

Kant's Theory of Biology

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Citations and Abbreviations

1 Citations

Citations to Kant's writings give an abbreviated English title of the work and the volume and page numbers of the *Akademie-Ausgabe*, except in the case of the *Critique of Pure Reason*, for which the page numbers of the first (A) or second (B) edition are given. Translations quoted are from *The Cambridge Edition of the Works of Immanuel Kant*, except where noted. The list below gives the *Akademie-Ausgabe* (AA) volume and page numbers for each abbreviated work. Where possible, the title of the *Cambridge Edition* (CE) volume in which a translation appears is also listed, along with the page numbers of the translation. Bibliographical information for the *Akademie-Ausgabe* and the volumes of the *Cambridge Edition* can be found in the bibliography of this volume.

2 Abbreviations

<i>Anthropology</i>	<i>Anthropology from a Pragmatic Point of View</i> AA VII 119–333 CE <i>Anthropology, History, and Education</i> , 231–429
<i>Argument</i>	<i>The Only Possible Argument in Support of a Demonstration of the Existence of God</i> AA II 65–163 CE <i>Theoretical Philosophy 1755–1770</i> , 111–201
<i>Correspondence</i>	<i>Correspondence</i> AA X–XIII CE <i>Correspondence</i> (selection)
<i>CprR</i>	<i>Critique of Practical Reason</i> AA V 1–164 CE <i>Practical Philosophy</i> , 139–271
<i>CPR A</i>	<i>Critique of Pure Reason</i> (1st Edition) AA IV 5–252 CE <i>Critique of Pure Reason</i>
<i>CPR B</i>	<i>Critique of Pure Reason</i> (2nd Edition) AA III 2–552 CE <i>Critique of Pure Reason</i>

<i>CPJ</i>	<i>Critique of the Power of Judgment</i> AA V 165–486 CE <i>Critique of the Power of Judgment</i> , 53–346
<i>Dreams</i>	<i>Dreams of a Spirit-Seer Elucidated by Dreams of Metaphysics</i> AA II 317–73 CE <i>Theoretical Philosophy 1755–1770</i> , 305–59
<i>Faculties</i>	<i>The Conflict of the Faculties</i> AA VII 5–116 CE <i>Religion and Rational Theology</i> , 239–327
<i>First Introduction</i>	The first, unpublished introduction to the <i>Critique of the Power of Judgment</i> AA XX 195–251 CE <i>Critique of the Power of Judgment</i> , 3–51
<i>Human Race</i>	<i>Determination of the Concept of a Human Race</i> AA VIII 91–106 CE <i>Anthropology, History, and Education</i> , 145–59
<i>Lect. Log. Busolt</i>	Notes to lectures on logic given by Kant in 1789 or 1790, attributed to Gotthilf Christoph Wilhelm Busolt AA XXIV/1.2 603–86
<i>Lect. Log. Dohna</i>	Notes to lectures on logic given by Kant in 1792, attributed to Graf Heinrich Ludwig Adolph zu Dohna-Wundlacken AA XXIV/1.2 687–784 CE <i>Lectures on Logic</i> , 425–516
<i>Lect. Met. Dohna</i>	Notes to lectures on metaphysics given by Kant in 1792–3, attributed to Graf Heinrich Ludwig Adolph zu Dohna-Wundlacken AA XXVIII/2.1 611–702 CE <i>Lectures on Metaphysics</i> , 355–91 (selection)
<i>Lect. Met. Herder</i>	Notes to lectures on metaphysics given by Kant in the early 1760s, attributed to Johann Gottfried Herder AA XXVIII/1 1–166 CE <i>Lectures on Metaphysics</i> , 1–16 (selection)
<i>Lect. Met. K₂</i>	Notes to lectures on metaphysics given by Kant and dated in the early 1790s, author unknown AA XXVIII/2.1 705–816 CE <i>Lectures on Metaphysics</i> , 393–413 (selection)
<i>Lect. Met. L₁</i>	Notes to lectures on metaphysics given by Kant probably in the mid 1770s, author unknown

- AA XXVIII/1 167–350
CE *Lectures on Metaphysics*, 19–106 (selection)
- Lect. Met. Vigilantius* Notes to lectures on metaphysics given by Kant and dated 1794–5, attributed to Johann Friedrich Vigilantius
AA XXIX/1.2 941–1040
CE *Lectures on Metaphysics*, 415–506
- Lect. Moral Phil. Collins* Notes to lectures on moral philosophy given by Kant probably in the mid 1770s (though dated 1784–5), attributed to Georg Ludwig Collins
AA XXVII/1 237–471
CE *Lectures on Ethics*, 37–222
- Lect. Moral Phil. Mrong.* Notes to lectures on moral philosophy given by Kant probably in the mid 1770s (but copied later), attributed to Christoph Coelestin Mrongovius
AA XXVII/2.2 1395–581
- Lect. Nat. Law
Feyerabend* Notes to lectures on natural law given by Kant probably in 1784, attributed to Gottlieb Feyerabend
AA XXVII/2.2 1317–94
- Lect. Phys. Danzig* Notes to lectures on physics given by Kant probably in 1785, attributed to Christoph Coelestin Mrongovius
AA XXIX/1.1 92–169
- Lect. Rat. Theol. Pölit* Notes to lectures on theology given by Kant probably 1783–4, attributed to Karl Heinrich Ludwig Pölit
AA XXVIII/2.2 998–1126
CE *Religion and Rational Theology*, 341–446
- Lect. Rat. Theol.
Volckmann* Notes to lectures on theology given by Kant probably 1783–4, attributed to Johann Wilhelm Volckmann
AA XXVIII/2.2 1127–225
- Logic* *The Jäsche Logic*
AA IX 1–150
CE *Lectures on Logic*, 521–640
- MM* *Metaphysics of Morals*
AA VI 205–493
CE *Practical Philosophy*, 365–492, 509–603
- Notes and Fragments* *Notes and Fragments*
AA XIV–XXIII
CE *Notes and Fragments*

