reason conducts into its own meanings ought to mobilize the term "life" to an extension that no positivity can restrict, precisely because this meaning—"life"—does not originate in any positivity. To grasp the relationship between

philosophy and biology, as made possible by the *Critique of the Power of Judgment*, is to unfold the facets of this paradox: positivity (namely, the scientific operationality of the concept of natural purposiveness, which reflects embryology and vitalist physiology, and allows for principles in comparative anatomy) *and* immoderate analogical extension.

Everything I have said suggests that life has become a necessary object of interrogation for philosophy, *as well as* a possible metaphorical language. This life is no longer understood as a complex of soul and body, but as an *organism*, thinkable in correlation with the possibility of a transcendental history (Chapter 9). As a language, it makes possible the thought of immanent entities in development, whether on a political or linguistic level: Schleicher's language-organisms, Herder's cultures as organisms, Hegel's *Staat* as organism, etc. (the organization of a state being precisely the only comparison given by Kant for the organism in §66 of the third *Critique*). Kant never subscribed to political organicism, because the distinction between the regulative and the constitutive prevented him from such ventures; but his followers, relaxing the distinction in various manners, soon adopted it.[9]

13.2.4 Post-Kantian metaphysics and contingency of thought

There are at least two meanings of "metaphysics" in Kant's writings: one, according to which metaphysics is entirely defined by the field of transcendental dialectic, i.e., by the quest for the unconditioned in the theoretical order; the other, according to which metaphysics is the science a priori by concepts, i.e., neither a priori by the construction of concepts in intuition (namely, mathematics) nor by concepts a posteriori like the empirical sciences. If we were to assume that a priori statements grasp things as they are in themselves, we would return to metaphysics in the first sense, and for Kant, philosophy is the critique of this metaphysics; if we hold that a priori statements provide the rules of our knowledge of phenomena, then metaphysics becomes partly "metaphysics of nature" together with "metaphysics, of morals," as Kant thought them, and partly transcendental philosophy, i.e., an elucidation of the foundations and validity of these metaphysics. This is "metaphysics of metaphysics" as Kant put it in a letter; in other words, it is the content of the three *Critiques*. In this second sense, Kant has thus come to think of metaphysics as "the knowledge that the understanding has of itself," by which it is immediately critical: "Metaphysics is not science, knowledge, but simply the knowledge that the understanding has of itself; it is therefore only the rectification of sound understanding and reason."[10]

More simply, the persistence of metaphysics in the first sense—the one found in the Transcendental Dialectic—explains why Kant still wanted to formulate a metaphysics after the critique, and why he always deferred this project. It is as if this ideal construction, which called itself *metaphysics* and which responded to

a "need of reason," still subsisted despite its critical ruin, and awaited an answer from Kant. Then it installed in him the hope, or expectation, or program of making a metaphysics, even though the unlimited procrastination of this project testifies to the fact that the critique had effectively discredited all future metaphysics (still in the sense of the Transcendental Dialectic).

The *Critique* thus points to the inherence of metaphysics within thought, as well as to the futility of its foundational project, and thereby reveals the profound meaning of metaphysics as a necessity of thought. As Gérard Lebrun put it: "One wonders whether Kant, unbeknownst to himself, might not, in the relationship he instituted between Criticism and metaphysics, have released the essence of the latter."[11] In the third *Critique*, which closes the critique of metaphysical meanings, the solidarity between the genesis of a metaphysical space (around the idea of God, the "intuitive understanding") and that of the meaning of "life" becomes apparent—a solidarity from which future philosophies of nature would draw their consequences.

Consequently, by showing how this metaphysical space is constituted in and by the contingency of our thought—precisely as the *inexplicable disquiet of this contingency*—the Kantian demonstration necessarily refocuses the philosophical intention on *thought* as such. While for Kant, the categorical imperative was the "fact" of reason, for his heirs, metaphysics itself became the "fact" of human thought: thus, from Schopenhauer to Heidegger, the essential interest of philosophy is less in metaphysical questions than in the fact that humans do metaphysics.[12] As metaphysical questions arise from the structure of thought, it is in the analysis of these questions themselves and their genesis that we can scrutinize the essence and requirements of our thinking.