<i>On the Common Saying</i>	<i>On the Common Saying: That May Be Correct in Theory, but it is of no Use in Practice</i> AA VIII 275–313 CE <i>Practical Philosophy</i> , 279–309
<i>OP</i>	<i>Opus Postumum</i> AA XXI and XXII CE <i>Opus Postumum</i> , 3–256
<i>Progress</i>	<i>What Real Progress has Metaphysics Made in Germany Since the Time of Leibniz and Wolff?</i> AA XX 257–332 CE <i>Theoretical Philosophy after 1781</i> , 351–424
<i>Prolegomena</i>	<i>Prolegomena to Any Future Metaphysic that Will be Able to Come Forward as Science</i> AA IV 255–383 CE <i>Theoretical Philosophy after 1781</i> , 51–169
<i>Races</i>	<i>Of the Different Races of Human Beings</i> AA II 429–43 CE <i>Anthropology, History, and Education</i> , 84–97
<i>Religion</i>	<i>Religion within the Boundaries of Mere Reason</i> AA VI 3–202 CE <i>Religion and Rational Theology</i> , 57–215
<i>Review of Herder</i>	<i>Review of J. G. Herder's Ideas for the Philosophy of the History of Humanity</i> AA VIII 45–66 CE <i>Anthropology, History, and Education</i> , 124–42
<i>Teleological Principles</i>	<i>On the Use of Teleological Principles in Philosophy</i> AA VIII 159–84 CE <i>Anthropology, History, and Education</i> , 195–218
<i>Theory of Heavens</i>	<i>Universal Natural History and Theory of the Heavens or Essay on the Constitution and the Mechanical Origin of the Whole Universe According to Newtonian Principles</i> AA I 217–368 CE <i>Natural Science</i> , 191–308
<i>Universal History</i>	<i>Idea for a Universal History with a Cosmopolitan Aim</i> AA VIII 17–31 CE <i>Anthropology, History, and Education</i> , 108–20

Ina Goy and Eric Watkins

Introduction

1 Kant's Theory of Biology

1.1 Historical Background

Whereas early modern advocates of experimental philosophy, Cartesian mechanism, and Newtonian mathematical physics avoided positing final causes and teleological explanations, many philosophers and natural researchers in the seventeenth and eighteenth centuries believed that efficient causes and non-teleological explanations were insufficient to explain the processes that regularly occurred in nerves and muscles, and in plant and animal generation, and thus tried to reinstate final causes and teleological explanations. For example, the physico-theological accounts of John Ray (1627–1705) and William Derham (1657–1735) shaped natural philosophy in England, while Christian Wolff's (1679–1754) deistic teleology was influential in Germany.

In the life sciences (at this time a field of research intersecting with medicine, anatomy, physiology, and physics) preformationist theories of the generation of living beings dominated the debate of the seventeenth and first half of the eighteenth century, whereas in the second half of the eighteenth century epigenetic accounts increasingly gained support. Defenders of preformation claimed—consistent with the creation narrative of the Old Testament—that the ultimate principle of an organism was a divine, preformed germ that contained in miniature all the predispositions of a prospective living being. Among them, ovists thought that the preformed germ was the female egg while animalculists identified it as the male sperm.

In the first half of the eighteenth century, the detection of the self-reproduction and regeneration of polyps¹ and the generation of deformed offspring provided counterexamples to the creationist narrative and fostered doubts about the explanatory reach of the doctrine of preformation. The appearance of the characteristics of both mother and father in inter-species hybrids (such as mules) also seemed to contradict the idea of a one-sided heredity of either the mother's (ovism) or the father's characteristics (animalculism) in newborns. These con-

¹ The experiments with polyps are famously reported in Abraham Trembley's (1710–1784) treatise “*Mémoires pour servir à l'histoire d'un genre de polypes d'eau douce*”, published in 1744.

cerns paved the way for epigenetic accounts of generation in the second half of the eighteenth century. Defenders of this new approach argued that organic life begins with unstructured matter and self-organizing powers. Whereas earlier epigenetic accounts described these forces mechanically, in Newtonian terms of attraction and repulsion, later accounts held that self-organizing powers must be vitalistic.

Immanuel Kant (1724–1804), who lived through the development of both preformationist and epigenetic accounts, was familiar with the classificatory schemes of theories of organized beings and the specific vocabulary that natural researchers used in his time. But he did not straightforwardly adopt these schemes and terms. When discussing possible explanations of plant and animal generation, for instance in §81 of the *CPJ*, he focused on the natural and divine contributions to generation and treated both “*individual preformation*” and “*generic preformation*” (which he equated with “*epigenesis*” [*CPJ* V 423.2–4]) as different forms of prestabilist as opposed to occasionalist views of creation (*CPJ* V 422.22). Kant praised epigenesis for relying less on God for the organization of the forms of nature. He adopted terms that were widely used in the preformation-epigenesis debate, such as ‘germs’, ‘educt’, ‘product’, ‘evolution’, ‘involution’, but he did not characterize his own position as either preformationist or epigenetic, nor, for that matter, as some blend of the two. Instead, Kant classified theories of generation as subspecies of what he called occasionalism and prestabilism (*ibid.*). This classification expresses a specific interest in organized beings that seems for him to have been inseparably connected to metaphysical and theological claims. One of the major historical scholarly controversies concerning Kant’s views on generation focuses on the extent to which his account tends to be preformationist or epigenetic, or an alternative to both (see Zammito 2007, Fisher 2007, Fisher and Goy in this volume).

Kant rejected the ancient view of a *generatio aequivoca*, a theory that explains the generation of organized beings occurs from “the mechanism of crude, unorganized matter” such as mud or slime. He also criticized the lack of empirical evidence for the *generatio univoca heteronyma*: theories that explain the generation of organized beings of one kind out of organized beings of another, such as the generation of land animals out of amphibians, and of amphibians out of aquatic animals. He thought that the *generatio univoca homonyma*, i.e., the generation of organized beings out of organized beings of the same kind, was most widely confirmed by experience (*CPJ* V 419.26–38 and 420.34–6).

Although apparently familiar with many natural researchers of his time, Kant seldom refers to them by name or discusses their accounts in detail. Kant’s works contain almost no extended discussion of specific individual’s accounts of natural research in the life sciences of his time. One exception is a brief

review of Johann Gottfried Herder's (1744–1803) "Ideas Toward a Philosophy of the History of Man" in 1785 (see Ameriks 2011, Zammito's articles, and Zuckert in this volume). A second is his response to Johann Georg Adam Forster's (1754–1794) objections to his own account of the origin of human races (see Forster 1786) in the third of his three short essays on human races. A third exception is his reaction to Johann Friedrich Blumenbach's (1752–1840) theory of epigenesis: Kant praises it in his *Teleological Principles* (VIII 180.31–5), in §81 of the *CPJ* (V 424.7–34), and in several other passages from the 1790s². He even exchanged two letters with Blumenbach in 1790 (*Correspondence* XI 184.30–185.25, 211.1–23). But generally Kant refrains from explicitly referring to contemporaries in these fields. This is all the more remarkable given that it was standard practice in the literature on organized beings at the time to present a new account or a modification of an existing one only after providing extensive quotations, excerpts, paraphrases and comments on earlier theories. Kant's ambivalent relationship to Blumenbach is another long-standing focus of historical scholarly debates (see Lenoir 1980, 1981, and 1982, Richards 2000 and 2002, Look 2006, Zammito 2012).

Kant also makes brief allusions to Pierre-Louis Moureau de Maupertuis' (1698–1759) "laws of desire and aversion" and to George-Louis Leclerc de Buffon's (1707–1788) "internal forms" in his early essay *Argument* (II 115.4–8). He quotes with meticulous accuracy from the first volume of Buffon's "Natural History", which, in B. J. Zink's German translation, contained Buffon's account of organized beings from the second volume of the "Natural History". He praises Hermann Samuel Reimarus' (1694–1768) physico-theology (*CPJ* V 476.36) and mentions Charles Bonnet's (1720–1793) idea of a natural chain of living beings in several places (*Teleological Principles* VIII 180.2, 31–5). Kant also speaks highly of the influential taxonomical ideas of Carl Linnaeus (1707–1778), lauding his "principle of the persistence of the character of the pollinating parts of plants", without which "the systematic *description of nature* of the vegetable kingdom would not have been ordered and enlarged in so praiseworthy a manner" (*Teleological Principles* VIII 161.18–21, *CPJ* V 427.4). Although a variety of learned remarks attest to Kant's interest in these studies, none of them directly impacted his writings on organized beings during the critical period to the extent that, for instance, disagreements with Gottfried Wilhelm Leibniz's (1646–1716) or

² Kant mentions Blumenbach in his *Lect. Met. K₂* (XXVIII/2.1 762.21), in notes on Soemmering's work (*Correspondence* XIII 400.7), in his essay *Faculties* (VII 89.5) and in his writing *Anthropology* (VII 299.15), in *Notes and Fragments* (XIV 619.4) on physical geography, and in his latest notes (*OP* XXI 180.27).

Isaac Newton's (1643–1727) theories had shaped his works in natural philosophy in his early years.

1.2 The Development of Kant's Thoughts about Organized Beings

The “Introductions” and the second half of the *CPJ* contain Kant's richest and most sophisticated account of organized beings, but his interest in the life sciences reaches far back to the beginnings of his career (Fisher's doctoral dissertation summarizes this long path). Remarks from 1755 confirm that Kant was aware of an intractable difference between organisms and objects that can be fully explained mechanically. However, he did not formulate a specific law for biological entities until much later. Though he was familiar with most theories of organisms of his own time, he adhered to none of them; and he passed over the problem of the inexplicability of organisms in his philosophical system for more than three decades, even as he presented that system as complete. It was not until 1788 that Kant discovered that the teleological lawfulness of organized beings could allow him to explain organisms theoretically while at the same time enabling him to find a place for them within his larger project of transcendental philosophy. Kant presented the most mature version of his doctrine of the teleology of organic nature in the second half of the *CPJ* in 1790, and he continued to revise his views on organized beings until the end of his productive career.

In his early *Theory of Heavens* (1755) Kant describes the cosmos as arising according to mechanical laws and uses this mechanical cosmology in a physico-theological proof for the existence of God. For the first time, he admits that he is unable to explain organized beings in terms of mechanical laws:

Are we in a position to say: *Give me matter and I will show you how a caterpillar can be created?* Do we not get stuck at the first step due to ignorance about the true inner nature of the object and the complexity of the diversity contained in it? It should therefore not be thought strange if I dare to say that we will understand the formation of all the heavenly bodies, the cause of their motion, in short, the origin of the whole present constitution of the universe sooner than the creation of a single plant or caterpillar becomes clearly and completely known on mechanical grounds (*Theory of Heavens* I 230.16–26).

In the early *Argument* essay (1763) Kant presents his views on philosophical arguments for the existence of God. He elaborates on the possible relations between God and the laws and powers of nature at length and responded to some of the positions of the preformation-epigenesis debate of his time. In his essays on human races in 1775, 1785, and 1788, Kant discusses generation and the heredity

of human beings and explains the origin and development of human races. He defends the view that there are four races that arose from “a single first [human] phylum” (*Human Race* VIII 98.36). The phylum is said to have contained the predispositions for all races in preformed germs, and to have developed into four distinct races under the influence of different climates and environments. In these essays, Kant also incorporates terms similar to those used in the epigenetic and preformationist debates, in which mechanism was no longer dominant.

In his review of Johann Gottfried Herder’s (1744–1803) “Ideas”, written in 1785, Kant criticizes Herder’s account of the generation of organisms. Herder defends the existence of a single “animating force that organizes everything [...] in such a way that the schema of the perfection of this organization is supposed to be the human being, to which all earthly creatures, from the lowest stage on, approach” (*Review Herder* VIII 52.24–7). Although Kant seems to agree with the notion of an organic power as “a principle of life” that “modifies *itself* internally in accordance with differences of external circumstances” (*Review Herder* VIII 62.26–7) he disagrees with the notion of the “unity of the organic force [...] which, as self-forming in regard to the manifoldness of all organic creatures, [...] is supposed to constitute the entire distinctiveness of its many genera and species”. In his eyes this notion lies “outside the field of the observational doctrine of nature” and is too speculative (*Review Herder* VIII 54.28–34). Instead he mentions “germs” and “original dispositions” of a self-forming faculty that would account for the diversity of organized beings (*Review Herder* VIII 62.34). Kant also objects to Herder’s idea that the organization of a human being presupposes and contains the organizations of all other beings.

Kant’s *Metaphysical Foundations* (1786) proposes a special metaphysics, in particular of “rational physics” or “[r]ational [p]hysiology” (*CPR* B 874–5), which is primarily concerned with moving powers (attraction and repulsion) and mechanical laws. In this work—while reflecting on the external mechanical causation of motion and rest as states of matter—Kant admits that he is unable to explain the phenomenon of life, understood as the capacity of a substance to determine itself to act or change from an inner principle (*Metaphysical Foundations* IV 544.1–30).

Finally, the appendices to the “Transcendental Dialectic” in the *CPR* (1781/7) express Kant’s search for the appropriate order of organized beings beyond mechanical laws: in these sections of the *CPR* Kant discusses reason’s attempt to form a regulative teleological order and to find unity among the a priori universal laws of nature. Similarly, in the third *Critique* Kant describes reason’s attempt to discover a teleological order and unity among the empirical laws of nature.

Kant’s search for the specific lawfulness of organized beings reached its turning point in the insight that organized beings can be characterized by

means of physical teleological laws that at the same time can serve as transcendental principles in his critical philosophy. In the *Teleological Principles* in 1788 Kant writes:

Since the concept of an organized being already includes that it is some matter in which everything is mutually related to each other as end and means, which can only be thought as a *system of final causes*, and since therefore their possibility only leaves the teleological but not the physical-mechanical mode of explanation, at least as far as *human* reason is concerned, there can be no investigation in physics about the origin of all organization itself. The answer to this question [...] would lie *outside* of natural science in *metaphysics* (*Teleological Principles* VIII 179.8–18).