With this move, it is clear that philosophy has definitively *freed itself from* the natural sciences. This emancipation rests, first and foremost, on the mathematization of physics, which allowed for the relative autonomy of the quest for its principles; and second, of course, on the experimental method, however it may be interpreted.[13] In the first *Critique*, the Kantian transformation of philosophy into criticism—in other words, into a discourse that no longer enunciates science but analyzes its conditions of possibility—has been presented as the result of philosophical awareness of these two points. At least, this is one way to read metamorphosis of philosophical questions between Leibniz, Spinoza, or Diderot, and Hegel, Schelling, Nietzsche, or Husserl: as the purification of questions now deemed scientific.[14] But that vast movement in the configuration of philosophy also rests on several minute transformations, including those I investigated here. In the Kantian journey of the question of the contingent order that I sketched in detail, those transformations bring out a new aspect of what has been called metaphysics, namely, metaphysics as a *question of and for thought,* correlatively with a new way of using the concepts "nature" and "life."

13.2.5 The metaphysical territory

Along the way I have studied the relationship between the radical transformation of philosophy implied by the project of a critique of metaphysics and the inauguration of a science of the living as such, based on the establishment of the scheme of the organism. Not surprisingly, an epistemological inquiry intersects with the metaphysical interrogations of the late 18th century. In addition to modifying the relationship between science and philosophy, what was at stake in this book was the constitution of the space of discourses that could be truly held on the living; biological science and philosophy (as critical philosophy and then as philosophy of nature) are two regimes of discourse in which a truth about the living can be said. In my study, metaphysics has emerged as that space of meaning in which thought formulates its anxiety concerning both its foundation and its objectivity, i.e., its possibility of reaching truth. Classical metaphysics, which Kant took in its Leibnizian form as the object of his critique, was a way of regulating this anxiety by opening up a certain type of regime of truth: under this regime, the science of nature could take a certain number of forms, which dissipated when criticism took metaphysics as its target; in the new conceptual space that opened up, a biology became then possible.

Even in its investigation of the conditions of possibility of a biology—namely, the critical elucidation of the concept of purposiveness—critical philosophy teaches us that metaphysics, before being *metaphysics*, i.e., a certain type of theory, dealing (as Aristotle said) with being in general or with the primary being, refers to what we might call, with a Kantian term, the *metaphysical territory.* On such a territory, the clarification of the primary and necessary meanings (such as "being," and "being possible") by which thought can unfold itself is played out. In this metaphysical locus, the concepts of "truth" and "being"—as the primary meanings of thought—receive the determinations and criteria that enable them to be used effectively. In this sense, even if we can to some extent affirm that, by its own movement, the science of nature first physics then biology, has indeed freed itself *from metaphysics*, the fact remains that the relationship it can or must maintain—as thought and as a claim to truth—*to the metaphysical territory*, cannot be taken as simple, still less as liquidated. When Kant defined philosophy as critical philosophy, meant that thought had taken on the infinite task of questioning the relationship between metaphysical territory—a territory born out of the relationship of finite thought to itself, hence of thought's concern for itself—and the very possibility of constituting itself as knowledge.

13.3 Metaphysics and biology

So, finally, what has this investigation taught us about my more general question of the heterogeneity of the references to "life" in discourses that set out to make

true statements about the living? And so, what extensions can be given to my examination?

13.3.1 Contingency and the discourses on life

"Life" is undoubtedly a relatively stable term in ordinary usage, at least when it comes to attributing it to objects, and even if the limits of the possibility of attribution are subject to historical and cultural variations. The science of the living conquered its specificity and autonomy by taking as its object the organism, as Kant reflected the concept. "Life," as spoken of in ordinary discourse, can no longer be its immediate referent. This impossibility arose in Kant's text itself, since I have shown (Chapter 7) how life, strictly speaking, is the object of another discourse (more first-person-oriented and anthropological) than the organisms, which are objects of biology. The obviousness with which the living necessarily thinks of itself as an organized being has been historically constructed.

Philosophy is not about knowing *what life is,* a question which, moreover, does not arise in ordinary discourse, where the major question is *ascribing* the term; nor does it make sense within biological science, where the problems presuppose the obvious apprehensibility of life as an organism. For Kant, and after him, life is a philosophical question in the sense that it imposes itself on thought as a specific problem, not as a phenomenon of the world to be known, but as correlated with a metaphysical concern of thought with itself, with its own contingency, with the constraints and forms that define its power to know. This is the sense of the Kantian shift from a critique of Leibnizian metaphysics and its notions of order and contingency to a critical investigation of the foundations of biological discourse.