Kant argues that an organized being is “a material being which is possible only through the relation of everything contained in it to each other as end and means”, and that a “basic power that is effectuated through an organization has to be thought as a cause effective according to *ends*” (*Teleological Principles* VIII 181.1–7). Two years later, Kant articulates a comprehensive metaphysical account of organized beings in both “Introductions” to the *CPJ* along with its second half. He would return to the life sciences in his last remarks in the *OP* during the years 1796–1804.

Kant’s theory of biology in the *CPJ* not only belongs to a series of writings concerned with natural philosophy, and in particular, the explanation of organized beings, but as part of the third of his three *Critiques* it also fulfills a specific function within his critical project. In the third *Critique* Kant tries to find the “bridge” (*CPJ* V 195.16) or “transition” (*CPJ* V 176.14) between two realms of philosophy. The theoretical philosophy of the first *Critique* deals with the sensible realm of nature, represented through the laws of understanding, while the practical philosophy of the second *Critique* concerns the supersensible realm of freedom, represented through the law of pure practical reason and the moral law in its more teleological expressions, such as the Formula of Humanity and the kingdom of ends. The third *Critique* is supposed to connect both parts of philosophy in the unity of a single philosophical system:

although there is an incalculable gulf fixed between the domain of the concept of nature, as the sensible, and the domain of the concept of freedom, as the supersensible, so that from the former to the latter [...] no transition is possible [...]: yet the latter *should* have an influence on the former, namely the concept of freedom should make the end that is imposed by its laws real in the sensible world; and nature must consequently also be able to be conceived in such a way that the lawfulness of its form is at least in agreement with the possibility of the ends that are to be realized in it in accordance with the laws of freedom (*CPJ* V 175.36–176.9).

The problem of the transition between the two realms of nature and freedom and their order is not primarily concerned with the agreement between the universally valid, a priori necessary laws of understanding (the universal laws of nature) and the universally valid, a priori necessary law of pure practical reason (the moral law): in the *Groundwork* (IV 421.18–20) Kant had already asserted an agreement between both kinds of laws in the second variant of the formula of the practical law³. Instead the transition concerns the possibility of a rational order of the contingent empirical manifold of nature, as represented in the empirical laws of nature (*CPJ* V 183.22–184.21). The contingency of the empirical order of nature could conflict with the necessary a priori order of pure practical reason.

An agreement between theoretical and practical laws is needed for the possibility of the realization of moral maxims (that follow from the law of pure practical reason) in the seemingly contingent manifoldness of the empirical forms of nature. It is needed both for the possibility of individual moral actions that are supposed to take place in nature, and for the possibility of the highest moral good, i.e., for an ideal world in which the totality of all moral maxims would have to take place in nature. Both thoughts presuppose that not only the universal structures of nature, but also the seemingly contingent empirical manifold of nature can be represented as a rational order. Organized beings and physical teleological laws account for the possibility of a rational order of the empirical manifold of nature since physical teleological laws contain the notion of a natural purpose, which is an idea of reason. The a priori unity of a natural purpose in physical teleological laws stands in a systematic connection with moral teleological laws since they both belong to the noumenal world. It would be useful if future research could explain the influence of Kant's changing views on organized nature upon the possibility of the realization of the practical law in nature and the possibility of the highest moral good.

1.3 Kant's Account of Organized Beings in the *CPJ* and Related Scholarly Debates

Kant's account of organized beings unfolds in four major parts of the text of the *CPJ*: in the first and abbreviated second "Introduction(s)", the "Analytic" and the

³ The second formula of the practical law says that one should "act as if the maxim of [one's] action were to become by [one's] will a universal law of nature".

“Dialectic”, and in parts of the “Methodology of the Teleological Power of Judgment”.

The prevailing concern in the “Introductions” is the clarification of the “transcendental principle” of the “formal purposiveness of nature” (*CPJ* V 181.13–5), a principle of the reflecting power of judgment that characterizes organized beings. Kant discusses it in particular in section V of the “Introduction”. He never provides this principle with a precise formulation, which invites diverse interpretations of its sentence structure and meaning. But Kant at least gives several explicit descriptions of its function and systematic place: it is a principle that brings a necessary unity into the otherwise contingent empirical manifoldness of nature (*CPJ* V 183.14–184.10). It helps us to understand why we apply physical teleological maxims when we consider nature, such as ‘in an organized product of nature nothing is in vain or purposeless’ (*CPJ* V 376.13–4), ‘nature takes the shortest way’, ‘nature makes no leaps, either in the sequence of its changes or in the juxtaposition of specifically different forms’, ‘the great multiplicity of its empirical laws is nevertheless unity under a few principles’, and the like (*CPJ* V 182.19–25). Kant claims that we must presuppose the transcendental principle of the formal purposiveness of nature since otherwise “no thoroughgoing interconnection of empirical cognitions into a whole of experience would take place” (*CPJ* V 183.30–1).

Further remarks in the “Introductions” could be read as suggesting that the principle of the formal purposiveness of nature is the underlying principle for all physical teleological laws. These laws are maxims of the reflecting power of judgment that are “grounded on a principle a priori”, although “we discover the end of nature solely through experience” (*First Introduction* XX 239.27–30). Kant seems to indicate that physical teleological judgments have two components: they contain an a priori principle of unity, on the one hand (‘search for the purposive unity in the empirical manifold of nature!’), and they contain an empirical concept that we achieve through experience, on the other hand (‘search for this unity under the empirical concept ‘for flying!’). In addition, physical teleological laws are thought to be final causal laws since a natural purpose (‘for flying’) is understood as a concept that brings about the united form of the organized being. It is the “concept of an object” which “contains the ground of *the reality* of this object” (*CPJ* V 180.31–2, *italics added*).

In the “Analytic of the Teleological Power of Judgment” Kant develops further claims about organized beings. One central statement is that organized beings are machines and mechanical aggregates, but not *mere* machines and mechanical aggregates. Organized beings can be explained to some extent based on mechanical laws and “*motive power*” (*CPJ* V 374.22), but cannot be explained based on mechanical laws and *motive* powers alone. Understanding them re-

quires final causal or physical teleological laws and a “*formative power*” (*CPJ* V 374.23). Different from mechanical machines like watches, which are brought about as aggregates by an external engineer, organized beings like trees are generated by an internal principle as self-organized purposive wholes.

Kant’s notions of mechanism and moving powers are a matter of controversy among scholars. He seems to presuppose these terms based either on discussions in his own earlier writings or on the historical context of his time; but he never explicitly defines them in the *CPJ*. Several scholars present catalogues of possible meanings of these terms (for example, McLaughlin [1989, 138–41/1990, 152–6, and McLaughlin in this volume]; Ginsborg [2001, 238–43]; Quarfood [2004, 196–205]; Zuckert [2007, 101–7]). One question is whether Kant’s notion of mechanical laws reflects the causal law in the second analogy of experience in Kant’s *CPR*, or the (dynamical and) mechanical laws in Kant’s *Metaphysical Foundations*, or empirical laws more broadly. Another scholarly debate concerns the meaning of physical teleological laws and the nature of the formative power, i.e., the laws and powers that characterize organized beings *as such*. This analysis is made particularly difficult due to the lack of explicit examples of physical teleological laws and due to the rare occurrences of the term ‘formative power’ (van den Berg 2009, Frigo 2009, Goy 2012). The most significant occurrence of latter term seems to be a sentence in §65 (*CPJ* V 374.21–6) stating that the formative power is a self-organizing power that, as part of Kant’s account of final causation, is responsible for the generation of the intentional, end-directed form of organized beings. For possible formulations of physical teleological laws one could begin with the antithesis of the regulative version of the antinomy (*CPJ* V 387.6–9). Further debates concern the relation of parts to parts and of parts to whole in an organized being, understood as a self-organized whole as opposed to a mechanical aggregate. Cheung (2009) provides new insights into the famous tree example on the basis of its historical context.

In the “Analytic” Kant claims that both mechanical and physical teleological laws characterize organized beings whereby only the latter are distinctive of organized beings as such. In the “Dialectic of the Teleological Power of Judgment” (§§69–78) Kant points out that an antinomy can arise within the power of judgment between higher-order mechanical and higher-order physical teleological laws, which unify the empirical laws involving organized beings. Kant attempts to show how the competition between these conflicting principles can be resolved.

The “Antinomy of Teleological Judgment” (§§69–78) is one of the most controversial passages of the *CPJ*. One controversy concerns what the conflict is about (see Frank/Zanetti [2001, 1288–9] and Quarfood [2004, 160–6]). It could be seen as a conflict between regulative maxims of the reflecting power

of judgment, i.e., a conflict between alternative forms of explanation, as most current interpreters think (Allison [2003], Ginsborg [2006], Goy [forthcoming], Watkins [2009], Breitenbach [2009, 109–31], McLaughlin in this volume). Or it could be seen as a conflict between constitutive principles of the determining power of judgment, i.e., a conflict between the structures of organized beings, as an earlier generation of interpreters like Erich Adickes, Alfred Cyril Ewing, Ernst Cassirer, and Rudolf Eisler thought (for brief surveys of both views see McLaughlin [1989, 125–37], Watkins [2008, 254]). Quarfood (2004, 160–208 and in this volume) suggests yet a third reading of the intended conflict. He thinks that the antinomy consist in the confusion of a pair of regulative maxims of the reflecting power of judgment with a pair of constitutive principles of the determining power of judgment. He argues that although mechanism and teleology are regulative maxims, we are inclined to take them constitutively, that is, we are inclined to ascribe ontological commitments to those claims. A fourth possible reading of the antinomy is that the antinomy consists in a conflict between a constitutive principle of the determining power of judgment and a regulative maxim of the reflecting power of judgment.

Another major controversy concerns the resolution of the antinomy. Several suggestions have been made in the literature. In Quarfood's reading the resolution consists in the detection of confusions between both kinds of laws as regulative and constitutive principles and in the avoidance of the ontological claims entailed by the constitutive principles. Other interpreters suggest that the resolution of the antinomy is reached in a supersensible ground that contains the original unity of both kinds of laws. For Förster (2002a und b; 2008; 2011, 149–60) it is an intuitive understanding; others have called it an indeterminate ground of nature, or a conjunction of both. A different line of interpretation claims that the resolution of the antinomy consists in a unifying principle for our human judgment, such as the hierarchy of the two kinds of laws (see Ginsborg [2006, 461–2], Breitenbach [2009, 124–31]). Further questions concern the function of §§72–3—Kant's discussion of dogmatic teleologies of nature—within the overall argument of the antinomy.

In the final section of the *CPJ*, the “Methodology of the Teleological Power of Judgment”, Kant describes the systematic order between organized beings (including human beings) and their natural purposes, and human beings as noumenal beings and their moral purposes. With regard to the relation between organized beings as natural ends and the human beings as natural and moral end(s) Kant claims that organized beings as natural purposes are ends in themselves that can serve as means and as ends for other organized beings. But they can serve as means only for the noumenal aspect of the human being and its moral purpose. The moral purpose of human beings as noumenal beings is

the final end of nature since it is the only unconditioned end in the world (see Guyer in this volume, Höffe [2008]). Kant then clarifies the relation between organized beings and their natural and moral orders and the divine being (critical notions of God), arguing that the divine being guarantees the original unity of the natural and moral orders in the world (see Goy in this volume). §§79–91 of the *CPI* in particular have not received sufficient critical attention so far.

2 Contributions to This Volume: An Overview

2.1 Part One: Kant's Theory of Biology and Research on Nature in the Seventeenth and Eighteenth Centuries

Part One consists of three essays that consider Kant's views on a range of topics in biology prior to 1790 and thus describe the immediate historical background to Kant's most explicit views as they are developed in the *CPI*. In "Metaphysics and Physiology in Kant's Attitude Towards Theories of Preformation", Mark Fisher considers Kant's complex attitude throughout his pre-critical and critical periods toward the theories of organic generation that were prevalent among his predecessors (such as Leibniz, Malebranche, and Maupertuis), namely preformation and epigenesis. Fisher asserts that Kant, relying primarily on philosophical argument rather than empirical investigation, reconceives of these theories such that they do not necessarily exclude each other, and emphasizes the distinction between occasionalism and prestabilism. Specifically, Fisher maintains that Kant rejects the *individual* preformation of preexistence theories (i.e., preformation theories maintaining that individual members of each plant and animal kind are co-created), on the grounds that they are as inconsistent with the scientific method as direct divine intervention into nature would be. However, Fisher claims that rejecting this kind of view does not prevent Kant from accepting a theory of *generic* preformation (i.e., preformation with respect to kinds). Fisher then shows that Kant's version of generic preformation is perfectly consistent with an epigenetic theory that is committed to a fundamental generative power, which involves an immaterial and thus unknowable principle. In this way, Fisher illustrates how Kant can account for the vital functioning of organic bodies (by way of an epigenetic account of generation) but without undermining a natural-causal account of the production of bodies from other bodies of the same kind (which presupposes generic preformation).