It would be absurd to reduce all modern ways of philosophizing about life to Kantianism, or even to see their origin in it. But one effect of Kantianism is from the birth of biology as an autonomous science, the locus of a properly philosophical interrogation of life was determined by the structure in which the meaning "life" emerged as an object of scientific knowledge. That structure is the necessary correlation of the meaning "life" with a concern for the anxiety of thought about itself that was classically called "metaphysics", which in Kant's hand, is no longer possible as it was, — the target of his critique in the Transcendental Dialectic. The so-called philosophies of nature in the German tradition (Schelling, Oken, Baader, Hegel, or even Schopenhauer) were exemplary figures of this correlation.[15]

As you will recall, one of the threads running through my investigation was the gradual disappearance of the soul–body schema for explaining the living, and its replacement by the obviousness of the living as an organized being, and the genesis of this obviousness. One of the main work in which these two now incompatible ways of thinking about the living were contemporary was in Leibnizian thinking about infinite organization. He saw that thinking of living things

in terms of soul and body *necessarily introduces a contingency* into the relationship between soul and body, which, as heterogeneous substances, do not need each other. In this scheme, we can already see that thinking about life implies granting contingency a status, which Leibniz identified through concepts such as "maxims of suitability" (*maximes de convenance*), double necessity (metaphysical/moral), divine will and divine understanding, etc. But, with the disappearance of the soul–body schema and its gradual replacement by that of the organism, this correlation of life and contingency clearly changed. We should then think differently about contingency in order to take philosophical note of this substitution. This book attempted to bring this requirement to light and show how it was realized in Kant's work.

13.3.2 Immanentization of purposiveness

However, if we take up this issue of the fading away of the soul–body schema in the apprehension of the living, we also see in retrospect something essential concerning purposiveness. To say that living beings can no longer be thought of in terms of soul and body is to say that the organized body does not receive its organization from elsewhere, that it is no longer the instrument of a soul. Stahl's animism gave a coherent form to this correlation, making the soul a kind of engineer housed within the body. Then, the model of the engineer, of the technician, must disappear if the soul–body schema is no longer relevant for thinking about life (see Chapter 1). This means that purposiveness became immanent to the organism itself: its preservation is its purpose, and it is in itself the means of this purpose. But it also means that such immanent purposiveness can no longer be thought in the terms of *the technician*: on the contrary, it is an internal activity of ordering, a kind of harmony that maintains itself. This dissolves the two dimensions of exteriority that fundamentally affect the technical model, namely the exteriority of the demiurge who creates the object, and the exteriority of the utilities that constrain its functions (e.g., utility for human beings). From *Critique of Pure Reason,* as we have read it, to *Critique of the Power of Judgment*, Kant reflected on this shift: the living being is no longer to be conceived in terms of means serving ends, but a process of self-organization, materially analogous to that formal purposiveness presupposed in nature by the reflective power of judgment (Chapter 9). This process is no longer so much thought in the mode of machines built for purposes, as in that of art—being its own end, serving no external utility: it is "purposiveness without purpose" *(Zweckmässigkeit ohne Zweck),* as Kant forcefully said in his Aesthetics. Similarly, while in the Appendix to the Transcendental Dialectic, purposiveness was a language for expressing nature and the living in terms of means and ends (Chapter 6), it remained external to the object. In the *Critique of the Power of Judgment*, purposiveness, being the principle of the very possibility of judging these objects, and therefore necessary for them to acquire the meaning they have in reflective

judgment, is no longer external to the object but becomes internal to the judgment on it. Therefore, the process of immanentization of purposiveness realized by the constitution of the concept of organism can be read in Kant's trajectory between the first and third *Critiques*. Adickes (1924) pointed out that, in Kant's contemporary scientific writings on life, the organism was the central concern of researchers who, at the same time, failed to see the essential point that Kant formulated, namely that purposiveness is placed in the foreground. But it must be added that it was essentially *the inflection of the sense of purposiveness* implicit in modern thinking on biology that Kant was able to identify.