In her "Epigenetic Theories: Caspar Friedrich Wolff and Immanuel Kant", Ina Goy investigates Caspar Friedrich Wolff's epigenetic account of organisms, describing in detail the essential force he asserts, the inorganic (mechanistic)

and organic processes for which it is responsible, and the part-whole relations that it produces. She then considers Kant's various uses of the term 'formative power', arguing that he employs the term with two different meanings, one epistemological, the other biological. With this background in hand, Goy provides a detailed interpretation of a crucial passage in §65 of the *CPJ*, in which Kant attributes a formative power to organisms. Specifically, she lays out its basic elements (which distinguish it from machines and matter as such) and then offers an interpretation of Kant's claim that the formative power propagates itself, according to which it generates a certain organization in matter and preserves *itself* as an organic power. Goy concludes by taking issue with prior interpretations of Wolff's influence on Kant by arguing that although Kant's invocation of formative power has less to do with Blumenbach than is often supposed, Wolff's account does not resolve the main problem of explaining generation and thus is not of use to Kant to such an end. At the same time, according to Goy, Wolff's account remains systematically important for Kant, because Wolff does invoke the part-whole relation to account for organisms, which was not standard at the time, and Kant is close to him on that point. However, Kant disagrees with Wolff about the precise way in which the part-whole relation obtains in organisms, since he does not divide the process of production into an inorganic and an organic phase and posit the former as occurring prior to the latter. As a result, though Kant is systematically close to Wolff, his ultimate view still differs from Wolff's basic account in fundamental ways.

Rachel Zuckert's essay, "Organisms and Metaphysics: Kant's First Herder Review", discusses Kant's reasons, expressed in his first review of Herder's *Ideas towards a Philosophy of the History of Man* in 1785, for rejecting his former student's proposal of a single organic force. Zuckert argues that Kant's objections are based not on his own metaphysical assumptions about the difference between human beings and other organic life forms or on the distinctiveness of organic beings as contrasted with inorganic matter (which might be just as dogmatic as the views of Herder that he is criticizing), but rather on appropriately critical epistemological grounds. Specifically, she asserts that Kant rejects Herder's position because it cannot be supported on the basis of inductive generalizations or the direct observation of nature, nor can it be articulated in the form of universal scientific laws governing natural kinds. For, on Kant's view, in proposing a single life-force Herder is in effect postulating an unconditioned entity that necessarily goes beyond any evidence or experience we could have, which makes it an inadmissible dogmatic metaphysical assertion. Zuckert then suggests that Kant's view during this period is somewhat different from that of the *CPR* and that of the *CPJ*, such that it represents a transitional period for Kant. In the first Herder review Kant thinks that there can be legitimate determi-

native teleological judgment concerning organisms and that regulative principles can help us to discover teleological *laws*, whereas Kant is silent on these points in the first *Critique* and then comes to reject them later in the *CPJ*, though he does not, as a result of this final shift, become any more sympathetic to Herder's organic force. What these shifting constellations reveal, according to Zuckert, is that the significant question that Kant ultimately faces is whether Herder's concept of a single organic force or his own concept of purposiveness is most satisfactory when serving as a regulative principle that guides our scientific investigation.

2.2 Part Two: Kant's Theory of Biology—Commentaries on the “Critique of the Teleological Power of Judgment” and Other Writings

Part Two is by far the most substantive part of this volume, consisting of ten essays that present Kant's views as expressed in specific sections of the “Critique of the Teleological Power of Judgment” in the *CPJ* and in the *OP*. Luca Illetterati discusses how to understand organisms as natural ends, which is the central topic of sections §§61–8, in “Teleological Judgment: Between Technique and Nature”. Illetterati argues that Kant attempts to find a coherent justification for a teleological explanation of organic life, one that does not require either backwards causation, which is metaphysically suspect, or the assumption of extrinsic purposiveness, which is plausible in the case of artifacts whose cause lies in the intentions of a designer, but not in the case of natural organisms. For natural organisms display a structure that is analogous to the technical-practical behavior of agents, but do not have intentions (except in humans) and would therefore have to have a different internal principle of self-organization. Illetterati argues that these reasons lead Kant to try to resolve the problem confronting our understanding of organisms by attributing to them a regulative rather than a constitutive status. Illetterati suggests, however, that Kant's solution is characterized by a lingering tension. On the one hand, Kant explicitly contrasts artifacts and organisms, since the former require, whereas the latter exclude external purposiveness. On the other hand, acknowledging that the principle of internal purposiveness can be attributed only a regulative status shows that we cannot grasp their true ontological status, since the only way we have of understanding it is by way of analogy with our technical-practical knowledge.

In “Kant's Account of Biological Causation”, Predrag Šustar focuses on Kant's analysis in §§64–6 of the unique causal structure instantiated in natural ends (specifically of organisms) as what is both cause and effect of itself, arguing

for two claims. The first claim is that Kant is committed to a dispositionalist view of biological causation. According to this view, biological processes are to be understood, fundamentally, in terms of powers, capacities, or dispositions and their necessary manifestations under appropriate circumstances and not in terms of Humean discrete events that are only loosely or contingently connected. Šustar also evaluates the strengths and shortcomings of Kant's account by comparing and contrasting it with an example from contemporary molecular biology, arguing that the case of photosynthesis reveals that Kant needs to appeal to a formative power and not simply a motive force. Šustar's second claim is that Kant's analysis is consistent with either eliminativism or deflationism about traditional metaphysical systems (such as hylozoism or animism), which has an influence on his dispositionalism about biological causation in general.

In "Nature in General as a System of Ends", Eric Watkins focuses on several passages in §§66–7 that assert that reflection on organisms necessarily leads to two claims about nature in general. The first claim is that not only organisms, but in fact *every* thing in nature must also be judged teleologically, while the second is that nature as a whole is a) a system of purposes that b) has a purpose itself. Watkins argues that Kant's distinctive conception of reason as a faculty that searches for the unconditioned condition of all conditioned objects is crucial to understanding Kant's arguments for each of these claims. For characterized in this way, reason has a legitimate interest not only in the inner form of organisms (with its reciprocal causal ties both among parts and between the parts and the whole they constitute), but also in the *external* conditions on these organisms and in the *purpose* of the *existence* of objects in nature. However, reason, in seeking further conditions in the systematic connections that occur within nature, also seeks a final unconditional purpose for nature as a whole. Such a purpose must of necessity lie outside of nature, and later on in the *CPJ* Kant identifies it with human beings, though understood not as natural organisms, but rather as free and rational noumenal agents.