In conclusion, it is useful to situate this inflection one last time in relation to the inaugural categories of *The Only Possible Argument. . .* in which Kant first approached the question. In the 1763 text, order was divided into two according to its modalities, and thus yielded the two dimensions of purposiveness: finality as system for the necessary order, finality as technique—*Kunst*—for the contingent order. At the end of our journey, however, this distinction is profoundly reelaborated, in relation to the deepening of the understanding of the organism undertaken in order to elucidating the specificity of biological knowledge. Purposiveness as "a system" can be seen at work in the presupposition of the reflective faculty of judgment concerning the unity of natural laws, and purposiveness as "technique" (in a profoundly renewed sense, somehow de-instrumentalized as I have shown) defines the domain of organisms. The distinction between formal purposiveness and objective material purposiveness thus appears to extend the 1763 "purposiveness as system / purposiveness as *Kunst*" distinction, but we have seen that things are more complicated.

From the moment when the model of technique is no longer so much the engineer who disposes for a useful purpose, but rather the artist who designs, the system of empirical laws of nature, considered from the point of view of the reflective faculty of judgment rather than from the point of view of reason (in the manner of the "Appendix to the Transcendental Dialectic"), can at the same time be thought of as a "technique of nature," as the *First Introduction* attests. Conversely, in the objective material purposiveness of the living, no longer thought in terms of the utility of parts, but in terms of *self-organization*, the aspect of *internal systematicity* comes to the fore.[16] The whole-parts relationship, proper to purposiveness *generaliter*, then justifies the use of the means-ends distinction, proper to "technique." Ultimately, organic purposiveness no longer falls under the disjunction of "system" and "technique," and the proper domain of the organism, as epistemologically autonomous, emerges out of the aporias in which *The Only Possible Argument. . .* placed it.

Correlatively, the unity of purposiveness is no longer to be found in the reduction of *contingent* order to *necessary* order. The unity of Kant's concept of purposiveness—the unity of "system" and "technique"—under the primacy of a reconceived systematicity stems from the reflective faculty of judgment itself, of which "purpose" proves to be the proper concept in all its aspects. Kant's

ultimate insight is thus provided by the final shift in the *Critique of the Power of Judgment*, whereby the question of order is transferred from reason to the power of judgment. The concept of purpose would have no unity, and order would still present unacceptable aporias with regard to the question of its necessity or contingency—aporias that rendered in 1763 the fact of life unthinkable—if we did not ultimately entrust the category of purpose to this reflective faculty of judging. As *finite*, reason cannot ultimately take upon itself the requisites of the *order* of nature—hence the inadequacy of the treatment of this question in the Appendix to the first *Critique*, and Kant's subsequent need to return to it in the third. In this way, the reflective power of judgment reveals its fundamental significance in critical philosophy: an instance that proves crucial once one has abandoned classical metaphysics and wants to coherently develop the implications of the finitude of reason.

In connection with the reflective faculty of judgment, purposiveness acquired its de-theologized meaning: it can be a *natural purpose*. As we have seen, this concept then became operative in the Cuvierian science of organisms, and more generally in the perspective of comparative anatomy. In a way, the scientific approach to life saw its philosophical territory opened up by such naturalization of the concept of "purpose," which could be said to have been expelled from theology. The autonomy of science as a body of knowledge, and thus the separation of philosophy and science initiated by Kantian criticism, is thus ultimately correlated with *a form of naturalization of purposiveness*, accompanying the break between philosophy (as criticism) and theology, and the suspension of any theological instance in the space of the self-questioning of thought that came to be known as "metaphysics."

13.3.3 Excess, reason, and perspectives

Let us speculate a bit, to end this conclusion. If we were to characterize the overall problem of the *Critique of the power of judgment* in critical philosophy, we could speak of a *thematic of excess*. Beyond the present work, Zuckert (2007) indeed similarly acknowledged this general theme speaking here of margins: "in the CJ, Kant attempts to explain how we may come to comprehend the empirically given, the particular, the contingent as such—i.e., precisely that which is marginal to, or lies beyond, the universal forms, concepts, or laws with which Kantian (and much other) philosophy is concerned" (p.6).

The notion of excess enables one to understand what is at stake in this third *Critique* in relation to the metaphysical question of laws. Empirical laws, as it were, exceed the universal laws of nature; more generally, the particular in its abundance exceeds the universal of the concept. The aesthetic register arises in addition to and alongside the knowledge constructed by logical judgment, exceeding the cognitive predicates of things. (Literally, Kant's aesthetics made the distinction between cognitive judgments and aesthetic judgments.) The

organism, for its part, exceeds the lawfulness that understanding imposes on nature; more precisely, the criterion that enables us to discriminate between viable and non-viable forms comes in addition to the universal laws of matter. In a nutshell, then: purposiveness is in excess of the mechanistic laws of nature, since what is grasped by these laws has no finality, or at least has not been objectively produced according to ends.

From aesthetics to teleology, via the question of the natural kinds of particulars, the aim is to think of this excess as nonetheless amenable to some *cognitive content*, that is, capable of being articulated within a type of explanation; hence, to understand it as the locus of a certain regularity. Here, the question of excess leads us back to the profound formula chosen as the *Leitfaden* of this book, and through which it can be approached: the "lawfulness of the contingent as such."

Kant's account made it clear that the epistemological territory of the life sciences, by the very fact of its constitution in the upheavals that altered the conceptual space of the *mathesis*, was affected by the question of excess over the legislation of the understanding. Taken in the broadest sense, this question, as we have seen, metaphysically imposed a rethinking of the modal meaning of *contingency*; but in this perspective, it unfolds an epistemological problematic of which the third *Critique* was one of the milestones, namely that of *the heterogeneity of explanatory schemes for scientific rationality*. Michela Massimi, elaborating a metaphysical pluralism (Massimi 2022), perfectly illustrates this very general conclusion of Kantianism, adapting it to the current state of natural science.

The enlarged rationality it aims at requires us to measure and articulate these different explanatory schemes. This is the common epistemological horizon that unites the new concepts of "natural purpose," "purposiveness without purpose," and "presupposition of the reflective faculty of judgment." As philosophy takes stock of what has emerged as "the sure pathway to a science" (using the terms from the preface of the first *Critique*), i.e., that methodology by which reason "takes the lead" and questions nature, some gaps and distinctions have emerged within the very idea of rationality, enjoining the philosopher to consider their possible articulation. This means allowing for the specificity of each of the types of intelligibility that thus emerge, and elucidating the norms of their explanatory schemes, while judging their compatibility. What arises here is the picture of a rationality that is not always homogeneous, but receptive to multiple types of intelligibility—a reason that makes its finitude an origin of its knowledge and manifests it in such division. At the end of our journey, the field of the living appears paradigmatic of this diffraction of rationality (if I ultimately dare to use a very non-Kantian formula).

If we consider that the laws of nature, as founded by the first *Critique* in the transcendental domain, are articulated on causality as a regular succession according to a rule, then understanding life implies understanding a cognitive

excess, taken in the double sense of an *excess over nomothetic explanation*, and an *excess over mechanistic causality*. In other words, on the one hand, explanations in terms of laws fail to account for the internal *normativity* of living things (no criterion for discriminating between viable and inviable forms), while, on the other hand, explanations in terms of causality leave in the shade the oriented *productivity* that is proper to them. Elucidating the conditions of intelligibility of the cognitive excess Kant identified means understanding how two correlative aspects of biological purposiveness can become vectors of knowledge: the *functions* of organs, with their own norms ("what the organ is supposed to do"), and the *specific type* targeted by the developmental process. Chapter 11 explained at length how these two questions, likely to receive the same answer in Kant's analysis, parted ways as the "two great laws of biology," such that their conciliation or incompatibility remains a major theoretical issue in biology.

13.4 Biology

The constitution of the concept of organism is a major episode in the history of the life sciences, and I hope that the present analysis, for which the problems of contingency and finality according to Kant have provided the guiding thread, will have shed light on certain presuppositions and metaphysical difficulties. A final question concerns the relevance of these analyses for science itself.