In "Biological Purposiveness and Analogical Reflection", Angela Breitenbach considers the peculiar status of teleological judgments about organisms, which depend in some way on the particular experiences of such objects that we have, but without making any determinate claims about those objects. Breitenbach argues that such teleological judgments can be elucidated by clarifying their analogical status. In particular, she argues that the analogy Kant draws between organisms (as natural ends) and the capacity of practical reason (rather than artifacts in general) can explain two especially unusual phenomena. First, when we find that we cannot explain a certain class of objects purely mechanically, thinking about those objects as if they were directed at their own ends can guide further scientific inquiry into the object. For example, even if

a bird's feathers cannot be explained purely mechanistically, thinking of them as directed to the end of flying can help us to direct our research into their weight, composition, and shape (rather than, say, their color). Second, and more important, the analogy explains why our encounter with living beings gives rise to the peculiar kind of experience that we have of organisms not merely as not mechanically explicable but also as eliciting the notion of objective natural ends, which one might otherwise never have reason to bring into conjunction with nature given that this concept is not, for all we know, a constitutive principle for natural objects. Specifically, Breitenbach argues that Kant takes the analogy to ground a *symbolic* representation of the purposiveness of living beings such that it makes the representation of something as a living being possible not by drawing out *existing* similarities between the apparent purposiveness of living beings and our own intentional activity, but by *projecting* thoughts that we associate with reason's intentional activity onto our consideration of organic nature, though without thereby assuming or asserting that nature must be that way. (This case is thus analogous to the aesthetic case in which our non-conceptual reflective response to an object gives rise to an experience of aesthetic pleasure but without representing the object as having the property "beauty".)

In "Mechanical Explanation in the 'Critique of the Teleological Power of Judgment'", Peter McLaughlin considers what Kant means when he refers, in the "Antinomy of Teleological Judgment", to the mechanism of nature that is necessary but still only a regulative maxim that reflects a peculiarity of our understanding. After canvassing a range of possible meanings of the term "mechanism" in this context, he argues that it has a reductionist meaning, according to which wholes (and their properties) are to be explained on the basis of their parts (and the interactions among them). McLaughlin then responds to several important objections that have been raised against this proposal in the literature. While some of these objections focus on specific features of the part-whole relationship that define mechanistic causality, the most serious objection, raised by Ginsborg, calls into question the very idea that mechanistic causality should be understood in terms of part-whole relations, on the grounds that machines are just as mechanistically inexplicable as organisms are. McLaughlin responds to this last objection by arguing that machines and organisms are mechanistically inexplicable for different reasons. Machines are mechanically inexplicable because they involve a form of concept-mediated causality, involving the actions of an embodied mind, whereas organisms seem to involve a causality *sui generis* that we cannot recognize as real. For this reason we must treat them as if they were, in part, ideal, in the sense that we know that the idea of the whole is not a cause, or real ground, of the organism, but rather simply a ground of cognition of the organism, or a sort of marker. McLaughlin then explores two differ-

ent ways in which one might try to understand the peculiar status of mechanism as necessary but still only regulative rather than constitutive. One possibility would be to appeal to the specifically spatial character of the part-whole relation in bodies, which would thus involve a relation between intuition and the understanding, while the other possibility focuses on the essentially compositional nature of the understanding itself. McLaughlin does not find either of these possibilities to be particularly well-supported (either textually or philosophically) and thus ends on a skeptical note, namely that we still lack a satisfactory account of how the maxim of mechanism is genuinely necessary but merely regulative.

Marcel Quarfood, in “The Antinomy of Teleological Judgment: What It Is and How It Is Solved”, argues for a novel interpretation of the “Antinomy of the Teleological Power of Judgment” and how Kant intends to solve it. Specifically, rather than choosing between standard interpretations of the antinomy available in the literature that focus exclusively on either the constitutive or the regulative principles that Kant formulates, Quarfood proposes that the antinomy arises when one takes the regulative maxims (which, he thinks, are not contradictory) as implying the constitutive principles (which are, in fact, inconsistent though not susceptible of direct proof). After explaining how his interpretation makes sense of why Kant discusses the “dogmatic” systems described in §72, Quarfood argues that the regulative principles do not involve a contradiction because they are what Kant calls “disparate principles” (*CPJ* 391.11–5), which differ without being contradictorily opposed. He also argues that we are tempted to switch from the perfectly legitimate regulative, but disparate principles to the contradictory and thus illegitimate constitutive principles due to the heteronomy of reflective judgment. In the course of developing his interpretation, Quarfood offers an interpretation of the proofs of the regulative principles and an analysis of how transcendental idealism underlies the temptation to take the regulative principles as constitutive, providing in this way a comprehensive interpretation of the most fundamental features of Kant’s antinomy of teleological judgment.

In “Purposiveness, Necessity, and Contingency”, Philippe Huneman addresses the concepts of contingency and necessity in the context of Kant’s discussion in §§76–7 of the *CPJ*. Specifically, after providing a brief description of Kant’s account of organisms as natural purposes, Huneman explains what it means for purposiveness to embody the “lawfulness of the contingent as such” by noting how biological phenomena are contingent with respect to the necessity of the laws of mechanics, but still possess a kind of lawfulness (that allows one to distinguish, for example, a well-formed chick from a monstrous outgrowth, despite the fact that both follow necessarily from eggs according to the laws of nature). Huneman then examines Kant’s transcendental genealogy of the very concept of purposiveness as necessarily embedded in the finiteness of our power of knowl-

edge (§77). He concludes by showing how this elucidation is consistent with Kant's doctrine of modalities and by providing a justification for the solution of the antinomy of teleological judgment. The central idea behind Huneman's argument here is that what appears contingent to a being like ourselves, endowed with a discursive understanding that represents possibility and necessity, and a sensible faculty of intuition that represents existence, is none the less thought by us to have a kind of necessity, yet one that we cannot grasp directly, but rather only indirectly, by postulating of a different, intuitive kind of understanding, which, in effect, cancels the difference between mechanism and teleology.

Ina Goy discusses Kant's attitude towards the so-called argument from design in "Kant's Theory of Biology and the Argument from Design", which Kant treats in several passages in §§65, 75, 85 of the *CPJ*. After first reconstructing three different versions of the argument from design by Aquinas, Hume, and Paley and raising several objections to the argument, Goy considers various ways in which one might see Kant as making an argument from design in the "Analytic of the Teleological Power of Judgement": one based on the similarities between the production of art and the generation of natural things, a second based on the notion of the supersensible that Kant introduces in §§66–7, and a third that draws on the potential source of organic matter and specific kinds of formative powers. She then turns to various arguments one might locate in the "Dialectic of the Teleological Power of Judgement": one based on his use of the term 'technique of nature' and a second in the explicit presupposition of an intentional designer, though only as a subjective principle for the reflecting power of judgment. Finally, Goy considers Kant's explicit statements about different theistic proofs in the "Methodology of the Teleological Power of Judgment", including the 'physico-theological' proof and the moral argument that he had first developed in the *CprR*. Goy concludes by responding to possible difficulties of her interpretation.