13.4.1 The conceptual space of the organism, summarized

In Chapter 6, I exposed a major cleavage in Kant's discourse on life; strictly speaking, life and organisms are, for him, two different things. I argued that "life" pertains to a discourse that is mostly first-person oriented, and relies on anthropological features, whereas "organism" is a key scheme of biological science. The distinction here appeared as a difference between the first and third person. It can also be phrased in terms of *agency* versus *organization*, this latter term itself giving way to two distinct interpretations, the internalist one, represented by self-organization mathematical models (e.g., Weber and Varela 2002; Moreno and Mossio 2015), and the externalist one, represented by the selectionist Darwinian explanation of organisms as "bundles of adaptations." Fundamentally, these two options implement what may be called the form way and the function way, which split after Kant's formulation of the transcendental presupposition of the reflective power of judging.

Ultimately, analyzing Kant's reflection on purposiveness and life allows one to detect threads and options, often intricate within Kant's thought, that developed into the main axes of the theoretical space of biology. These axes indicate that, in this space, some approaches radically diverge from others and therefore grasp from the same objects—animals, plants, bacteria—completely different

aspects or snapshots. The issue of the compatibility of these approaches translates into an issue of coexistence and proximity or distance in a theoretical space.

Wrapping up some of the results of the last two chapters, we can sketch elements of this theoretical space.

The "natural purpose" concept required two criteria, the *design* and the *epigenesis* criteria, delineated in *Critique of the Power of Judgment,* §65. While intertwined in Kant's account, they gave rise to two different accentuations, depending upon whether one privileges form or function. This partition was implemented respectively by the comparative anatomies of Cuvier and Geoffroy Saint-Hilaire (Chapter 11 on the "great laws"). Yet *design* can itself be understood in a rather *functional* or rather *formal* way, depending upon the emphasis put on the finality of parts and of the whole, or on the overall organization plan.

This latter distinction in turn implies two distinct ways of articulating the two criteria—design and epigenesis. The functional, adaptationist viewpoint embraced by neo-Darwinians implies that the self-organization of organisms, object of the epigenesis criterion, can be accounted for by the same reasons that explain the bundle of adaptations and then yield the integrated adaptive cohesiveness that characterizes organisms, namely, natural selection. By contrast, the formal viewpoint on design holds that self-organization accounts for the overall design and ultimately for the functional capacities of the integrative parts and the organisms as such.

I added (Chapter 11) a major distinction regarding the justification of the biological teleology deployed by these criteria. While Kant's justification was *transcendental*—namely, the principle of the reflective judgement—both Darwinians and self-organization theoreticians want to see teleology as something *natural*, either grounded in *natural selection*, or in *self-organization* processes found in physics (including the various forms of self-assembly, self-maintenance, and self-preservation). Thus, the space defined by the two above-mentioned dimensions is duplicated, depending on which justification one adopts. I explained in Chapter 11 how the transcendental perspective allowed one to keep some unity between the criteria of organism, while naturalism loses this unity; and I also explained why the transcendentalist viewpoint cannot be naturalized.

Yet this does not fully describe the theoretical space of biology, indexed to the concept of organism. In Chapter 11, I showed how the question of why life happens mostly as organisms yields two opposite answers. Kant's answer invoked teleology and the notion of natural purpose as a presupposition for biology. Darwinians, in the wake of the METI program (Maynard-Smith and Szathmary 1995), see in general biological individuals as the result of the evolution of some group of lower-level ontological status, which, under specific conditions, resulted in a cohesive and integrated system, reproducing as a single unit. I explained how, in this context, individuality is not restricted to organisms, because there can be more or less integrated forms of individuals; a pack of wolves is more

organism-like than all the plankton in the ocean, but less organismal than ant colonies, which feature division of labor between casts of bees.

Being an organism in this approach is not the same as being an organism in Kant's sense (namely, satisfying necessary and sufficient conditions), but rather existing somewhere in a space of individuality. I contrasted this Darwinian view, which is more liberal, with the Kantian view, which subscribes to the idea that there are criteria to be an organism (see also Huneman 2023c). This distinction correlates with the former one regarding Darwinian and self-organizing naturalist viewpoints, namely the two takes on the notion of organism; yet it is not the same exactly, since the "organism" obviously accommodates a transcendentalist account, and the selectionist account may in turn focus solely on the organism and its integrated adaptations, as evolutionary theorists like Wright, Mayr, or Dobzhansky did before the advent of the METI program.[17]

13.4.2 Life in the first and the third person

Now, the entire theoretical space around the concept of organism has ultimately to be confronted with the distinction that opened this paragraph, namely, the distinction between the Kantian discourses on life and on the organism. The former approach is the ancestor of the multiple theories that, today, claim that "agency" is a necessary concept to make sense of organisms and their evolution. Walsh (2015) exemplifies this approach, from the side of philosophy, and it is supported by biological treatises such as those by West-Eberhardt (2003) or Sultan (2015). The analysis of Kant's ideas suggests that the agency and the double criteria (design/epigenetic) accounts of organisms are not compatible (see Chapter 7). Granted, the problems and the philosophical contexts are very different, and nobody today arguing about agency thinks about the anthropological background that Kant had in mind. Yet I believe that his inability to formulate the problem of natural purpose and teleology in the framework of the discourse of life as desire, and reciprocally, the absence of any locus for this notion in the framework of the organism as an object of biological inquiry, are meaningful well beyond Kant's own case. One could argue that there are eventually two incompatible takes on biological facts and teleology, namely the "natural purpose" concept, and then the faculty of desire.

In this book, I also wanted to propose a genealogy of this split between general approaches to the living. It eventually turned out that Kant's reflection on what was happening at the same time in biology allowed us, upon investigation, to discern important moments in the constitution of the notion of organism but also the constant presence of another idea of life, not miscible with this soon-to-be scientific concept. The contestations and discussions that nowadays appear vivid regarding the notion of agency and its role in biology are—e.g., DiFrisco and Gawne 2025—surely justified by the state of the biology of plasticity, ecosystem engineering, niche constitution and a few other phenomena that require first, to

position the analysis at an organismal level, and second, to possibly grant some causal consistence/role/status to organisms themselves and what they do. But they also seem to reactivate an older split between two approaches to the understanding of life, which occurred when mechanism as a general stance on nature and life met with well-founded criticism from the successors of Descartes (Leibniz) and its discontents in the field of physiology and medicine (Stahl, Haller, Bordeu, etc.). In the framework of the present study, the very condition for the emergence of such cleavage, contemporaneous and simultaneous with a crisis of mechanism analyzed brilliantly, from another viewpoint, by Gaukroger (2010), is the overall demise of *mathesis* as a structured space of knowledge uniting metaphysics, mathematics, and natural science (see Chapters 1 and 12).

To conclude, I want to emphasize some major differences characterizing the present status of this cleavage, compared to the state of the art when Kant elaborated his account of organisms. Although genealogy was my first concern—an enterprise requiring that one draw parallels and connections between patterns of science that are manifestly not comparable—I indicated in several places the transformations that seem both deep and promising, which affected the two stances here described, agency and organization, which took form in the intrinsic cleavage (life vs. organism) within Kant's work, explored in Chapter 7.

In short, the mathematical tools that we use to address the processes and phenomena tackled by scientists at Kant's time are very different. This sounds trivial, but given that Kant's analysis took the Newtonian model of science as the paradigm of science and that most of the life scientists concerned by his work, that he read and whose work I examined in this study, also positioned themselves vis-à-vis Newtonian physics—as Zammito (2018) definitively established it—, the reference to infinitesimal calculus and the mathematical notions then in use plays an immense role. I indicated that Goethe forged a way out of Kant's proscription of an "adventure of reason," regarding the transformation of species, by referring to a mathematical understanding of forms that would later become topology (Chapter 10). And I think that this shift is still fruitful, and that a portion of the studies devoted to a self-organization approach to organisms is embedded within this trend. Moreover, in a word, a tradition that might include D'Arcy Thompson and later René Thom emerged, in which other forms of mathematics than calculus, and let us say a form of topology (Thom's *théorie des catastrophes*, for example) are better suited to model teleology as a defining feature of organisms. This contrasts with Kant's idea that mathematical science governs the mechanisms, while teleology concerns norms that are presupposed by the biologist. Granted, one may think about naturalizing those norms, as selectionist, Darwinian thinkers did, for whom norms can be naturalized because selection explains them (e.g., Neander 1991; Millikan 1984), but here I mean an understanding of teleology that relies on other mathematical principles of explanation

than the tools of either Newtonian mechanics or Darwinian statistical-modeling population genetics.

This would define a project of naturalizing teleology, (that is, the transcendental presupposition of reflective judgement sensu Kant) according to a scientific approach completely alien to Kant's Newton-inspired framework. One aspect of this project is search for mathematical principles that would indeed make sense of the agency stance, translating its heterogeneity with the other stance into a disparity between mathematical frames.