In "Freedom, Happiness, and Nature: Kant's Moral Teleology", Paul Guyer argues that two paradoxes concerning freedom and teleology that naturally arise on the basis of passages in §§83–4 and §§86–7, can be resolved. The first paradox is based on two conflicting claims about the status of freedom. According to the first and second *Critiques* Kant views freedom as a *non-natural* capacity, but according to the *CPJ* freedom is supposed to serve as the final end of *nature*. The second paradox concerns Kant's account of happiness. According to the second *Critique*, happiness is included in the final end of nature in the form of the highest good. In the *CPJ*, by contrast, freedom, not happiness, is viewed as the final end of nature. Guyer resolves the first paradox by noting that freedom is not the final end *within* nature since nature cannot produce freedom. The final end within nature is culture, which serves as the preparation for freedom. Free-

dom, by contrast, is the normative final end of nature, which is distinct from nature and thus non-natural. Guyer resolves the second paradox by noting that the meaning of happiness that is part of the highest good as the final end of nature is not one's own happiness, but the happiness of all human beings. Moreover, Kant does not commit himself to the strong claim that nature guarantees our happiness but only to the weaker claim that nature accompanied by the right moral choices enables us to work for as much happiness as possible.

In his paper, "The Role of the Organism in the Transcendental Philosophy of Kant's *Opus Postumum*", Ernst-Otto Onnasch discusses Kant's views on the special status of organisms, especially concerning our grounds for asserting their actuality, given that we cannot intuit them a priori. After connecting Kant's views to Stahl's and showing that Kant wants to reject hylozoism as inconsistent with Newton's law of inertia, Onnasch argues that over time, and most clearly in the *OP*, Kant comes to adopt a model of cognition according to which experience is possible only if it is assumed that it is had by an organism. For to subsume the data given in intuition under concepts, it is necessary that a subject forms an intention or purpose that selects which data are relevant. So Kant is committed to the organism being not the object, but rather the subject of knowledge, and such an organism receives its organization not from without, but rather from its own spontaneous self-affection. The actuality of the organism is thus not determined through intuition (as it is for empirical objects), but rather as a condition of the possibility of experience, a view that becomes, Onnasch argues, more prominent in the *OP*.

2.3 Part Three: Kant's Theory of Biology in the Present Time

Part Three consists of two substantive essays that explore the significance of Kant's views for contemporary biology and philosophy of biology. In "Oughts without Intentions: A Kantian Account of Biological Functions", Hannah Ginsborg articulates and defends an account of biological functions in terms of a notion of normativity that draws on Kant's account of organisms as natural purposes (insofar as his account involves a notion of purposiveness that does not invoke actual objective purposes). According to Ginsborg, in the context of biology, a function of a trait or entity is neither what it was in fact designed, or selected, to do (as it would be on historical or etiological approaches to functions), nor what it contributes to what the organism is designed to do (as it would be on the causal role approach), but rather simply what it should, or ought, to do, which one might think of as a kind of 'natural ought'. Ginsborg's notion of normativity is, however, not the non-normative notion of prediction. It is more fun-

damental than either the notion of function that it is intended to explain or the notion of an intention in a designer or rational agent, which is often thought to be required for normativity. Ginsborg illustrates the notion by appealing to what she takes to be a primitive awareness of normativity in the workings of our own cognitive faculties, drawing in part on the later Wittgenstein's analysis of pre-conceptual rule following. She clarifies her account of a function further by showing that it is intended not to provide a naturalistic reduction of the notion of function in biology, but rather simply to remove the main conceptual obstacle to making functional ascriptions in biology (namely that it can seem problematic to ascribe oughts without intentions). She also clarifies that her account is not committed to any specific account of the circumstances in which function ascriptions are or are not justified, though she notes that it could be supplemented by a range of such accounts. In this way, Ginsborg draws on some basic features of Kant's account in laying the foundation for a contemporary theory of functions in biology.

In "Kant, Polanyi, and Molecular Biology", Siegfried Roth argues that Kant's anti-reductionist account of organisms is highly relevant to molecular biologists today. Though molecular biology, as currently practiced, seems to be reductionist insofar as, e.g., phenotypic features of organisms are explained on the basis of particular molecular changes, Roth argues that the reductive approach is not, in fact, as extensive as is often maintained. Roth sets the stage for his argument by providing an analysis of Kant's and Polanyi's views. On his interpretation, Kant adopts a generic preformationist view, with a concept-like self-representation of the organism controlling the epigenetic process by which the special kind of complexity distinctive of organisms arises, whereby the representation of the whole exists prior to its realization. Though he employs different terminology, Polanyi similarly maintains that the genetic material within an organism that contains the instructions for self-production is a system with higher and lower levels of control. Roth then turns to the contemporary context and shows that the structure of the sequence-based macromolecules of living cells (DNA, RNA, and proteins) cannot be explained purely on chemical grounds, but requires functional and evolutionary considerations and thus represents structures under dual control. Therefore, modern biologists ought to be sympathetic to Kant's and Polanyi's views and recast Kant's famous remark that there will never be a Newton who could make comprehensible the generation of a blade of grass, such that this is just as true even of the simplest bacterium.

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The idea for a major conference that would bring together researchers in the field of Kant's theory of biology for the first time in the hopes of intensifying and enlivening the discussion (something that was, and continues to be a great need in the field), was born at the end of a research journey to California that Ina Goy made in spring 2009 to work closely with Hannah Ginsborg in Berkeley and with Eric Watkins in San Diego. The conference was supposed to take place at the end of April 2010 but was prevented by the eruption of the Eyjafjallajökull in Iceland (challenging our beliefs in the teleology of nature), since it forced the cancellation of most travel to and within Europe for several days, including that of our conference speakers. Fortunately it was possible to reschedule the conference for December 2010, when it finally took place in the beautiful castle of Hohentübingen surrounded by an exceptionally romantic and snow-covered countryside. We would like to thank the Fritz-Thyssen-Foundation and the Universitätsbund Tübingen for their financial support, especially for their flexibility and generosity regarding the repeated planning of the conference. We also thank all who were involved in the extensive logistical preparations for the project, in particular Christoph Wehle, who helped us to organize the conference twice, and Michael Demo, who helped us to edit the conference volume. Eva Oggionni and Julius Alves also provided support during the conference.

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**Part I. Kant's Theory of Biology and Research on
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Centuries**