If a lesson of the third *Critique* consists in acknowledging a pluralism or perspectivism (as I diagnosed above), then one current manifestation of this pluralism is the multiplication of mathematical modeling styles. This suggests that Kant's partition between what is determining and reflective, then constituting and regulative, and in rough terms, the mathematical physics versus the normative, could be rethought. While the organism, which was, as Kant maintained, the central concept of nascent biology until neo-Darwinism, seems to return to the center of the considerations of biologists and philosophers of biology, under the many guises that features the current conceptual space of the theoretical biology (see, e.g., Bateson 2005; Huneman 2010; Walsh 2010), it was worth explaining the scientific and metaphysical reasons why this concept acquired its significance and gradually came to represent the main epistemological dimensions of modern life sciences in their unity. I tried in these pages to contribute to this endeavor, offering an archeology of the now commonsensical idea, shared by scientists after Blumenbach, Wolff, Cuvier, Kant, and their contemporaries, that the living must be apprehended as organized and self-organizing entities.

Notes

1 See also my Huneman 2007b.
2 GP IV, 296; *De Are Combinatoria*, §1.
3 GP IV, 292.
4 Since the Hegelian position imposes the reinterpretation of scientific knowledge ("finite sciences") in philosophy, and not a return to their conditions of possibility in finite thought (Huneman 2010c).
5 On these notions, see Huneman (2006c).
6 On this neutralization, see Huneman (2019a).
7 Thomas Aquinas, *Summa Theologica*, Quest. 18 art. 3, "the being whose nature is identical with his intelligence, and who does not see determined by another what he naturally possesses, this one obtains life in the supreme degree" with obvious reference to *Metaphysics L*—and art. 4, "everything intelligibly found in God is both his living and his very life."
8 Hegel's entire lexicon of the "life of the spirit" bears witness to this inflation—think of the famous sentence on "the life of the spirit, which is not that life which preserves itself pure from death etc.," in *Phenomenology of the Spirit*. But consider also the Schellingian philosophy, for example in the 1809 *Philosophical Investigations into*

the Essence of Human Freedom, where it is argued that "all effectivity (nature, the world of things) has activity, *life* and freedom as its foundation" (Suhrkamp ed., p.46, my emphasis).

9 Such organicism differs from ancient metaphors of the body politic as much as the biological organism presented here differs from the Galenic organism, not least because it does not immediately involve the soul, i.e., the issue of government, and instead is thought of in terms of vital, immanent forces, with the spirit of the people taking the place of the formative force in biology—and is thus immediately correlated with a view of the history of the people.

10 R.4284, Ak. XVII, 495.

11 Lebrun (1970, p.506).

12 This is the meaning of the Schopenhauerian determination of the human as a metaphysical animal: "Man is a metaphysical animal" (*The World as Will and Representation,* 851). See also *Parerga*, "On Religion": "Man is a *metaphysicum animal*, i.e., he has a strongly predominant metaphysical need: whereby he grasps his life primarily in its metaphysical significance, and therefore wants to deduce from it everything he knows" (p.79).

13 Either empirically, or rationalistically ("reason takes the lead in questioning nature"), as Kant himself does in the Preface to the *Critique of Pure Reason.* See Gaukroger (2006, 2010), for an exhaustive exploration of the divergences and controversies in the establishment of this experimental method from Bacon to Locke.

14 On this point, see Gérard Lebrun (1970 pp.8–10): "unless (. . .) we see pre-Kantian philosophies as nothing more than presentations of pseudo-sciences, and pay attention only to their truth of judgment," or connect them to a resolutely dogmatic "history of Being," we must consider them as "samples of reason's discourse on itself, and ultimately impose on these ancient theoretical knowledges the anachronistic deformation that Kant had already imposed on Leibniz" (p.9).

15 See Huneman 2006c.

16 This, at last, clarifies the affinity between reason and the organic, whereby in the Methodology of the *Critique of Pure Reason*, reason could be expressed in the language of the organism. Judith Mensch (2013) extensively analyzed such Kantian organicism of reason.

17 Those three authors defined a version of organicism, against the genetic reductionism preached by Fisher (see Gayon 1998).

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